



A Framework for Developing a Maternal Health Informatics System for an Urban City in the Philippines

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Abstract: This paper provides a framework for developing a Maternal Health Informatics System (MHIS) for the use of health centers in an urban city in the Philippines. It introduces the use of Information and Communications Technology (ICT) in helping health centers solve maternal health care problems. The current prenatal and postnatal care processes of the health centers in the pilot city were studied through interviews with different health professionals and expectant mothers in order to identify problem areas. Benchmarking from various maternal health ICT solutions was done to identify important system modules and features and assess the appropriate tools to develop the system. Lastly, concepts, systems theories, and models such as the Kaiser Integrated Healthcare Model, Health Belief Model, and Care Model were used to develop the framework. The framework provides three system modules namely: 1) Patient Health Monitoring, 2) Referral, and 3) Pregnancy App/SMS. The Patient Health Monitoring module has five main features: electronic patient records, queuing, risk assessment, medical mapping, and statistics and health reports. The Pregnancy App/SMS has nine main features for the pregnancy app: health records, pregnancy timeline, weight status, symptom checker, journal, FAQ, media gallery, medical dictionary, and nutrition guide; and two features for the SMS: health inquiry and reminders. All the said modules are integrated to produce information that will be used for decision-making purposes.

Key Words: maternal health; health informatics; Information and Communication Technology; information system; framework

1. INTRODUCTION

The current status of maternal mortality and morbidity in a worldwide scale is certainly devastating because of the 800 approximated deaths that are related to pregnancy and childbirth (WHO, 2012). The overpowering number of preventable

deaths has led the United Nations to make maternal healthcare one of the Millennium Development Goals (MDG) for 2015. The goal of MDG is for global leaders to lessen the maternal mortality ratio by three-fourths by 2015; however current data shows that accomplishment of this goal stays notably unlikely.



Solving this issue is very important because mothers provide unparalleled and a vital part of a child's care. According to Ann M. Veneman, Executive Director of UNICEF (2008), "Evidence from the World Health Organization shows that a motherless child is more likely to die before the age of two than an infant whose mother survives." If the maternal mortality rate is high, there is also a high probability that the infant dies, thus making this issue a chief concern of all societies.

Given the study of this research, most of the maternal death cases are avoidable if there will be sufficient health care to prevent and manage those complications and illness. And Information and Communication Technology (ICT) can help reduce the said maternal health care problems. Maternal Health Informatics System focuses on the use of the applied IT in Maternal Health Care, and may not only create a seamless and comprehensive health care system, but also can assist health professionals to solve problems, make decisions, and provide better customer service more effectively and efficiently. Moreover, it also focuses on system development of ICT in giving support and preventing maternal complications and diseases in order to lessen maternal mortality rate through collaboration between key users in Malabon City such as: city health officer, midwives, physicians, secondary health providers, and expected mothers.

2. METHODOLOGY

The Rapid Application Development (RAD) is a development life cycle that is designed to give a faster approach when it comes to the development of a system. It provides high quality results compared to other system life cycles. RAD also raises the quality of finished systems while reducing the time it takes to build them. RAD is used by most organizations in order to develop strategically important systems while reducing development cost and maintaining the quality. Many organizations used RAD because of its advantage of having automated tools and techniques to restructure the process of building information systems. This methodology is used to minimize the development time and its cost, but increase the probability of

success of the new system (Shelly, Cashman & Rosenblatt, 2007).

The life cycle of RAD has four stages: for the first stage, requirements planning, the primary goal of this phase is to conduct preliminary investigation and to be familiar with the nature and the scope of the business, which can either be presented as an opportunity to be developed, or a problem to be solved. This phase ends when the proponents come to a decision on the key issues and acquires authorization from management to push through with the project (Shelly, Cashman & Rosenblatt, 2007). In this phase, the group interviewed medical staff in health centers such as midwife and physician, and nursing supervisor in city health department, and consult with the academic faculty member in order to identify system scope and process. The group also has defined requirements of the new system by identifying the old system's weaknesses and strengths and links the different gaps that are present within the current system. The identified gaps will then be included in the proposed system while the strengths will be further improved and be used as basis for other processes.

For the next stage, user design, this stage uses workshops to model the system's data and processes and to build a working prototype of critical system components. Users meet and discuss with the system analysts to develop the prototypes that utilize all the required inputs and process it into desirable outputs that are quite essential for their use. This goes on until both sides see it fit for the organization as a need and a want to gain a competitive advantage in the industry. This is the only time that the system analysts will be able to start constructing the system (Shelly, Cashman & Rosenblatt, 2007). The first step that the group did was to gather user requirements wherein the group interviewed the people directly involved in the processes, along with some observations during health center visits. Likewise, information regarding the requirements for both the users and the new system must be first identified before designing the system. The group also had benchmarking of similar systems, and



created drafts for system screens, forms and reports specifications.

For the third stage, construction, this stage completes the construction of the physical application system, builds the conversion system, and develops user aids and implementation work plans. This phase initiates the programming of the system and the application development of the project compared to the SLDC phases (Shelly, Cashman & Rosenblatt, 2007). In this phase, the group designed the final database structure based on previous data structure, and completed modules and system documentations.

For the final stage, implementation, this stage includes final user testing and training, data conversion, and the implementation of the application system. This phase represents the final tasks in the RAD phase; this includes conversion of data, testing, transfer to the new system, and training of users (Shelly, Cashman & Rosenblatt, 2007). This phase is the last of the four and will be accomplished at the end of the project lifetime. This phase includes the data conversion, testing, implementing as well as user training.

3. RESULTS AND DISCUSSION

The Maternal Health Informatics System focuses on the use of ICT in giving support and preventing maternal complications and diseases in order to lessen maternal mortality rate through collaboration between key users in Malabon City such as: city health officer, midwives, physicians, secondary health providers, and expected mothers.

The scope of the system development covers both prenatal and postnatal care process. And these include *Patient Health Monitoring*, *Referral*, and *Pregnancy App/SMS*.

For the *Patient Health Monitoring*, it covers five subcomponents such as *Electronic Patient Records* wherein all patient records ranging from basic information to check-up notes and results, health conditions, medical requests or transactions, and past/current prescriptions (i.e. past laboratory values and current diagnoses and medications). Other health centers and service providers such as hospitals and laboratories can access these data but

is limited only to general information excluding confidential data; *Queuing* wherein it has the ability to arrange the queues of patients for checkup session for one checkup day/session; *Risk Assessment* wherein it covers the detailed assessment and interpretation of medical records from patient's history, checkup records up to the latest test result in order to further know whether the patient is risky or not. Risk point system is used to assess the total risk level accumulated by a patient; *Statistics and Health Reports* that auto-generates statistics and health reports based on the data inputted in the system; and *Medical Mapping* wherein it displays data by plotting sections of a map. It helps the user specifically the city health officer (user of medical mapping) study geographically the health condition, helps him identify what area/s should have prioritization of needs, and helps him in decision-making.

For the *Referral*, it is a combination of the basic referral process and the collaboration of updating the health records. System user in a health center may refer a patient to other healthcare provider such as hospitals and laboratories to seek for special care. Referral starts with the need of a patient to have a special care from other provider that is not achievable in the current provider.

For the *SMS/Pregnancy App*, it covers two features for the SMS such as *Health Inquiry* wherein it allows users to send messages and ask questions via SMS; and *Reminders* that is for all prenatal and postnatal reminders to the pregnant women, and other announcements in relation to the health center. Pregnancy App on the other hand has nine features such as *Health Records* that lets the user access and views their medical health records done in the health center such as their check-up summary, and all other related medical records; *Pregnancy Timeline* that is used as a weekly guide to pregnancy. It includes the expectations during the certain stage of pregnancy, do's and don'ts, top symptoms, and other general information they need to know; *Weight Status* that shows and tracks the (gain/loss) weight of the user; *Symptom Checker* that shows the lists of symptoms in order for the user to be knowledgeable about the do's and don'ts related to their symptoms; *Journal* that is like a diary that simply updates or records notes or happenings, uploads pictures or videos, which the user inputted in order for her to track and capture happenings or different memories during/after their pregnancy; *FAQ* that shows the common questions pregnant women ask in order for her to have immediate access of the answers to their

questions: *Media Gallery* that lets the users visualize and understand maternal healthcare easily; *Medical Dictionary* that comprises common maternal terminologies, translation, and definition; and *Nutrition Guide* that recommends the proper nutrition and education for pregnant women.

All the data that will be recorded will be put into a database. All the said modules will be integrated to produce information that will be used for decision-making.

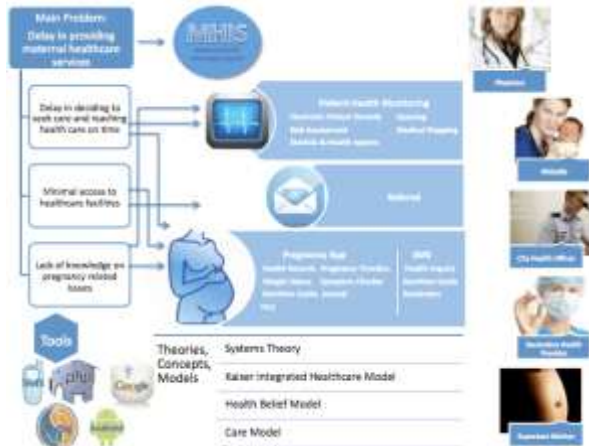


Fig. 1. Conceptual Framework

4. CONCLUSIONS

The Maternal Health Informatics System serves as an ICT solution to the health centers in the pilot city. It serves as a storage and repository of the Mother's pregnancy cases. Physicians can access maternal health information, especially of those who were referred by a Midwife, so that no vital information will be spared upon transfer. And through the user-access to the Maternal Health Informatics System, expected mothers will be able to keep track of their health records and easily connect with their handling health practitioner virtually at any remote area given access to Internet service. Aside from that, the expected mothers have access to Android app that can be used anywhere to check all about Maternal Health and self-care. The SMS module with its push SMS function also serves as reminders for the Mother to undergo checkups.

With the standardized forms and reports based on the current practice and best practices of

health centers, midwives are able to closely monitor expected mothers by capturing data that are vital to both the mother and fetal development. Moreover, since Barangay Health Workers are not able to do regular barangay visits, Statistics and Health Reports feature allow them to prioritize barangays based on the number of high-risk expected mothers in the area. Manual tallying and compiling will be replaced with auto-generated reports collated from each risk factor, complication, etc. of every expected mother. Aside from exact calculations, the City Health Officer will be able to focus on creating solutions and health programs geared towards problems seen in the reports and statistics.

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