An Effective m-Health System for Antenatal and Postnatal Care in Rural Areas of Bangladesh

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Abstract: *In South Asia, Maternal Mortality Rate (MMR) is so high due to the lack of health facility, doctor's insufficiency, lack of communication facility and also the poverty. Bangladesh is also suffering from this unexpected death during child birth or after that because of the insufficiency of antenatal and postnatal care especially in the rural areas. On the other hand, ICT is now a burning issue in all over the world. In Bangladesh, ICT is going to be included in every sector. Mobile Communication is the most increasing and successful achievement in our country. In this paper, we suggest and design an m-health system for the prenatal and postnatal care of women in rural areas of Bangladesh. This system is based on the mobile SMS and also the web interface is available there. It also ensures the neonatal care up to the age of complication within our limited resources.*

Keywords: *Pregnancy monitoring system, antenatal and postnatal care, mHealth system*

I. Introduction

In Bangladesh, 65% people lives in the rural areas. All the developing countries are facing a great problem about the health care facilities especially in their rural areas. The health specialists are beyond their reach for their particular diseases. The women from these areas are facing the complications during their pregnancy. So this is a major issue in the health sector of rural areas. Due to lack of gynecologists in rural areas, problems like mortalities occur. Every year, over 350,000 women and about 9 million children die from preventable deaths and diseases that occur during pregnancy and after childbirth. It is a great fear that with the United Nations' Millennium Development Goals for 2015, developing nations will lag behind the achievement of their goals in reducing child mortality and improving maternal health. However, the improvement can be achieved through technologically innovative strategies [1].

Over the years, ICT is used as a powerful tool for improving health and development in poor and remote areas. ICT has reduced the gap and encouraged collaborations between national governments and diverse international stakeholders in putting on mobile-based health solutions (m-Health). It has a powerful prospect for improving health in remote areas. ICT has been effectively used by patients and medical professionals for communication, searchable database, distant learning, inventory requirements and the patient's history, epidemiological analysis, disease Surveillance and for Arranged telemedicine, teleconferences, e-health cards, and medical Transcriptions [2]. Therefore, health care services in rural communities could be developed through the use of ICT. Inadequate resources and greater need for outreach within short time duration may make ICT a decent preference.

Bangladesh is one of the countries that accounted for 65% of global maternal mortality in 2008, having major segment in maternal deaths globally [3]. World Health Organization (WHO) says about 800 women die worldwide per day for the complications of pregnancy or related to childbirth. 99% of maternal deaths are in poor countries. And only 46% of their women benefit from skilled care during childbirth. So the millions of births are not helped by a midwife, doctor etc. The women in rich countries obtain at least four visits prenatal care, rounded by a skilled health worker during childbirth and access to post-natal care. On the other hand, in poor countries just over a third of all pregnant women have recommended four visits prenatal care. Poverty and distance are the important factors that prevent women to receive care during pregnancy [4].

In Bangladesh, the mobile users are allowed subscribing at a reduced rate of SMS service in 2010. That can broadcast messages in health topics. The patients throughout the country could be advised from the health workers via SMS through their mobile telephones. From those patients, the pregnant woman can register their mobile numbers to receive prenatal advice [2].

Considering all the above matters in mind, a m-Health system is designed for pregnant women to succor them safely through the pregnancy care advice and the newborn health care advice by broadcasting SMS text messages and with the help of Lady Health Worker. As a result the maternal mortality could be reduced at a great amount.

II. Related Work

MoTeCH: In 2000, the government of Ghana reformed its health care system by decentralizing the planning and management of health services from the national to the district level. The Navrongo Health Research Centre given an initiative designed to improve access to basic health care. In a policy known as the Community-based Health Planning and Services (CHPS) Initiative, the Ghana Health Service aims to scale up community-driven health care services. Mobile Technology for Community Health (MoTeCH) is a system of health management that have yet to fully address the information needs of frontline CHPS workers. Beginning in 2009, a study team launched a program to design MoTeCH so that it would facilitate the capture of CHPS primary health care service information and then feedback of essential health information to mothers, workers, and managers. Beyond adding functionality, however, the MoTeCH team aims to document and address critical limitations of the system [5].

MobiHealth: The forthcoming wide availability of high bandwidth public wireless networks will give rise to new mobile healthcare services. To this end, the MobiHealth project has developed and trialed a highly customisable vital signs monitoring system based on a body area network (BAN) and a mobile-health (m-health) service platform utilising next generation public wire-less networks. The developed system allows the incorporation of diverse medical sensors via wireless connections, and the live transmission of the measured vital signs over public wireless networks to healthcare providers. Nine trials with different healthcare scenarios and patient groups in four different European countries have been conducted. These have been performed to test the service and the network infrastructure including its suitability for mobile healthcare applications. Preliminarily results have documented the feasibility of using the system, but also demonstrated logistical problems with use of the BANs and the infrastructure for transmitting mobile healthcare data. The concepts behind the MobiHealth project (MobiHealth, 2002) was to bring together the technologies of Body Area Networks (BANs), wireless broadband communications and wearable devices to provide mobile healthcare services for patients and health professionals. For patients, these technologies enable remote patient care services such as management of chronic conditions and detection of health emergencies [6][7].

RapidSMS-MCH: An SMS-based system was developed to improve maternal and child health (MCH) by using RapidSMS, a free and open-sourced software development framework. To achieve the expected results, the RapidSMS-MCH system was customized to allow interactive communication between a community health worker (CHW) following mother-infant pairs in their community, a national centralized database, the health facility and in case of an emergency alert, the ambulance driver. The RapidSMS-MCH system was piloted in Musanze district, Northern provinces of Rwanda [8].

Millennia2015 [2010]: Under supervision of UNESCO the Women and eHealth made WeHealth as international working group was released at Aug 2010 in Namur. WeHealth supports actively to access better health care facilities for the women with technologies, the benefits of that system are [3]:
1) Increase use and access to health services
2) Low the maternal morbidity and deaths
3) Minimize death of infants at birth.

V. M. Pomazan, Lucian Petcu and others [2009] designing **eHealth monitoring system** to the data transmittance and processing, they referring to be implemented in an eHealth monitoring system dedicated to pregnant women with chronically diseases. The suggested design will transfer data from different standards to make the medical staff enable to update the patient's data as well as increase the efficiency of disease management [4].

The whole previous eHealth/mHealth systems were designed for other countries. No such systems are existed in Bangladesh for the prenatal and postnatal care for the pregnant women. We are trying to design a mHealth system by considering all our shortcomings and availability of resources in mind. The suggested mHealth system is based on the mobile communications and also a web based application.

III. Proposed System

To overcome the weakness of the current Bangladeshi pregnancy monitoring system; we propose this project, which is an effective m-health system for antenatal and postnatal care. It provides an easy to use, efficient and cost-effective mobile based as well as web based system while making use of multimedia environment and real time technology. The main features of this system can be summarized as:
i. Creating an easy and cost effective service for the people of the rural areas.
ii. Trying to investigate and overcome the weaknesses of the current pregnancy monitoring systems.
iii. Offering real time communication between the pregnant woman, health-worker, doctors and the admin officer through SMS (Short Message Service) as well as email.
iv. Developing a real time agent based system by using mobility technology

v.   Offering User friendly web interface application for the hospital staff to interact with the system.
vi.   Offering guidance and address to the nearest lady health worker as well as the health care center or hospital.
vii.   Arrange all the required equipments needed in emergency cases (OT room, Labor room, ambulance, doctor, etc.)
viii.   Offering multiple languages (English and Bangla) in the system.

III.I   Information flow of the proposed system
The main task of the proposed system is summarized below by a flow diagram. The flow of information is explained as follows:
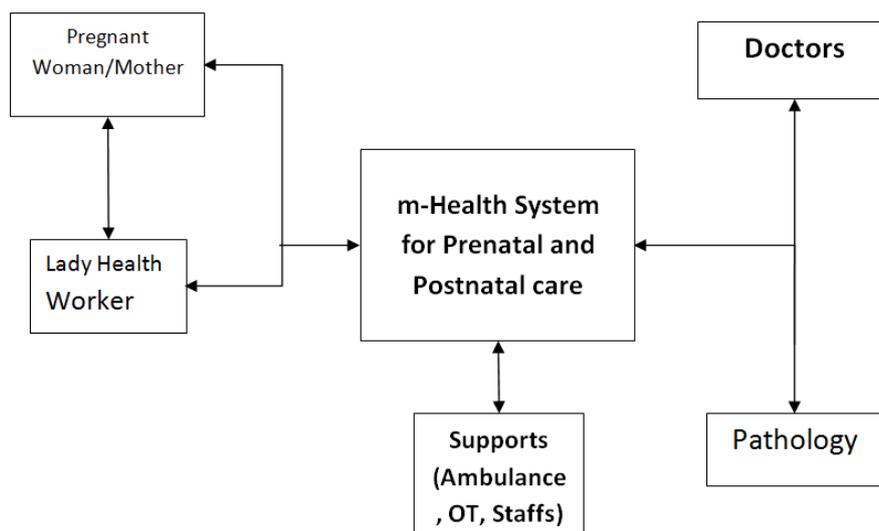
(i) Pregnant Woman first registers in the system with her LMP, name, address (only area) and age by using cell phone. Sometimes the health workers help them to register if they are not capable to do that.
(ii) System instantly confirms their registration by sending an SMS with an ID and her EDD (expected delivery date) and assigns a health worker who is nearby to her to look after her. System also informs that health worker by sending SMS. Both the pregnant women and the health workers will be always got regular suggestions from the system through SMS.
(iii) After knowing the registration information, the health workers go to the patient premises for collecting the initial information about the physical condition (like weight, BP, Temperature etc.) of the pregnant woman and sends the information to the system.
(iv) After analyzing the data, system send the general suggestion to the patient and also the health worker in a definite period of time. If the data is not in the regular pattern, send an SMS with the ID number of the patient to the initial level doctor to see the matter.
(v) From the doctor's panel, he or she will give suggestion immediately. The system immediately sends an SMS to the patient or the HW or both according to the doctor's suggestion. If any review is needed a schedule for review is given to the patient. If the condition is more complicated then suggest communicating with the experienced doctor by generating an urgent alerting message in the system.
(vii) The system (Administrator) then communicates to the experienced doctor through SMS or email.
(viii) If the patient needs any laboratory test then send an SMS to the pathology with the ID of the patient as well as an SMS to the patient. The pathology centre sends the report to the system directly. Based on the pathological report, system gives advice to the pregnant woman through SMS. If the reports are not in a regular pattern, system sends an SMS to the doctor to give a feedback. If needed, a schedule of review is given to the patient.
(ix) If patient or HW sends any SMS for emergency cases, system will send SMS to the staff management to send the ambulance or preparing OT and staffs.
(x) Registration is valid for a pregnant woman till the age of a newborn is 1 year. After succoring, they get the advice about the newborn health, immunization as well as the family planning.
(xi) When the registration becoming invalid, the information of the woman will be stored in an archive. When she will register in future, the information could be accessed from the archive.
(xii) All the SMS are maintained in a prescribed format that can be easily extracted by the system.

III.II   System Design
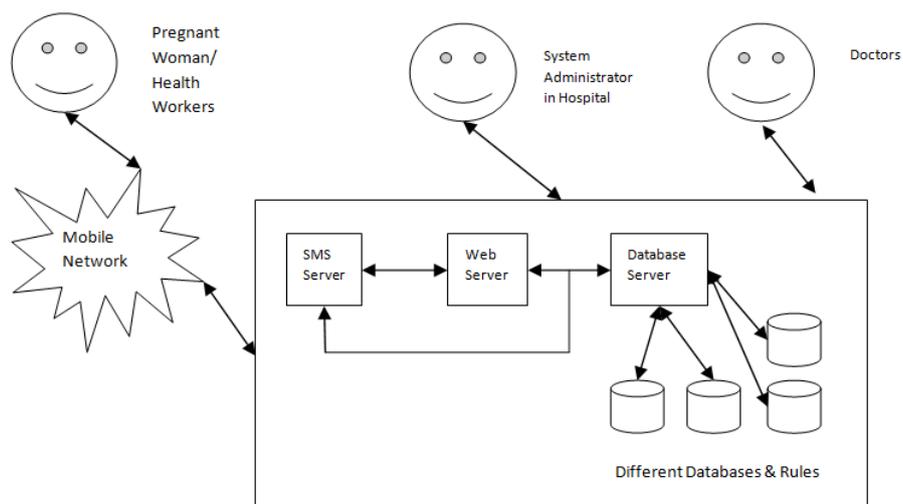
Web Server will listen for the requests from web browsers and upon receiving a request for a file sends it back to the web browser. It will host the program and control information for the system.

Database is a fundamental part of the system. It stores all important and detailed information about the system stakeholder such as general users, system administrator, doctors, patients, hospitals and health care centers, places or locations and events within the area of implementation. Beside that there is detail set of prerecorded SMS, which are suitable for different period of pregnancy and guidance cases. In addition, the database supports real-time information. Hence it has both temporal validity and precise timing constrains, which allow it to store the most recent data and effect instant changes as soon as they occur.

SMS server will be responsible for the communication between the pregnant woman / user (lady health worker, doctor, staffs) and the system. The SMS server will continually listen for incoming SMS messages, process and pass them to the system. The system will respond accordingly and the SMS server will deliver the response back to the user.

 Web Interface is simple, user friendly and requires little input from the user, mostly in the form of choices. Here, a panel is designed for the system administrator, a panel is designed for doctor and a panel is designed for the client/pregnant woman and also for the health worker.

IV.   Outcomes And Some Challenges

The following outcomes could be possible from the proposed system:

(i)   Helping the women who are out of health care services during pregnancy.

(ii)   As doctors are insufficient in the rural areas, Lady Health Worker can monitor them under the supervision of the proposed system. The lady health worker will be attached to a pregnant woman by matching the area's longitude and latitude of the patient and the health-worker.

(iii)   As mobile communications are available in every corner of the country, and SMS service is cost effective service, so it will be very acceptable and effective to the people of the rural areas.

(iv)   Monitoring the health position of the rural pregnant woman as they could not face any complex condition that leads them into death.

(v)   As all the women are not so literate to read and write SMS, the Lady Health Worker can help them.

(vi)   Most of the people in rural areas are poor; they do not have sufficient money to go to health care centre or hospital for succoring. So the lady health worker must be trained up about succoring in a normal case or some registered midwife could be attached in this system.

(vii)   The pregnant women have to move only one time for the review of the doctor during pathological test is needed in regular cases. So they get a relief as the communication is not so easy in the rural areas.

(viii)   They can notice priory through the systems analysis if any irregular condition arises. So they can move for the hospital or health care centre for the betterment of the mother and child. As a result mother and baby could be saved.

(ix)   Gynecological department of any hospital can use the system and the system could be merged with main i.e. national health care system in future. So, all the doctors can see the information.

(x)   Registration is valid for a pregnant woman till the age of a newborn is 1 year. After succoring, they get the advice about the newborn health, immunization as well as the family planning.

(xi)   A fewer number of doctor can give the services to a large number of women.

Some implementation challenges are discussed below:
(i) The Lady Health Worker could be trained up. They should have done their job sincerely because this is a matter of life.
(ii) The mobile companies will have to minimize their SMS charges in this regard. So the poor people can get the service smoothly. The government should have got the initiative to arrange the matter.
(iii) Some counseling program should be conducted to make the rural people interested about the system.

V. Conclusion

For addressing the prenatal and newborn health, m-Health could be the new emerging trends. Now a day's mobile technology has empowered the service providers as well as the people who want to get the health services. The governments in the developing countries like Bangladesh should incorporate m-health in the health management system in expediting emergency obstetrics referrals and enabling health workers to collaborate and improve the delivery of health care. The proposed system represents an important contribution to m-Health development by serving the needs of both mothers and frontline workers with a wide range of information capabilities. It is designed to be adaptable and extendable for anchoring the process of generalized National Health Management System by integrating data capture, management, and feedback for various requirements of the continuum of care. It also represents work in progress. Once the full ranges of development steps are taken, this model may prove to be a powerful ways that save lives.

The important conclusions which are obtained from proposed pregnant women monitoring system are (i) access to the health services for the pregnant woman, (ii) reduce the unexpected maternal mortality and newborn death, (iii) the proposed system is easy and more effective than other systems because it support locally registration of pregnant woman (from her home or her place), call for review, advising, interactive, etc. with the help of the lady health workers (iv) proposed system based on mobile SMS mode is cost effective comparing to other modes like modem solution, (iii) this proposed system can offer succoring locally in an emergency cases for pregnant women which is registered. In future, a mobile app could be incorporated with the system. Those who are using smart phone could easily get the services from the system. Day by day, the system could be extended for covering the services of the urban areas as well as nationally.

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