

Design and Implementation of SMS-based Enhancements to a Community-based Health Information Management System

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Project Overview

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Project Abstract

This study describes the potential uses of SMS technology enhancements in health in terms of addressing the information needs of a village health center,

identifying which health unit services can be enhanced through the use of SMS technology and SMS-based applications, while also determining the improvements in the delivery of health care services urban health centers using SMS. The maternal health care program of health centers in Pasay City, an urban area south of Manila in the Philippines, was chosen as the focal point for the study.

This study involved health center staff in Pasay City, particularly the midwives and *Barangay* Health Workers (BHWs), and the resident pregnant patients of the San Pablo and Cuyegkeng Health Centers in Pasay City enrolled in the maternal care program. Key informant interviews, focused group discussions (FGDs), joint application development, training workshops with midwives, BHWs and patients, application beta-testing and code modification, review and optimization of the application, as well as application implementation were employed to gather the data. Health center staff were engaged from the initial design to the actual implementation of the SMS appointment reminder system since they were the ones who would be integrating the system in their everyday workflow. The system involved midwives enrolling pregnant patients in the maternal care program of the city for the SMS reminder system. Patients then received the appointment reminder a few days before their scheduled appointment for a pre-natal check-up. Overall response from the patients and health center end-users were positive, with patients mentioning the received SMS reminder message during their prenatal follow-up. Integration of the SMS appointment reminder system has been found to be most efficient at the post-consultation process where the patient receives information for her next follow-up. However, there were still inconsistencies that were determined as the result of unsatisfactory turnout of follow-up patients.

Both health centers also came up with a manual tally of registered patients in the appointment reminder system to address the difficulty in finding information in the confirmation message when the number of registered patients amounted to more than 30. The manual tally is comprised of the patient's name, code, cellphone number, and dates of follow-up. Comparison with the manual tally of patients showed that the health centers had no difficulty in adopting the system into their workflow. However, decline in the use of the SMS reminder system was apparent in the last few months of the testing period.

Keywords: SMS appointment reminder, Focused Group Discussions (FGDs), application beta-testing, Philippines, Cuyegkeng, San Pablo

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1. Research Problem

Potential uses of SMS technology for health paved the way for the University of the Philippines Manila - National Telehealth Center (UPM-NThC) to be engaged by the International Development Research Centre (IDRC-CRDI) in developing enhancements for health care delivery through mobile technology. These enhancements were conceptualized together with the

health center staff members of Pasay City since the Pasay City Health Office has been a pioneer in electronic public health information systems since 2004 when they began implementing the Community Health Information Tracking System or CHITS.

This study hypothesized that there would be better compliance to appointments for pre-natal visits by sending SMS reminders to the clients and/or to the *barangay* or community health leaders because of the interactive nature of the health facility. The CHITS time-stamps were used to measure compliance after the SMS was sent. Reminder application was also implemented. The past three years of CHITS data were used as control data.

The following research questions were formulated to guide the project in its direction:

General Research Questions:

- What information needs at the village health centers can be addressed by short messaging systems (SMS)?
- What health unit services can be enhanced with SMS?
- How can SMS improve/enhance the services of the RHU?

Specific Research Questions:

- Can SMS reminders improve the compliance rate for maternal care?
- Can SMS improve the timeliness and ease of reporting of prenatal care statistics?

2. Objectives

2.1 General Objective

To develop a health informatics application that will employ use of mobile phone technology to facilitate delivery of primary care services

2.2 Specific Objectives

- Enumerate the basic features of the health informatics application that will use mobile phone and SMS technology;
- Design an information workflow for the health informatics application;
- Determine the confirmation messages that the end users will receive through SMS;
- Promote the health informatics application to the patients that will potentially benefit from it; and
- Facilitate a Focused Group Discussion with the end-users of the application regarding their knowledge, attitude, and practices with regards to mobile phone technology

3. Methodology

3.1 Research Design

As an operational research, this study used the following methods:

- Joint application development – The application was developed through the combined efforts of the University of California Berkeley (UCB) and UPM-NThC. Mr. Bowei Du, a PhD candidate from UCB, and Engr. Randy Fernandez, lead software developer of UPM-NThC, collaborated in the development of the application. The application for the SMS reminder system was divided into two main components:
 1. SMS appointment reminder system through mobile phone technology – for health centers without electronic health records (EHRs)
 2. SMS appointment reminder system via CHITS (Community Health Information and Tracking System) – for health centers with existing CHITS, an electronic health records system implemented for government health centers in the urban and rural areas which generate the needed data as prescribed by the Department of Health in the Philippines
- Training workshops with midwives, BHWs, and patients – For those without EHRs, a two-day training workshop was conducted to facilitate learning the syntax used in sending health information via SMS to a gateway computer.



Figure 1: Training with Health Center Staff.

- Key informant interviews – Interviews were conducted with health center physicians and nurses to determine the workflow of information

exchange.

- Focused Group Discussions – FGDs were conducted to determine the acceptability of the application with the end users. Discussions were conducted to health centers with and without existing electronic health records (EHR).
- Application Beta-testing and code modification – A weekly, progressive integration of the SMS application was conducted in the two health centers in Pasay City. Update was expected after one month of progressive integration.
- Review and optimization of application – Redesign of application was dependent upon review from the end users.
- Application implementation – Scheduled upon completion of application review and optimization.

3.2 Study Population and Sites

The study was composed of health center staff in urban Metro Manila. Target population included the health center staff (midwives, BHWs) and the resident pregnant patients found in the Cuyegkeng and San Pablo Health Centers in Pasay City who were enrolled under the maternal care program.

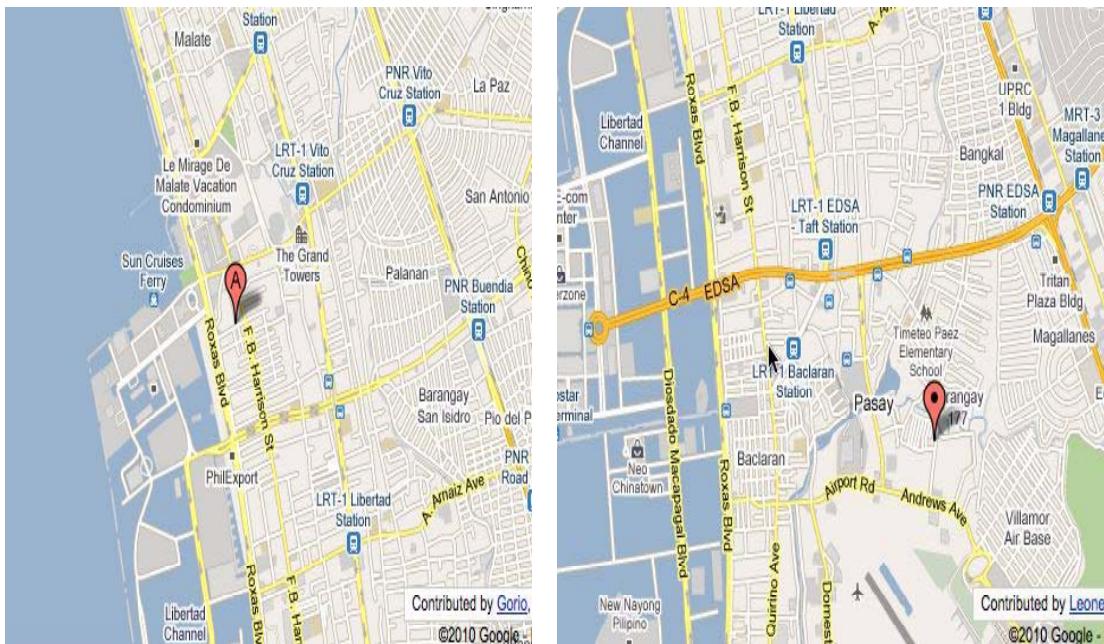


Figure 2: Study sites. *Cuyegkeng Health Center (L) and San Pablo Health Center (R)*

3.3 Inclusion Criteria

The study included population having the following conditions:

1. Signed informed consent in participating in the study
2. Ownership of a functional cellphone (For this study, a functional cellphone is defined as having the ability to send and receive SMS messages)
3. Health center staff willing to undergo training and capacity-building

3.4 Indicators

Indicators included the accuracy of syntax of messages, timeliness of messages, and adherence to appointment. Data collection included collection of time-stamps from SMS logs in the telehealth server and collection of data from logbooks from the health centers.

3.5 Ethical Considerations

The subjects involved in the study included the health center staff in urban Manila and the resident pregnant patients who were undergoing maternal care consultations and follow-ups in their respective health centers.

The health center staffs were recruited through the coordination and consent/approval of the health center physician. For health centers in Pasay City, the centers are also presently involved in the community project with the UP Community Oriented Medical Education. Upon approval of the health center physician, an introduction and training workshop will follow with the willful and voluntary participation from the health center staff. Through this workshop, a consent form was provided for them and only through the signed informed consent forms were the health center staff deemed eligible for inclusion in the study.

The resident pregnant patients were recruited through their consultation or follow-up at their health center. Upon consultation or follow-up, the patient was informed of the SMS appointment reminder system and asked if they would like to become part of the study. The patient was then also asked if she owns or uses a functional mobile phone. If so, she was then provided with a consent form and only through the signed informed consent form was the patient deemed eligible for inclusion in the study.

Those included in the study were informed of the ongoing study of the UP Medical Informatics Unit (MIU) to utilize SMS technology in health care. Through their participation, the MIU determined the feasibility of using SMS technology for appointment reminders of pregnant patients.

The health center staff members were asked to provide the GSM number of their functional cell phone. The health center staff integrated the use of cell phone in encoding the necessary syntax for staff and patient registration, as well as for the patient reminder message. In addition, the pregnant patient was asked to provide the GSM number of their functional cell phone. Once part of the study, they received an SMS message approximately 3 days before their scheduled follow-up appointment.

Through regular and constant consultations and coordination with staff members of the health centers in Pasay City, a protocol was designed to utilize short messaging system (SMS) messages in delivering health information to the their patients. This protocol aimed to demonstrate enhancements to the existing information system of selected health centers with the goal of enhancing the health care delivery system using SMS. Specifically, this project aimed to demonstrate an effective appointment reminder system for use in maternal prenatal care.

4. Project Activities

4.1 Timetable

Activity	S e p t 0 8	O c t 0 8	N o v 0 8	D e c 0 8	J a n 0 9	F e b 0 9	M a r 0 9	A p r 0 9	M a y 0 9	J u n 0 9	J u l 0 9	A u g 0 9	S e p t 0 9	O c t 0 9	N o v 0 9	D e c 0 9	J a n 1 0	F e b 1 0
Mobilization and situational analysis																		
Systems development																		
FGD/Workshops																		
Testing (one center)																		
Implementation (other health centers without CHITS)																		
Evaluation and reporting																		

4.2 Focused Group Discussions (FGDs)

In an effort to address the needs of the end-users with regards to the cell phone applications for health, a focused group discussion was held which aimed to determine the knowledge, attitudes, and practices of Filipino midwives, BHWs, and pregnant patients with regards to mobile phone technology. This was in preparation for the development of mobile phone applications for the enhancement of primary health care delivery in the Philippines.

At least 80% of the total human interaction in the SMS appointment reminder system involved midwives, BHWs, and the target pregnant patients. In the development of the system, the majority of those involved had to be included. Hence, inclusion of the end-users beginning from the initial design to implementation of the appointment-system provided a more customized application for everyday use in the eventual full-scale implementation of the system.

The objectives of the focused group discussion were as follows:

- **General:** Determine the knowledge, attitudes, and practices (KAP) of selected end users regarding the use of mobile phone technology to facilitate delivery of primary care services.
- **Specific:**
 - Determine KAP of Midwives, BHWs and pregnant patients on mobile phone technology.
 - Determine the usefulness of mobile phone technology in the participant's role in the public health sector.
 - Determine the [technology] needs of midwives, BHWs, and pregnant patients given their current role in the public health sector.
 - Evaluate and redesign, as necessary, the existing application workflow of the appointment-reminder system based on data gathered from the FGD.

The focused group discussion involved the health center staff, mainly the midwives and the barangay health workers. It was held last January 9, 2009 at the Malibay Health Center, and another one last March 6, 2009 at the Lagrosa Health Center, Pasay City, Philippines. The FGD team was composed of a facilitator and a documentor. Participants were assured of their privacy and the confidentiality of their answers. A consent form was provided in the to address the ethical issues and concerns surrounding data gathering from the participants of the focused group discussion.

5. Project Outputs

5.1 Focused-Group Discussions (FGDs)

The following important points were extracted from the focused group discussion:

- The midwives, BHWs and doctors were very proficient with regards with the different functionalities of the mobile phone, with SMS and call services being used frequently.
- They were open to the possibility of using the mobile phone for health applications.
- The potential benefits of using the cellphone for health applications include follow-up reminders, reminders for defaulting patients, and for reporting cases during weekend.
- Another advantage of using the cellphone for reminders is the fact that patients will bring their cellphone almost anywhere everytime, thus decreasing the chances of forgetting the reminder.
- The possible barriers to the implementation of the use of cellphone for health applications include the cost, the syntax (format and content) of the SMS message, and the possible dependency that the patient would develop from the SMS technology.
- With regards to using SMS technology for sending alerts on cases of notifiable diseases, this was removed from the scope of the project due to the fact that the BHWs did not possess the necessary skills and were not adequately trained to be able to identify such diseases. Capacity-building in identifying such cases was also not a project component. Hence, more focus was placed on maximizing the potential use of SMS technology for delivery of maternal health care services.

This activity also paved way for the following conclusions and recommendations:

- That the previous ideologies pertaining to the workflow of the SMS reminder system are consistent with the views of the midwives and the BHWs.
- That there is a need for close coordination with the health care providers with regards to the syntax to be used in the reminder system.
- That the reminder system can be explored to include vaccination and follow-up of patients with tuberculosis.
- That the reminder system can be explored to include defaulting patients.
- That the reminder system can be explored to include feedback option

for the patients.

- That the reminder system can be explored to include a way for BHWs to refer cases to the health centers. Possible things that should be further studied include the nature of case that they can refer, the syntax that to be used in referring the case, and cost analysis on this feature.

The focused group discussions concluded with the general acceptability of SMS technology use for health care.

5.2 Joint Application Development

Guided by the opinions and comments of health center staff members gathered through focused group discussions, the project team created a basic information workflow for the SMS appointment reminder system (Figure 1). The application identifies the source of information as whether it has CHITS or not. The application, then, communicates with the central server, Martian, and carries out features depending on the codes used in the SMS message.

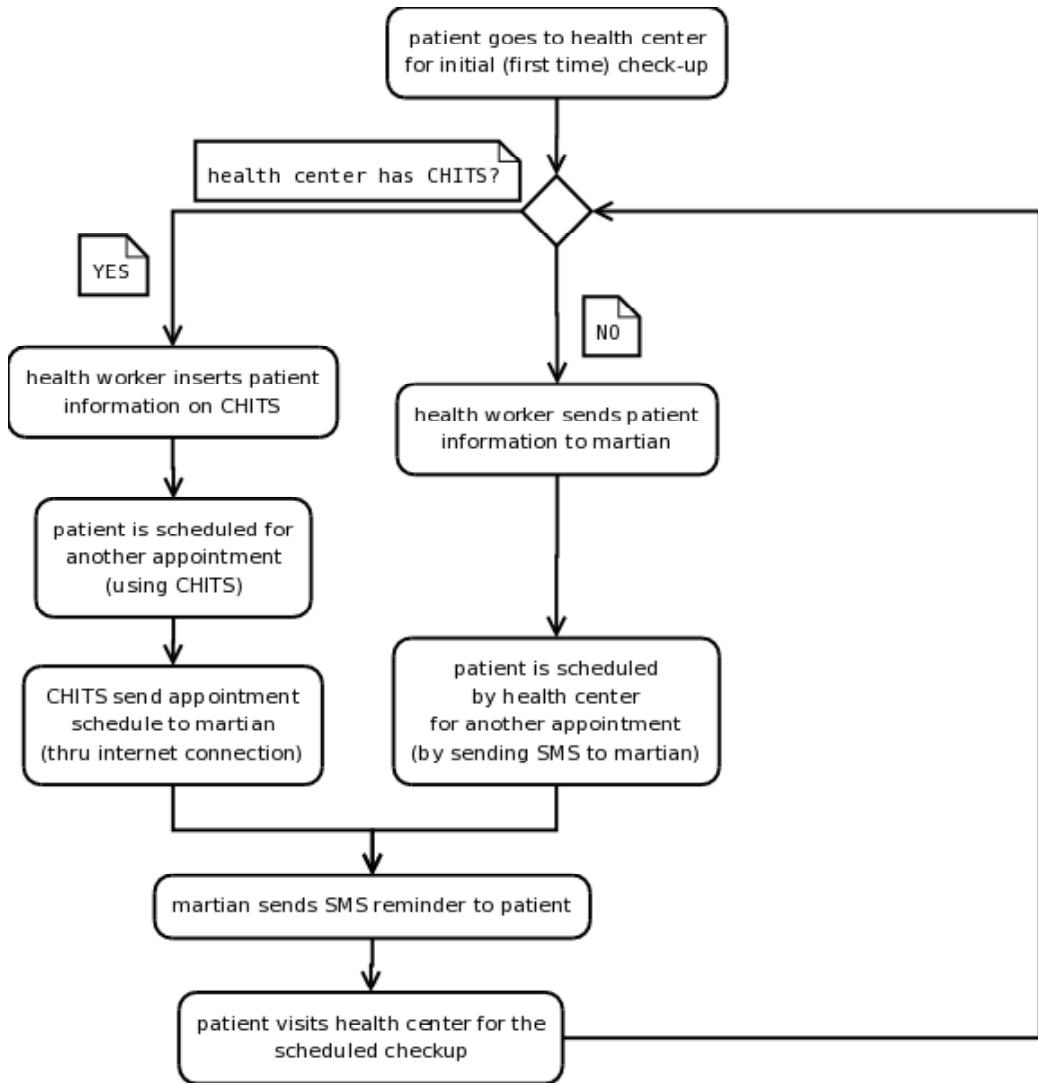


Figure 3: General concept of the SMS appointment reminder system for pregnancy care.

With regards to the workflow that was used in the participating health centers, the application was divided into two main processes, one with and the other without pregnant patients. Those processes not involving a patient were assigned for administrator and health worker registration. As a prerequisite, the administrator and health worker must have attended the training workshop for the SMS appointment reminder system and have full consent to participate in the study. A consent form was provided before administrator and health worker registration. Once the health worker is registered, processes involving patients can already be done.

Patient involvement consists of registration of eligible patients and the prenatal reports done every follow-up checkup. For a patient to be eligible, a

properly accomplished consent form must be filled up, and the patient must be within the inclusion criteria stated in this study. When the patient becomes registered, the health worker and the patient received confirmation messages. These confirmation messages allowed the health worker to verify that the contact number which the patient gave was correct, and that any errors in the number given can be reported through landline communication with the host of the project's central server – The National Telehealth Center (NThC). The confirmation message also contained the keywords that were used on the patient's follow-up:

PNCU/<patient name>/<patient code>/OK/Y-N/Y-N/<date of next appointment>

This allowed the user to just browse through the Inbox on the mobile phone, select the confirmation message for the patient, and edit the information for date of next follow-up, questions on quality of service, and the patient's general condition. Quality of service questions included the following:

- a.) Whether the patient received the reminder text message or not, and
- b.) Whether or not the message was helpful in reminding the patient of her follow-up.

For a more illustrated workflow, kindly refer to the brochure flyer at the end of this document.

As with errors concerning the patient's mobile number, any information that a patient may wish to correct, such as change in her Last Name, can be done through a landline communication with the NThC. Mobile-assisted correction of errors was avoided because of the added training workload for the end-users of the application.

Birth report is done through a follow-up at the health center at a maximum 24 hours after giving birth. As required by the Philippines' Department of Health, patients are likewise required to follow-up within one week after giving birth. This is the last information added in the patient's pregnancy case record. This signaled the end of the information loop that was started with the patient's registration. This also marked the end of any activities associated with the patient's pregnancy.

In summary, the following were the features supported by the system:

- Registration of Administrator: Administrators are able to register other phone numbers in the health center, and can encode patient information as well.
- Registration of Health Worker: Health worker can encode patient information

- Registration of Patient
- Report of prenatal care
- Birth report
- Report of postpartum care up to 1 week post-partum

Feedback features were also included in the application development to confirm a successful registration/report and inform the health worker for any errors in the encoding of patient information.

Aside from input processes, the SMS appointment reminder system also featured a report system which allowed end-users to get feedback on the number of successful inputs on the pregnant patient check-up days, as well as monthly accounts of successful registrations, follow-ups, while accounting for those who failed to follow-up on their appointment dates.

5.3 Application Promotion

In an effort to promote the health informatics application, flyers and posters were designed with brief descriptions and pictures of what to expect from the application. The posters were designed using Filipino as the major language as they were aimed to address the needs of the pregnant patients. On the other hand, the flyers were more directed for the health workers, using more technical concepts with the English language used. The flyer sample can be found towards the end of this report.

SMS APPOINTMENT REMINDER SYSTEM for Pregnancy Care

Ang SMS Appointment Reminder System for Pregnancy Care ay gumagamit ng *cellphone* at *text messages* upang makapagbigay ng serbisyo pangkalusugan para sa mga BUNTIS.

Hindi na kailangang mag-alala na makakalimutan ang araw ng pagkonsulta. Hintayin na lamang ang matatanggap na *TEXT message* dalawang araw bago ang takdang araw ng pagpunta sa *health center*.

STEP 1 Admission

- ✓ Sumadya sa lokal na *health center*
- ✓ Magpasailalim sa ilang *laboratory tests*
- ✓ Magparehistro sa *health center*

STEP 2 Consultation

- ✓ Magpakonsulta sa doktor na nakatalaga sa *health center*

STEP 3 Post-Consultation

- ✓ Makinig sa mga edukasyong pangkalusugan na ituturo ng *health worker*
- ✓ Kunin ang mga gamot at bitaminang inireseta ng doktor
- ✓ Gagabayan ka ng *health worker* kung paano magparehistro at gamitin ang SMS Appointment Reminder System for Pregnancy Care

STEP 4 Follow-Up

- ✓ Dalawang araw bago ang takdang pagpunta muli sa *health center*, makakatanggap ka ng *TEXT message* na magpapaalala sa iyo ng araw ng pagkonsulta.

*Kung mayroon kang iba pang katanungan, magsadya lamang sa lokal na *health center*

DESIGNED BY: IAN FRANI, R.N. ianfrani@yahoo.com <http://therising.deviantart.com>



Figure 4: Poster of the SMS appointment reminder system for health care.

5.4 Application Beta-Testing

Mr. Bowei Du, Dr. Cedric Festin, and Engr. Randy Fernandez, using Python as the primary programming language, developed the initial application. Development and initial alpha test with Dr. Ryan Banez, Dr. Alvin Marcelo, and Engr. Randy Fernandez were done from November 2008 to May 2009. The increase in length of application development was influenced by the feedback that the project team got from the workshops and FGDs conducted within the interval of application development. Workshops with the Cuyegkeng and San Pablo health centers were also done to introduce the SMS application and train the end-users in the registration and input of follow-up information.

The beta testing phase started in June 2009, and was led by Dr. Raymond Sarmiento, along with Engr. Randy Fernandez. For this phase, the following objectives were set out as follows:

- To determine at which point of the health center workflow will the SMS appointment reminder input process be most appropriate to integrate.
- To integrate the application to the existing workflow that the health center staff members follow during a pregnant patient encounter.
- To determine the estimated cost of maintaining the SMS appointment reminder system given a certain number of pregnant patients seen per month.
- To evaluate the workload value of the SMS appointment reminder system as it is integrated in a health center workflow.
- To determine the opinions, comments and suggestions of health workers in the use of the SMS appointment reminder system.

With regards to the initial data gathered from the first month of beta testing, it comprised mainly of registered patients with follow-up dates on the next month. The Cuyegkeng health center was able to register 26 patients on their initial consult, while the San Pablo health center registered 58 patients on their initial consult.

Analysis of data also included information during the time that the health centers were still not using the SMS appointment reminder system. This was to assess any change in terms of follow-up rates of patients after using the SMS-based application.

6. Project Outcomes

As of July 30 2009, the SMS appointment reminder system project in Pasay had reached its second month of beta testing. The first month was well-accepted by the health center staff members and minimal difficulty was found in integrating the mobile phone information encoding process in the post-consultation area. Concerns with regards to receiving reminder text messages and the server downtime were also raised and addressed.

Feedback was gathered initially on the fifth week of beta testing, when there were already patients who were coming back from their initial registration to the SMS reminder system, thus making it possible to extract patient opinions based on what the health center staff members recall. Overall responses from the health center end users were positive; patients would often mention the received reminder text message during their follow-up. Integration of the SMS appointment reminder system was found to be most efficient at the post-consultation process where the patient received information about her next follow-up appointment.

Feedback also consisted of comments from the end-users. First was the inconsistency in the date that the reminder text was received by the patient. Inconsistencies in the delivery of reminder text resulted to an unsatisfactory turnout of follow-up patients in one health center. Another inconsistency was with regards to the time the reminder text messages were received. Because of this, the research team decided it was best to send another reminder message one day prior to the appointment date.

Another concern raised was regarding the server downtime, with accidental unplugs and power interruptions accounting for the most common reasons leading to server downtime. To address this, the research team developed a monitoring system that relayed messages to the project lead and technical lead members regarding daily server status.

Both health centers also came up with a manual tally of registered patients in the appointment reminder system. This addressed the difficulty in finding information in the confirmation message when the number of registered patients amounted to more than 30. The health center staff members saw the manual tally as a highly valuable tool in terms of validating their productivity in encoding follow-up patients. The manual tally was comprised of the patient's name, code, cellphone number, and dates of follow-up. The research team also considered the option of providing an electronically produced tally of patients for the health centers.

As of December 30, 2009, there were 576 patients seen at both health centers, as reflected in their manual census. Of these, only 325 (56.42%) patients were enrolled in the SMS reminder system. A monthly comparison (Figure 5) showed a decreasing trend in the use of the application. However,

the use of the application significantly influenced the number of monthly follow-up visits to the health centers (Figure 6).

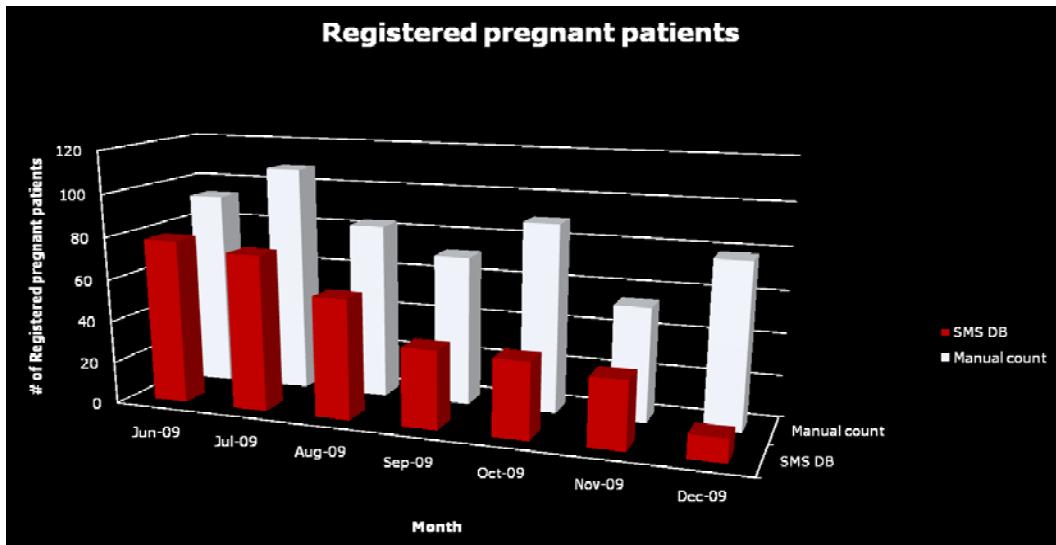


Figure 5: Graph showing monthly use of the SMS appointment reminder system.

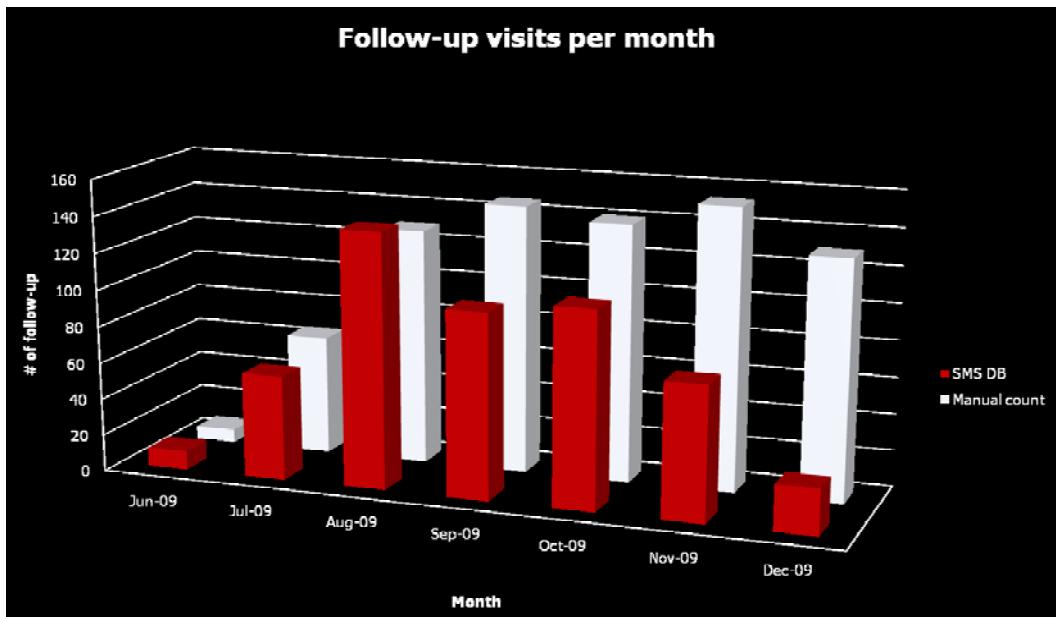


Figure 6: Graph showing the patients' monthly visits from using the SMS appointment reminder system.

Changes in behavior, attitudes, practices, capacities, health policies,

relationships, perceptions on the use of technology were observed in the health center midwives as well as in the enrolled pregnant patients. Currently, the midwives have become more pro-active in their line of work in terms of seeking out pregnant patients who missed their pre-natal follow-up visits. Overall responses from the patients have also been positive; they believe that the SMS appointment reminders help immensely in reminding the patients about their pre-natal status. A survey of the midwives also showed that the use of SMS technology could simplify maternal care recording. Once fully integrated into the workflow, the research team believes that these changes will eventually result in promoting an improved delivery of services for the maternal health care program in a sustainable and equitable manner.

Furthermore, to promote the results of this study, an abstract presentation was done during the 15th Annual International Meeting and Exposition 2010 of the American Telemedicine Association (ATA) last May 16-18, 2010 in San Antonio, Texas, as well as two poster presentations at the American Medical Informatics Association (AMIA) 2010 Annual Symposium held last November 13-17, 2010. They were presented under the topic on syntax and usage analysis of the SMS reminder system.

7. Overall Assessment and Recommendations

Conclusions Regarding Use of SMS-based Applications for Enhancing Maternal Health Care Program

Initial results showed that the use of SMS enhancements in appointment reminder systems is an effective means of simplifying maternal care recording. This research project has also shown that using SMS helps in monitoring the performance of the health center. The health center staff now have a better grasp and a better understanding of the maternal care data that they gather, which in turn leads them to take the necessary steps for the system to continue to function well, particularly by seeking out those patients who have missed their pre-natal check-ups and encouraging them to attend their next follow-up appointments.

The members of the health center staff were very successful in incorporating the SMS application in their existing management routine. This shows that mobile health applications are of high potential for countries with sufficient knowledge on the use of mobile phones for communication. However, such applications should address factors that could contribute to its decreased usage over time, such as:

- Continuous monitoring and feedback: The study was done with emphasis on the involvement of midwives during application design and subsequent deployment. Focused-group discussions were done to determine their knowledge, attitudes, and practices with regards to mobile phone use. The discussions were also vital in determining the health program in which the SMS reminder system was based. However, the midwives' involvement should extend throughout the beta testing process, where they could direct changes and improvements that the application will need.
- Ease-of-use: Mobile phones, in general, have a small viewing screen and a compact keypad. These make encoding data difficult and error-prone.
- Sustainability: The adoption of the system was well adequate, as reflected in the first three months of the study, but evidence of low turnout towards its end suggests failure to sustain the needs of the health center staff. Costs incurred during the beta testing were shouldered by funding for this project. The ideal situation is that the end-users would not be the ones shouldering the entire cost for maintenance in the full implementation of the application. Thus, the involvement of government sectors, as well as mobile service providers, was seen as a factor in determining the long-term success of a program using mobile health applications.

In order to improve further on this project, the SMS appointment reminder

system may also be expanded to include the Expanded Program for Immunization (EPI), TB-DOTS program, and other health programs as required by the Department of Health.

Another suggestion would be the further development of additional modules such as the Birth Module. The birth module is still not developed. If it were, it would basically contain the following rules:

- If the prenatal checkup does not indicate a next date of appointment, the pregnant patient is then assumed to have been referred to a lying-in clinic or hospital where she would give birth. The confirmation message that the health center staff member will receive will have a format as below:

PPCU/<patient name>/<patient code>/baby bday/<Y-N>/<Y-N>/<Date of next appointment>

PNCU is replaced with PPCU, indicating a postpartum followup. The status field for the patient has been replaced with a birthday field for the Baby.

- The last obligated checkup for the mother will be one week after her first post-partum follow-up. The patient will be given a reminder text two days and one day before the last allowable day of the week for her one-week post-partum follow-up. From the patient registration data, the system can automatically calculate the estimated date of confinement (EDC). The system will then send a reminder text to the patient a week before the EDC, informing the patient to follow-up with her health center 24 hours after giving birth. This process will effectively close the information loop, with the patient's second post-partum follow-up as her conclusive visit for that pregnancy care.

The project can also be directed to include the development of an internet-based SMS appointment reminder system. Majority of the work done so far involves the mobile phone-initiated SMS appointment reminder system. There is also the CHITS-initiated SMS appointment reminder system wherein the health center with CHITS will be provided Internet capabilities and will be capable of sending information to Martian with information regarding patients that will receive appointment reminder text messages. Development of this system, however will be simple as it will need a mobile phone number field in the CHITS system and a module that will send the patient's unique ID, cellphone number, nature of consult, and date of appointment to Martian, who will schedule the push of reminder text message to the pregnant patients. The format of the messages will be the same as the reminder text messages that the pregnant patients receive in San Pablo and Cuyegkeng health centers.

Teledermatology

This project also tried to investigate the effectiveness of mobile phones in delivering telehealth services such as teledermatology. A test study was conducted to develop a protocol for teledermatology wherein a teledermatology session was organized at the Pasay City jail as part of a scheduled medical/dental mission since it was observed in previous medical/dental missions that the patients there complained of allergies and other skin problems. Informed consents from the patients were gathered before conducting the teledermatology session. The system involved the doctor, on the ground, taking three pictures of the skin lesion from three different angles (as recommended by a dermatologist) and then sending the photos together with the patient's medical history via MMS to a dermatologist stationed at the UPM-NThC. The dermatologist at the UPM-NThC would then send back his or her expert opinion regarding diagnosis as well as the appropriate management for the patient. The doctor, on the ground, would then hand out the necessary medication. However, post-session evaluation showed that there was difficulty seen in sending descriptions of skin lesions using SMS/MMS. The dermatologists deemed the whole process to be too tedious for the problem to be fully addressed using a simple mobile phone. The photos of the skin lesions taken from different angles using the camera from the mobile phone were not able to help paint a clear picture for the dermatologist so as to facilitate the handing out of diagnosis and providing treatment options. In addition, there was a noticeable lag in sending multiple MMS messages simultaneously. Thus, it was recommended that the use of mobile phones with cameras were not the appropriate technology to be used for teledermatology.

Notifiable Diseases Reporting

The original proposal for this IDRC-funded SMS reminder system included an objective for collecting Notifiable Disease data for the 17 Notifiable Diseases. However, this objective was not met within the project time period for the following reasons:

- 1.) Notifiable Disease reporting by SMS was not deemed a priority of the end-users (a result of the FGDs). The end-users showed more preference in doing the maternal care reminders first because it was simpler and they did not want to do two programs at the same time to manage the workload on the health workers.
- 2.) Notifiable Disease reporting by SMS was too difficult to do in the field not because of SMS issues but due to the low capacity of the field worker to reliably recognize and diagnose notifiable diseases. An example of which is that a village or *barangay* health worker could not be able to differentiate measles from TB. The BHWs did not have the requisite knowledge and skills to

do so.

Because of these issues, the Notifiable Disease reporting by SMS was not done during the project period. Focus and priority was placed in enhancing the maternal care program through reminder SMS.

However, there were lessons learnt in the maternal care reminder aspect of the study which can inform the Notifiable Disease study, to wit:

- 1.) Data quality is best if the reporter is facility-based and is consistently the public health nurse.
- 2.) Public health nurses, unlike the previous end-users (BHWs), can reliably recognize and identify notifiable diseases.

After placing most of the resources to fully pursue the study on maternal care reminder through SMS as well as after asking for a no-cost extension, pursuing the Notifiable Disease reporting was deemed unfeasible due to lack of personnel (some health centers did not have a public health nurse, while those who did have one were unable to pursue the study due to their current workload in the health center). In addition, the funds were not substantial enough to afford to address the capacity-building of the BHWs in identifying notifiable diseases (an option to address the lack of personnel previously stated) as well as for the sustainability of pursuing the Notifiable Diseases reporting for at least a six-month duration (most of the costs for pursuing this aspect of the study would then have to be shouldered by the end-users, a less than ideal situation and something which the end-users were unwilling to do)

Final Recommendations

It is the goal of this SMS project to facilitate the information workflow through automated processing of raw data. For the health center to reap the benefits of mobile health informatics, the manual curator processes in paper form must be replaced with computer interfaces. The syntax must also be revised in the registration process to accommodate more keywords or at least allow the function of two keywords.

Furthermore, due to the high cultural impact of the use mobile phone technology for Filipinos, it is highly recommended that sociological/anthropological studies to be done with the results gathered in this project. This will guide the research project head and minimize bias resulting from cultural influences, particularly influences in the use and preference of mobile phone.

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