

Supporting Antenatal Care in Developing Countries through Mobile Diagnostic System

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ABSTRACT

This paper describes the preliminary design of a maternal diagnostic system for rural pregnant women to improve antenatal care. Our design is based on literature review and feedback from midwives who have worked in developed and developing countries. From the systematic review of existing literature we developed a list of design requirements. Later on we filtered them by consulting midwives & gynecologists. Based on the refined requirements we developed the concept of a rural diagnostic application to support antenatal care. Furthermore, we identified the technical requirements and limitations that should be taken into account to implement the system in a rural setting. We believe that our initial exploration will help to design a usable system which will play a key role in improving antenatal care in developing countries.

Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: user interface

General Terms

Design, Human factors

Keywords

Antenatal care, developing countries, diagnostic support system

1. INTRODUCTION & MOTIVATION

Each year worldwide 529000 maternal death occur [2]. The target set for MDG-5 is a 75% reduction of maternal mortality ratio between 1990 and 2015. Developing countries are struggling to achieve the Millennium Development Goal (MDG). Each year roughly 27 million women give birth in India and of these 136000 die as a direct result of their pregnancy and delivery [2]. The reason is partly due to poor diagnostic capability and on the other hand pregnancies are often not reported for such cases. The ongoing high maternal mortality in low-resource countries shows that there is a need to identify and implement strategies that are most effective to reduce maternal mortality [3].

There are three main approaches of safe motherhood strategies which are developed based on different phases in a women's reproductive cycle. The phases are classified as pregnancy,

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DEV'13, January 11–12, 2013, City, Bangalore, India.

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antenatal, delivery and postpartum period [4]. In this project the central question is how we might improve antenatal care in low-resource settings? It has been identified that there is direct relationship between lack of pregnancy related care and maternal death [5]. Antenatal care consists of a number of interventions administered to women during pregnancy, including screening tests, immunizations, and treatment for identified complications. It has been established that the detection of early signs or risk factors for, morbidity and mortality can be detected and effective interventions are possible [7]. Overall the main aim of antenatal care is to produce a healthy mother and baby. Appropriate technology such as simpler clinical diagnostic tool may help at primary healthcare level to improve antenatal care.

There are several well-known challenges in low-resource settings such as a) shortage in numbers of skilled birth attendants, b) no access to IT or prior experience, c) lack of financial support and accessible emergency obstetric care [2, 7]. In this project we aim to improve antenatal care by creating a diagnostic support system for rural pregnant women. The diagnostic support system which will be operated by rural health workers has the following objectives: a) improving point of care diagnostic support, b) screen for patients who need to visit a physician and c) provide advice/tips for those who do not need to visit a physician.

2. RELATED WORK

There are lack of antenatal care in developing countries. However there are couple of ongoing projects that aim to improve antenatal care in developing countries such as Bangladesh. One notable example is click diagnostic application. The application has been designed to support maternal, neonatal and child health. The basic idea of the application is that community health workers collect data about pregnant women and send to a specialist. The specialist view the patient information and provide feedback to the cell phone of the community health workers [1]. This is a promising application however, many places in developing countries do not have any internet. Another application called Early Detection and Prevention System (EDPS) developed in India by the George Foundation. The systems has been used in India for eight years and allows people without extensive training to help diagnose illness [6]. The system has 94% accuracy record which is equivalent to diagnose of an experienced doctor. However, the system has not been designed to support antenatal care rather to support epidemiological studies. A web-based clinical diagnostic system to improve antenatal care has been used in Brazil and the system is called SUAP (prenatal care unified system). SUAP uses agent technology to manage healthcare records, to act as a clinical decision support system and to handle the logistics of high risk pregnancy cases [8]. The project is still ongoing and cannot be directly implemented in a low-resource environment.

Patient registration	Demographic module	Disease history module	Antenatal care module	Diagnosis: cause-effect decisions	Treatment: vitamin/exercise
New/registered patient	Name/age/sex/address	Anaemia, diabetes etc.	POC: blood pressure, ultrasound		Referral: specialist

Figure 1: The block diagram of the proposed diagnostic support system for pregnant women. POC=point of care testing

3. DESIGN APPROACH

A user centered design approach has been followed in this project. The design process is divided into three phases: inspiration, concept creation and evaluation. In the first phase relevant literature in PubMed, Google Scholar, and ACM digital library were reviewed. Studies that are related to antenatal care were selected, sorted out and relevant studies were thematically analyzed. Later on, key design aspects for the decision support system were identified. The design aspects were verified and refined after consultation with experienced midwives. Furthermore, feasibility of the generated concepts were evaluated against criteria such as technology, cost, manpower that are available in low-resource settings.

Here we present the key design requirements that are distilled. A diagnostic support system should be easy to use by community health workers with minimal training. It should have short answering time and can classify different diseases for pregnant women with high accuracy. Actions to be supported are a) recording and reporting of vital information such as store and display patient information, b) diagnostics such as analysis and generating diagnosis report, classify different diseases and analyze risk factors, & c) consultation such as provide referral information. The diagnostic support system will have a database where demographic information, visits to the primary healthcare center information and previous pregnancy details will be stored. The graphical user interface part will be used for information retrieval and access point for the primary care center. The front-end GUI design will utilize visual programming and for the backend database design MySQL sever has been chosen due to its robustness. An automated algorithm will analyze risk factors and provide decisions. Furthermore, we have chosen to use windows machine due to its availability and lesser price in low-resource environments. Overall, our antenatal diagnostic system will support rural expectant mothers based on local contextual factors such as primary healthcare needs, most commonly occurring diseases etc. during the pregnancy period.

4. DISCUSSION & FUTURE WORK

There are couple of challenges that need to be considered for the rural diagnostic software. One of the key factors is the implementation of the diagnostic system with the local primary care center. Strong cooperation is required to make the antenatal care system successful with local stakeholders such as NGOs, doctors etc. Training to the community health workers is also an important issue. We aim to provide one to one training in addition to video training material for the health workers. Technical infrastructure such as maintenance of the computers and electricity is also an issue since in remote areas electricity is not

always available. Another key issue is the visits to the primary healthcare center. As it is already known that the number of visits to the antenatal care center is relatively low in rural setting where pregnant mothers have lack of primary education [2]. Initiative to make them motivated for the first and follow-up visits is a key aspect for the success of the proposed diagnostic system. Our proposed design is different from the approaches described in [1, 9]. For example, in our approach a) data collection and treatment will be provided in the primary healthcare center, b) the data will be transferred to the regional hospital when required. Our objective is to combine the antenatal care with primary healthcare support in rural areas. We aim to refine the concepts and build the prototype in coming months and improve it iteratively. Later on we would like to deploy the prototype in a rural setting in Asia for a field test.

5. ACKNOWLEDGMENTS

We thank the midwives for their feedback. The project has been funded by the Dutch Government.

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