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e-Maternal, Neonatal and Child Health and Nutrition with Geographic Information System and Decision Support System

Noel P. Sobejana,
Department of Information Technology Education
University of Mindanao – Digos College
Philippines,
Email: noelpsobejana@gmail.com

Abstract

The study focused in developing an electronic Maternal, Neonatal and Child Health and Nutrition application system with Geographic Information System and Decision Support System as an electronic means of monitoring and guidance in decision-making on the health and nutrition status of mothers and their infants and children. A mixed-method type of research was employed. Experimental design was used to develop the system based on the eXtreme Programming software development methodology. Second, descriptive-quantitative design was used to describe the satisfaction and acceptability of the users (midwifes, BHWs and mothers) and determine the best determinant or predictor of acceptability of e-MNCHN. Lastly, qualitative design was used to come up with the feedbacks of the mothers regarding their use on the system. Based on eXtreme Programming, gathering of necessary information from the midwife and community health workers became the necessary basis in programming the e-MNCHN's preliminary algorithms. The application system was rated both by the expert and the mothers as very effective. It was found out to be satisfactory at some extent, and acceptable at some extent. Documentation is the best and only determinant of acceptability of the system. This means that the documentation aspect of the system. Lastly, themes from emerge from the mothers' feedbacks, namely IT factors, personal factors and social factors. This implies that the physical, graphical and infrastructure requirements of the system, the personal experiences, beliefs and profile of the users, and the role of the government and the users' peers in the use of the e-MNCHN application system.

Keywords: *e-Maternal, Neonatal and Child Health and Nutrition, Geographic Information System, Decision Support System*

1. Introduction

With the twenty first-century coming in, technology has spelled a lot of differences in the current way of life. Technology has shown its presence with the occurrence of the use of gadgets and applications which makes life easier and certain services accessible. With regards to health, all professions have gone into informatics and use of technology to assist the service providers into provision of better and quality service.

Over the past decade, the number of primary studies evaluating the practical implementation and integration of electronic systems as applied to health and nutrition monitoring has steadily grown. As the research community has sought to make sense of these studies, systematic reviews attempting to identify and describe barriers and facilitators to implementation have proliferated. More so, the health status and conditions of the mothers and their children become a center of attention of scholars and policy-makers across the globe. Various literatures reported that these two are taken as important parameters of a country or a region's mechanism to improve its human development and quality of life indices. Although the reviews have furthered knowledge by identifying factors thought to influence implementation processes and their outcomes, the underlying mechanisms at work have not been well characterized or explained.

The United Nations Children's Fund (2010) recognized the central role of education in the Millennium Development Goals during the MDG SUMMIT 2010 High Level Round Table on September 22, 2010 at the United Nations, New York. Accordingly, the behavior and habits of the future parents are determined by the education of today's children and youth. They said that children of parents with at least a basic education are more likely to survive after the age of five because educated parents, particularly mothers, have been reportedly shown to make better use of available health services and provide greater quality care to their children. They even cited one of the findings presented by the United Nations Educational, Scientific and Cultural Organization (UNESCO) that mothers with primary education reduced child death rates by almost half in the Philippines and by around one-third in Bolivia. Education also delays the age at which young women give birth; adolescent girls are up to five times more likely to die from complications in pregnancy than women in their 20s, and their babies are also at higher risk of dying; poorer and less educated women, especially those living in rural areas, are far less likely to give birth in the presence of a skilled health worker than better educated women who live in wealthier households.

In the Philippines, 3.4 million pregnancies occur every year, half are unintended, one-third of which end in abortions (Darroch, Singh, Bal & Cabigon, 2009). An estimated 11 mothers die of pregnancy-related causes every day, most of these deaths could have been avoided in a properly functioning health care delivery system. Among the leading direct

causes of maternal deaths in the country are: post-partum hemorrhage, hypertensive disorders of pregnancy, abortion-related complications and obstructed labor. Beyond the glaring data of mortality lies a huge toll of ill health and disability due to pregnancy-related complications and infant and child deaths and deepening poverty in families where a mother has died. It is estimated that for every maternal death there is at least 20 to 30 other women who suffer from serious complications, some of which are life-long. Maternal health conditions are the leading causes of burden of disease among women. Due to these reasons, monitoring and evaluation (M&E) system in health programs play a crucial role in addressing the issue of maternal, newborn and child health and nutrition (MNCHN) for the Philippines to achieve Millennium Development Goals 4 (Reduce child mortality) and 5 (Improve maternal health) (Darroch, et al., 2009).

Locally, Birondo (2014) assessed the maternal and child care conditionality of the Pantawid Pamilyang Pilipino Program (4Ps) in Santa Cruz, Davao del Sur. The research reported that compliance to maternal health conditionality among the barangays in Santa Cruz have poorly complied with the child health conditionality. Also, the apparent lack of database to monitor individual information and condition of each member was one of the future agenda laid by the research to effectively and closely monitor the members' conditions during the duration of the grant.

2. Description of Research

Considering the issues at hand, the researcher created a study entitled "e-Maternal, Neonatal and Child Health and Nutrition" (e-MNCHN), in order to effectively and easily monitor the maternal, neonatal and child health and nutritional status in an electronic platform in the Municipality of Santa Cruz, Davao del Sur. The use of Geographic Information System (GIS) in the study integrated, analyzed, and displayed geographic and spatial information of the mothers and children located in the study area to determine who are considered in the critical level in terms of health and nutrition for easier monitoring and appropriate intervention. On the other hand, the Decision Support System (DSS) allowed the formulation of appropriate decisions concerning maternal and child health and nutritional monitoring such that it will provide collated statistics of which area is critical or not in a given time. At present, all barangay health stations (BHS) monitor and report maternal, neonatal and child health and nutrition reports to the City Health Office using a health manual, or the "pink card". This manual system of maternal and child health monitoring have the mothers devoid of access and guidance as to health information, notification and tracking of health progress.

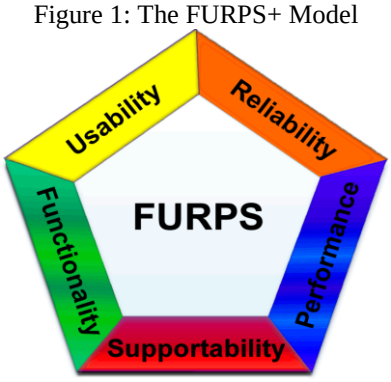
The e-MNCHN, following the standard international index of database, would enable barangay health stations to consolidate information, prepare and collate these for reporting to Department of Health, and in return, serve as a guide in easy dissemination to the mothers

about their health and nutritional status and of their infants and children via an electronic platform. With these thoughts interplaying, the system could make the transaction of each barangay, town or province easier and helpful, and the decision and the monitoring of the health and nutrition information would be more precise to give proper support and implementation of the current health programs.

2.1 Theory and Research Framework

This study anchors on the theory that a system can achieve its standard level of quality by clarifying the needed requirements of the systems' developers and users and understanding the nature of the system (Grady & Caswell, 1987). The well-known model is called the FURPS+, which stands for Functionality, Usability, Reliability, Performance, Supportability and the "+" extends the acronym to include quality components that are specific to individual software like design, implementation and physical requirements. Figure 1 shows how the study uses this FURPS+ model to check and clarify the effectiveness of the system. The study utilizes the FURPS+ by defining each of the letters of the acronym. The breakdown suggests some questions around the need of establishing the e-MNCHN. F stands for functionality, which poised questions like "What does the health centers and more specifically, the mothers, want?" U stands for usability, entailing questions like "How effective is the e-MNCHN (the developed system) from the standpoint of the users? Is it aesthetically acceptable? Is the documentation accurate and complete?" R stands for reliability. This answers the questions like "What is the maximum acceptable system downtime? Are failures predictable? Can we demonstrate the accuracy of results? How is the system recovered?" P stands for Performance. This poised questions like "How fast must the system be? What is the maximum response time? What's the memory consumption?" S stands for supportability, in which the concern are the questions like "Is the e-MNCHN testable, extensible, serviceable, installable, and configurable? Can it be monitored?" Lastly, the "+" reminds us of a few additional needs that a user (in this case, the BHWS, midwives, doctors/physicians, and most especially, the mothers) could have. These include design constraints, implementation requirements, interface requirements, physical requirements, among others.

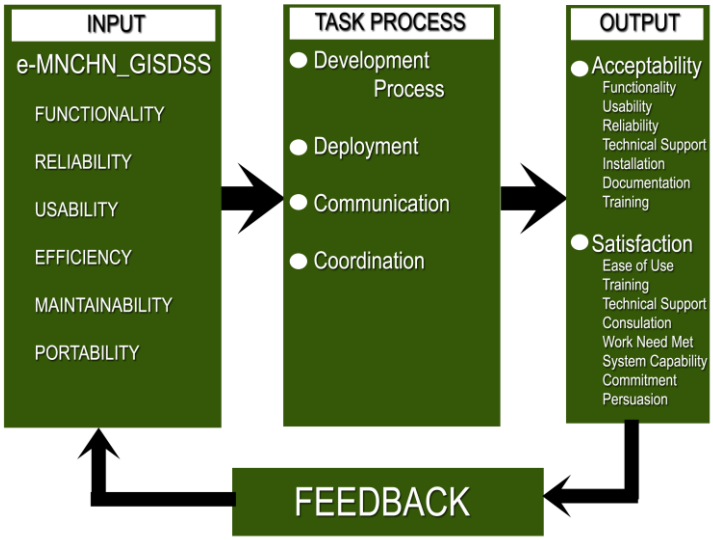
Figure 1: The FURPS+ Model



In support, the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh, et. al. (2003) was used as a theoretical basis for this study. The Unified Theory of Acceptance and Use of Technology aims to explain user intentions to use an information system and subsequent usage behavior. The theory holds that four key constructs: 1) performance expectancy, 2) effort expectancy, 3) social influence, and 4) facilitating conditions; the first three being direct determinants of usage intention and behavior, and the fourth a direct determinant of use behavior. The theory was developed through a review and consolidation of the constructs of eight models that earlier research had employed to explain information systems usage behavior. In this study, the utilization of the theory is manifested on the usage of mothers on the e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system. Performance expectancy pertains on the performance of the system as tested for use by the mothers. Effort expectancy pertains to the degree of ease of the mothers associated with the use of the e-MNCHN. Social influence is the degree to which the mothers perceive that what others believe in using the e-MNCHN system is an important consideration for their use also. Lastly, facilitating condition is defined in a manner that the mothers believe that an organizational and technical infrastructure exists to support the use of the e-MNCHN. With these four elements interplaying, this theory proves useful as a supporting model for the study.

The conceptual model of this study, shown in Figure 2, consists of four elements, namely: (1) Input; (2) Task Process; (3) Output; and (4) Feedback.

Figure 2: Conceptual Framework of the System



The elements of input are functionality, reliability, usability, efficiency, maintainability, and portability. Task process involves development process, deployment, communication and coordination. The output parameters of the study are acceptability and satisfaction of the system. Acceptability can be defined in terms of ease of use, training, technical support,

consultation, work needs met, system capabilities, commitment, and persuasion. Likewise, satisfaction can be defined in terms of functionality, usability, reliability, technical support, installation, documentation, and training. From the output comes feedback, which channels back to the input for checking.

2.2 Research Questions

The study aimed of developing an electronic Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system with Geographic Information System (GIS) and Decision Support System (DSS) as an electronic means of monitoring and guidance in decision-making pertaining the health and nutrition status of mothers and their infants and children.

Specifically, this study sought to provide answers to following problems:

RQ1. What is the process of developing the e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system?

RQ2. How effective is the e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system in terms of functionality, reliability, usability, efficiency, maintainability, and portability?

RQ3. What is the level of acceptability of the e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system in terms of ease of use, training, technical support, consultation, work needs met, system capabilities, commitment, and persuasion?

RQ4. What is the level of satisfaction of the mothers in using the e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application system in terms of functionality, usability, reliability, technical support, installation, documentation, and training?

3. Method

3.1 Research Design

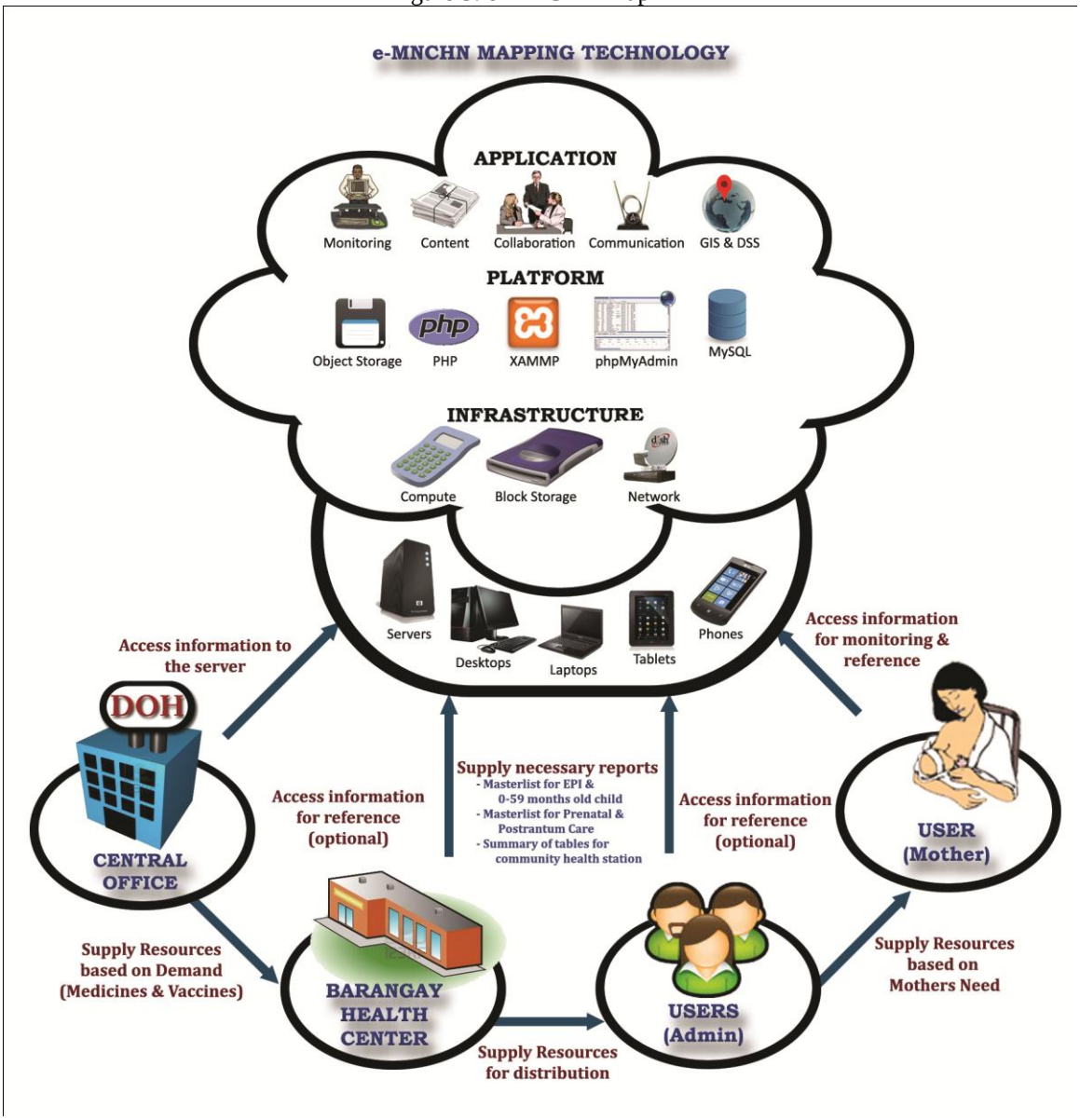
The research will use the systems development and design. It will also integrate the Geographic Information System and Decision Support System.

The research's general goal is to develop a system known as electronic Maternal, Neonatal and Child Health and Nutrition (e-MNCHN), a system designed to provide Geographic Information System (GIS) and Decision Support System (DSS) pertaining to the nutrition and health status of women, infants and children in a specific area or community. With this, all successful system needs blueprints or master plan to facilitate faster and accurate process.

Figure 3 illustrates the e-MNCHN map. The map gives a big picture of the process flow of the proposed project. The figure is based from the framework of the cloud computing. The cloud represents the web server where the application, platform and the infrastructure are

located. Meanwhile, outside the cloud, an overseeing process involves chain of activities, defined in a twofold course of action: access and supply.

Figure 3: e-MNCHN Map



The relational flow or phase that exists in the e-MNCHN map in Figure 3 can be manifested based on necessity and purpose. The Department of Health (DOH) Central/Regional Office accesses information from a cloud server to any electronic device at the office for a specific purpose, i.e. verifying health reports from and of a community. The community health center accesses the information from the cloud server in the manner of encoding, processing, collating and storage of relevant information concerning maternal, newborn and child status. Third, the system administrator(s) access the system when the midwife or any barangay health worker in-charge records the information of the mother and/or infant/child, gets the health and nutritional parameters, any prevailing health condition, etc. In turn, the system automatically collates all the gathered information results to a

consolidated health report that can be freely-accessed. In addition, the system enables the creation of masterlists for EPI & 0-59 month old children, prenatal and postnatal care, and summary of tables for community health station's use or reference. Lastly and most importantly, the mothers (who are the system's ultimate users) access the cloud server in a manner of reference and guidance, i.e. knowing the schedule for prenatal and postnatal checkup.

3.2 Survey Questionnaire and Data Collection

The researcher made use of both observation method (present scenario) and survey method to collect data. The observations were conducted to determine the need for maternal and child nutrition and health tracking or monitoring system through observation of its operations, processes and the implementation of health programs.

The experts were informed via letter that they were chosen to test the viability of the system before deployed for the mothers in the chosen site. They were 15 minutes for them to check the system. Afterwards, the questionnaires for the experts were distributed for them to evaluate the system in terms of satisfaction and acceptability. In assessing the system, the researcher noted and took into consideration the suggestions of the experts with the viability of the system before deployment.

Orientation was first conducted by the researcher with the means of accessing the e-MNCHN. A list of mothers in the pilot area was furnished from the Barangay Health Center. The list of mothers was thoroughly screened based on the selection criterion that a mother must be actually living in the area, must have children aging 3 and below, and must have smartphones. After the predetermined number of mothers was identified, the system was allowed for access via smartphone. They were instructed to register in the e-MNCHN and go in its features

After the preliminary system check, the questionnaires were distributed to the respondents after the system is fully installed and fully functional. After the usage experience, the mothers evaluated the system as to its acceptability and performance, and their satisfaction of using it.

The questionnaires of the respondents were retrieved after answering. The questionnaires were checked and the scores were tallied and tabulated into a master datasheet. The results were tabulated in Microsoft Excel. The datasheet through the questionnaires was then subjected for statistical analysis. To compute for the weighted mean on each item in the evaluation, SPSS will be used. After the statistical analysis, the results were analyzed and interpreted based on the purpose of the study.

3.3 Instrumentation

The researcher made use of both observation method (present scenario) and survey method to collect data. The observations were conducted to determine the need for maternal and child nutrition and health tracking or monitoring system through observation of its operations, processes and the implementation of health programs**.**

The following instruments were used in the different areas of the study:

Instrument 1: e-MNCHN Project Management Plan. This instrument was used in the development of the e-MNCHN System. It contains the overview of the e-MNCHN project, project organization settings, managerial process plans, and technical process plans. This plan was based on the eXtreme Programming.

Instrument 2: e-MNCHN Test Case Report. This instrument was used in checking the overall and pre-defined procedure in manipulating specific module of the e-MNCHN system.

Instrument 3: e-MNCHN Test Case Scenario. This instrument was used in checking the effectiveness of the e-MNCHN application system in terms of functionality, reliability, usability, efficiency, maintainability, and portability. The level of effectiveness is established through the ratings of the mothers and experts. The participants were asked to check the appropriate box for their ratings using a scale of 5 to 1 where 5 is excellent, 4 is very good, 3 is good, 2 is fair, and 1 is poor. In addition, reliability test was carried out via test-retest method using both Spearman-Brown coefficient and Guttman split-half coefficient. Results reveal that the test case scenario has a value of .976 for both tests.

Instrument 4: Software Satisfaction Survey. This instrument was developed by Linda, L. (n.d.). The survey instrument is composed of a total of eighteen (18) items. The questionnaire has two questions or items for each of the quality requirements of the indicators, namely functionality, usability, initial reliability, long-term reliability, technical support, installation, documentation, and training. The level of satisfaction is established through the ratings of the mothers and experts. The participants were asked to check the appropriate box for their ratings using a scale of 5 to 1 where 5 is strongly satisfied, 4 is satisfied to some extent, 3 is neither dissatisfied nor satisfied, 2 is dissatisfied to some extent, and 1 is strongly dissatisfied. In addition, reliability test was carried out via test-retest method using both Spearman-Brown coefficient and Guttman split-half coefficient. Results reveal that the test case scenario has a value of .905 for Spearman-Brown and .893 for Guttman split-half.

Instrument 5: Software Acceptability Survey. This instrument was developed by Burges, L. et al (2008). The survey instrument is composed of eight parts with a total of twenty-four (24) items. The questionnaire has 161 set of questions for each variable. The indicators include the ease of use, training, technical support, consultation, work needs met, system capabilities, commitment, and persuasion. The level of acceptability is established

through the ratings of the mothers. The participants were asked to check the appropriate box for their ratings using a scale of 5 to 1 where 5 is strongly acceptable, 4 is acceptable to some extent, 3 is neither acceptable nor not acceptable, 2 is not acceptable to some extent, and 1 is strongly not acceptable. In addition, reliability test was carried out via test-retest method using both Spearman-Brown coefficient and Guttman split-half coefficient. Results reveal that the test case scenario has a value of .885 for Spearman-Brown and .864 for Guttman split-half.

4. Results of Analysis

4.1 Description of the Present System

The status of the Municipality of Sta. Cruz, Davao del Sur on the implementation of MNCHN is discussed below as a result of the data gathered from the conducted interview and observation among the health workers and mothers. Figure 4, 5, & 6 illustrates the transaction flow inside the health center during the scheduled visits.

Figure 4: Existing Manual Transaction Flow of MNCHN Status Monitoring (Register & Ask for Booklet)

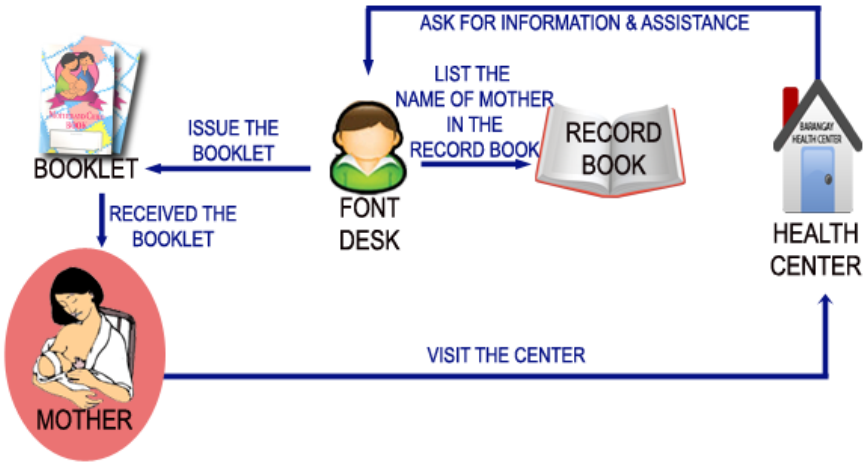


Figure 5: Existing Manual Transaction Flow of MNCHN Status Monitoring (Prenatal & Postnatal Process)

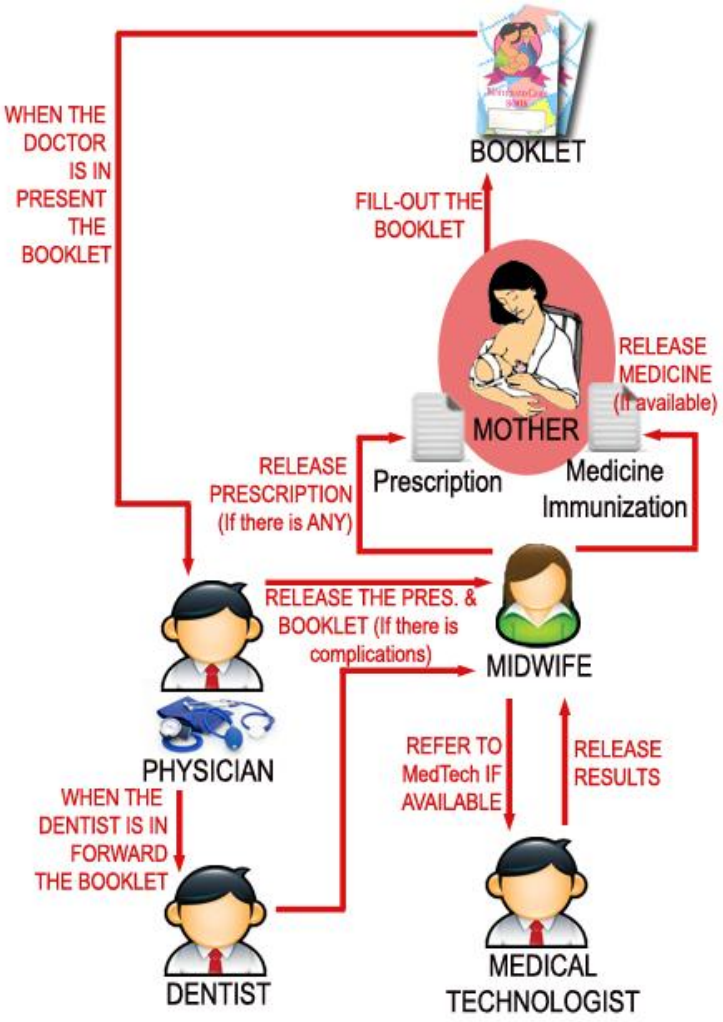
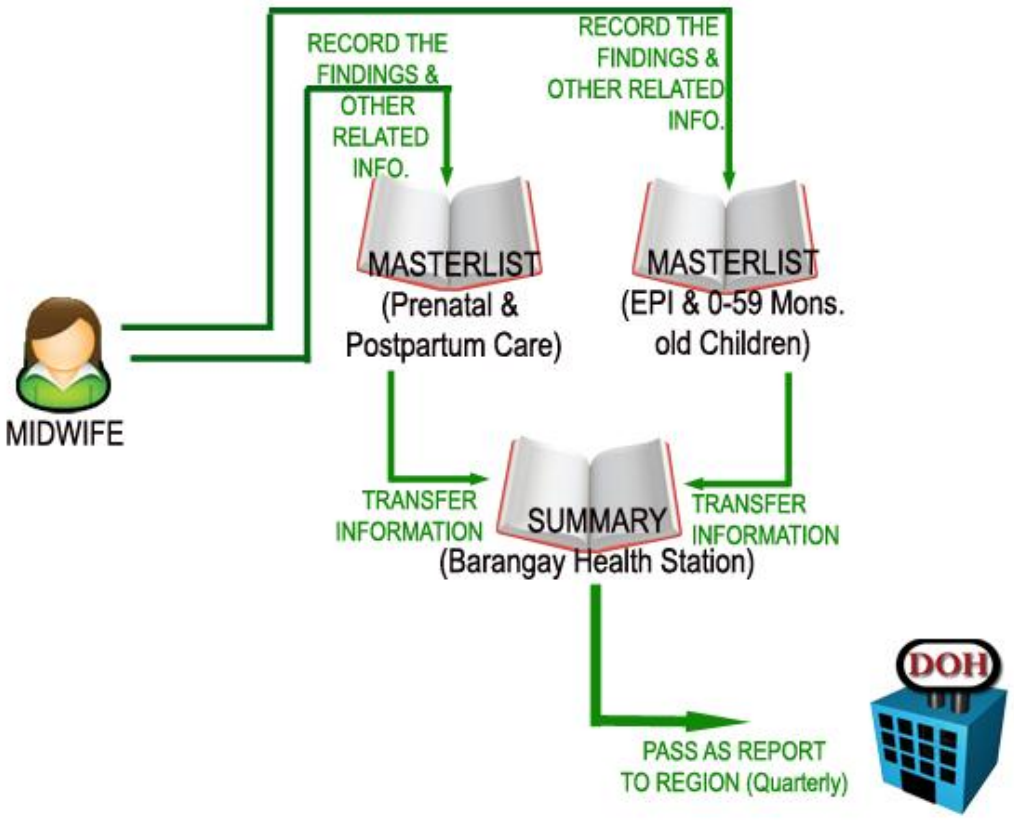


Figure 6: Existing Manual Transaction Flow of MNCHN Status Monitoring (Prenatal & Postnatal Process)



To address the common quandary of addressing what system to develop, the system developer conducted observations and later, preliminary interviews to countercheck the observed situations inside the barangay health stations. As observed, there is a long line-up of mothers every Tuesday (the scheduled check-up by the physician and dentist) in checking and updating the MNCHN Booklet. Releasing of medicines and immunizations is also an issue, because at times, there are situations of medicine prescription insufficiency and/or non-availability. This prompts for the midwife or the community health workers release a prescription to buy or to refer to private centers.

The processes to be done for the mothers to be attended are the following:

1. Ask assistance and information to the front desk (CHW, nurse, midwife, etc.) to list down in the logbook then run through a series of monitoring the vital signs and other assessment (manner of questioning).
2. Release the Booklet.
3. Fill-out the Booklet.
4. Present the Booklet to the physician and dentist for check-up. When the medical technologist is also available the mother will be referred for series of test.

5. When there are complications or there are findings upon diagnosis, the doctor will issue prescription to be forwarded to the midwife for documentation and updating on the booklet.

6. The midwife will release the prescribed medicine(s) (if available on site) and perform the immunization (if available).

7. When the medicines are not available the midwife will release the doctors' prescription.

8. After all the required services (medical and dental check-up, immunization, releasing of medicines and hemoglobin test) are done, the results and other related information are recorded in the Client Record Book (masterlist for prenatal and postpartum care and masterlist for EPI and 0-59 months old children) then transferred in Summary of Tables.

9. The midwife will specify another schedule for the mother or child's next visit for check-up and monitoring.

10. If the mother is pregnant the mother needs to be scheduled for check-up regularly, on a monthly basis. If possible, the mother must weekly visit the health center on a weekly basis.

11. If the mother delivers the child, the child will be monitored with the EPI and growth monitoring for 0-59 months or until 4 years old.

4.2 Description of the Proposed System

Figure 7, 8, 9, & 10 below illustrates the transaction flow of the e-MNCHN, involving the processes undertaken (1) by the mother from registration towards guidance in immunization and release of prescriptions, (2) by the users in the barangay health station from confirmation towards report submission, and (3) by the physician/dentist/medical technologist in the input and release of necessary prescriptions.

Figure 7: Transaction Flow of e-MNCHN Status Monitoring (Log-in & Register Flow)

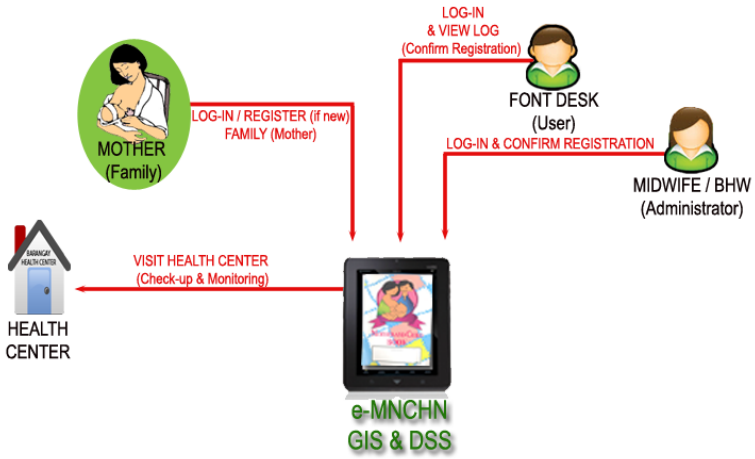


Figure 8: Transaction Flow of e-MNCHN Status Monitoring (Prenatal & Postpartum Schedule Flow)

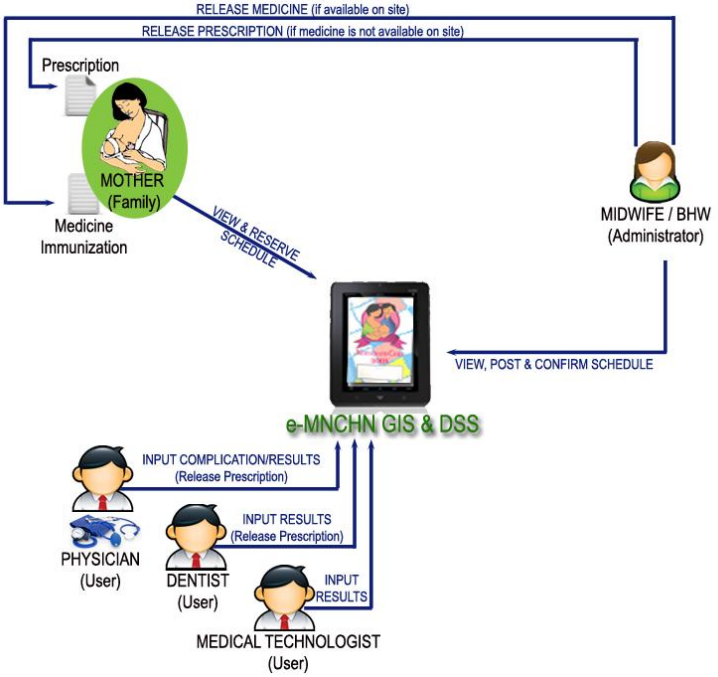


Figure 9: Transaction Flow of e-MNCHN Status Monitoring (Visiting the BHW)

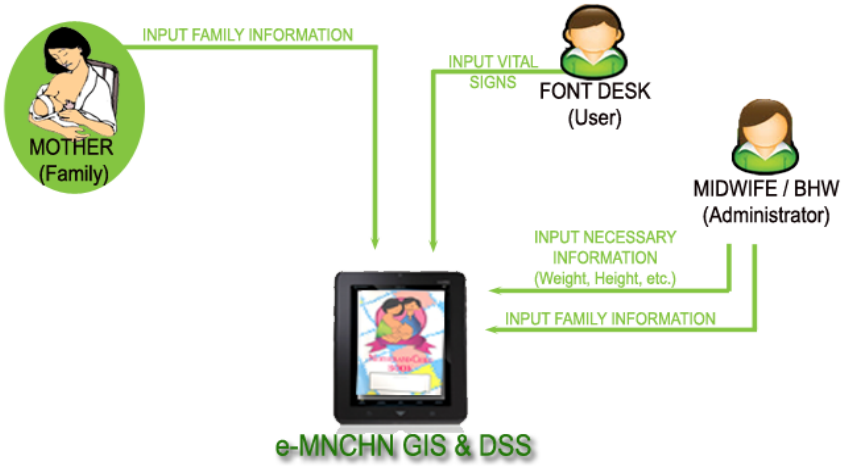
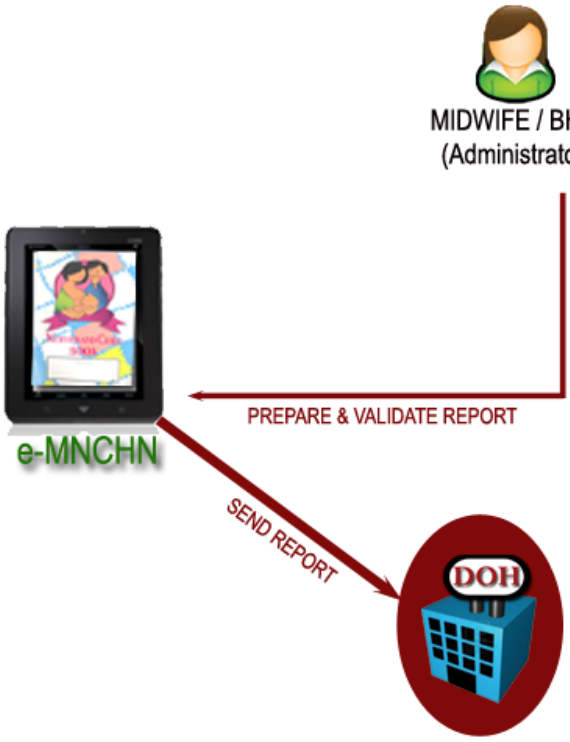


Figure 10: Transaction Flow of e-MNCHN Status Monitoring (Print Report Flow)



As shown in Figure 7, 8, 9, and 10, the proposed e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application enables the mother to register in the system, to input necessary information free from queuing in the barangay health station and release result or medicine prescriptions, and submit prepare/validate report to the DOH Central Office. The mother undergoes to a process flow which involves the following steps:

1. Log-in or register to the system if new.
2. Upon confirmation of registration, the mother **completely inputs the required family information, as well as hers and her newborn or child's** information.
3. The mother views available schedule of physician/dentist/medical technologist visit and prompts to reserve for an appointment.
4. Mother waits for her schedule and appears at the barangay health station for her and/or her infant or child's scheduled appointment with the physician/dentist/medical technologist.
5. With the result of the physician's (or of the dentist or medical technologist) checkup posted in the system, the mother views the result and the prescription for her information, guidance and action.

In the same manner, the proposed e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application enables the barangay health station workers and the midwife to confirm registration of the mothers in the system, schedule mothers for appointment or checkup to doctor/physician/dentist/medical technologist, input necessary information

resulting from the mother's appointment from the doctor/physician/dentist/medical technologist and be guided in schedules of going to the BHS as well as the advisory or prescriptions. The process flow involves the following steps:

1. The frontdesk, any BHW in-charge, or the midwife herself logs in the system and confirms the initial log-in/registration of the mother.
2. Any BHW in-charge or the midwife herself inputs the schedule of visit of the doctor/physician/dentist for consultation. (This will be the basis of the mother in scheduling for her appointment upon logging in.)
3. After the scheduled appointment of the mother and/or her newborn or child, any BHW in-charge (frontdesk) and/or the midwife inputs in the vital signs of the patient. Vital body information like height, weight, body temperature is also recorded in the system.
4. With the result of the physician's (or of the dentist or medical technologist) checkup posted in the system, the BHW or the midwife releases medicine (if available at the health station) or prescription (in case of non-availability) to the mother.
5. The BHW and/or midwife prepare and validate report based on the historical log in the system and on the document(s) per se. These will be submitted to the Municipal and Regional Health Office as compliance report. The information recorded and logged in the system can be freely accessed by the Municipal and Regional Health Office to countercheck or refer to the submitted compliance report.

Lastly, the proposed e-Maternal, Neonatal and Child Health and Nutrition (e-MNCHN) application enables the doctor/physician/dentist/medical technologist to input necessary findings or diagnosis resulting from the mother's (or the infant's or child's) appointment or checkup, as well as recommend prescribed medicines. The process flow involves the following steps:

1. Having the BHW in-charge or the midwife input the schedule of medical and dental checkup (in consensus and agreement with the doctor/dentist), the doctor/dentist/physician views his or her scheduled visit to the barangay health station.
2. The doctor/physician/dentist/medical technologist inputs the results or diagnosis of the checkup and posts the prescriptions in the system for guidance. Release of medicine will be done by the BHW/midwife if available and prescription, if medicine is not available.

4.3 Physical Design

This part illustrates the two physical parts of the system that includes the testing results. The first part is the hardware physical design with the graphical user interface test and the second part is the software physical architecture with the operating system test.

Figure 11 explains the physical design of the system in terms of hardware set-up. The following hardware peripherals are installed as part of the proposal.

Figure 11: Hardware Physical Design of e-MNCHN

The modem peripheral can be connected to a specific internet provider that is available in the area. When internet provider is not available, a broadband of any telecommunication company can be used as modem so that the community can access to the system.

4.4 Effectiveness of the Developed e-MNCHN Using the Test Case Scenario

Overall, the experts rated the system 82.94% while the mothers rated the system 94.88. The rating of the system in each parameter is somewhat higher than what was recommended by Flores-Mena (2011), who suggested that the system at its initial phase or deployment must be at least 90% efficient and effective. She likewise found out that for the second testing, the system must be 95% complete and rectifications for the first evaluation must have been addressed.

4.5 Level of Satisfaction of Using e-MNCHN

Results reveal that that the overall mean score of satisfaction of the mothers in using the system is 4.08 with a verbal description of **Satisfied to Some Extent.**

Looking on the dimensions, the factor that attained the highest mean score is the usability of the system, having a mean score of 4.21 with a verbal description of **Satisfied to Some Extent**. This means that the e-MNCHN is perceived to be usable and poses practicality in use. This was followed by Technical Support as well as Documentation, both with mean score of 4.14; Installation, having a mean score of 4.13, Training, with a mean score of 4.10; Functionality and Overall Satisfaction, both with a mean score of 4.08; and Initial Reliability,

with a mean score of 4.02. On the other hand, the factor with the lowest mean score is Long-Term Reliability, having a mean score of 4.01. All of the factors have verbal description of **Satisfied to Some Extent.** The overall and per-construct level of satisfaction is almost the same as with the findings of Mohamed (2010) on the users' level of satisfaction on having an electronic monitoring system for mothers in Malaysia. The result indicates that training of the users before their usage must be ensured, such that high importance is regarded on training the users.

Table 1. Level of Satisfaction of the Users (Mothers) in Using e-MNCHN

Items	Mean	Verbal Description
Installation	4.13	Satisfied to Some Extent
Initial Reliability	4.02	Satisfied to Some Extent
Long-Term Reliability	4.01	Satisfied to Some Extent
Usability	4.21	Satisfied to Some Extent
Functionality	4.08	Satisfied to Some Extent
Technical Support	4.14	Satisfied to Some Extent
Documentation	4.14	Satisfied to Some Extent
Training	4.10	Satisfied to Some Extent
Overall Satisfaction	4.08	Satisfied to Some Extent
Overall	4.08	Satisfied to Some Extent

4.6 Level of Acceptability of the e-MNCHN

Results reveal that that the overall mean score of acceptability in using the e-MNCHN application system is 4.14 with a verbal description of **Acceptable to Some Extent.**

Looking on the indicators of acceptability, the factors that attained the highest mean score are Ease of Use, Persuasion and Technical Support, both having a mean score of 4.19 with a verbal description of **Acceptable to Some Extent**. This means that the e-MNCHN is acceptable when the system and its physical features are easy and convenient to use, the authorities (i.e. BHW, midwives, doctors/physicians) are promoting and encouraging of using the system, and there are available technical support in times of trouble and errors in using the system. The three dimensions with highest scores are followed by Commitment, with mean score of 4.16; Training and Work Need Meet, both having a mean score of 4.14; and Capability, with a mean score of 4.09. On the other hand, the factor with the lowest mean score is Consultation, having a mean score of 4.08. All of the factors have verbal description of **Acceptable to Some Extent.**

Table 2: Level of Acceptability of Using the e-MNCHN

Items	Mean	Verbal Description
Ease of Use	4.19	Acceptable to Some Extent
Training	4.14	Acceptable to Some Extent
Technical Support	4.19	Acceptable to Some Extent

Consultation	4.08	Acceptable to Some Extent
Work Need Meet	4.14	Acceptable to Some Extent
Capability	4.09	Acceptable to Some Extent
Commitment	4.16	Acceptable to Some Extent
Persuasion	4.19	Acceptable to Some Extent
Overall	**4.14**	**Acceptable to Some Extent**

5. Conclusions

The e-MNCHN application system was rated both by the expert and the mothers as very effective. It was found out to be satisfactory at some extent, and acceptable at some extent.

Documentation is the best and only determinant of acceptability of the e-MNCHN application system. This means that the documentation aspect of the system, i.e. provision of guides and manuals, is the most determining indicator in the acceptance of the mothers of the system for its use.

The physical, graphical and infrastructure requirements of the system, the personal experiences, beliefs and profile of the users, and the role of the government and the users' peers in the use of the e-MNCHN application system affects the acceptability, satisfaction and perceived effectiveness of the system.

The implications of the developed system include expanding the geographical scope of deployment, inclusion of the system towards the policy agenda of the Department of Health, inclusion of the study on a continuous research agenda, and adoption of the study's system for budgetary appropriations for improvement and mass testing and deployment.

6. Implications

For the researcher, future researchers and the government through Department of Health that will adopt and benefit from the study, it is recommended that other software development types or a combination of such will be used to reprogram or reconstruct the programming specifications based on the necessities of maternal, neonatal and child health and nutrition monitoring, assessment and decision-making.

To the Department of Health, it is recommended that DOH officials and concerned policy-makers to review on the efficacy of the system for its application. Budgetary allocation can be preliminarily allocated to review the system, conduct studies of its feasibility on a national or regional scale, modify or rectify programming specifications and requirements, and improve the overall system for it to be fool-proof and more comprehensive.

Future researchers are encouraged to test the system either in a different geographical area or a bigger scope to test whether the same statistical results are achieved. It is also safe to say that while documentation becomes the sole determinant of acceptability, the former can be determined by other indicators which were found to be insignificant.

Enhancing the system to conduct automatic analyses of particular design flaws, such as susceptibility to data loss and possible infiltration, might also be recommended for the system developer as well as future system administrators who will handle the system.

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