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The Effect of the Wireless Access for Health Electronic Health Record System on Rural Health Units in the Philippines

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The NYU Health Agents for Access Capstone Team

DESCRIPTION OF CAPSTONE

Established in 1938 as New York University's Graduate School of Public Administration and renamed the Robert F. Wagner Graduate School of Public Service in 1989, NYU Wagner offers graduate degree programs in public and nonprofit management and policy, health policy and management, and urban planning. NYU Wagner is dedicated to preparing students to address the serious issues facing society today. The academic programs emphasize a mix of theory and practice, so that students can build a portfolio based on their curriculum and real-world experience in their specific area of interest.

NYU Wagner's Capstone program is a requirement for graduation and successful completion of the Master of Public Administration (MPA) and Master of Urban Planning (MUP) degree. During the final year of the MPA and MUP degree program, NYU Wagner students are required to work in teams on a project proposed by a professional public service organization. Client organizations design yearlong projects that require Wagner students to apply the skills learned throughout the Wagner curriculum. These skills include research, monitoring and evaluation, management, teamwork, report writing, as well as others. Whether in the U.S. or abroad, the Capstone program also provides Wagner students with the opportunity to do fieldwork to gain knowledge and applicable, transferrable professional experience.

Faculty oversight of student teams and projects ensures that both the client and the students are maximizing the opportunities presented by the program as well as to ensure high-quality deliverables, professional conduct, professional development of students, and timely project completion. Student teams are required to meet with faculty advisors regularly and attend a class on a weekly basis, during which all student teams provide insight and share experiences with one another on project progress, presentations, working as a team as well as client relations. The Capstone program is learning in action, providing students with a real-world experience and clients with quality projects that positively contribute to the field of public service.

EXECUTIVE SUMMARY

The Wireless Access for Health (WAH) Initiative is a non-profit e-health organization in the Philippines designed to improve local health governance and access to better quality health data, management and provision. WAH's mission is to improve governance and access to better quality data by clinicians, health managers and local governments by providing them with a customized electronic health record (EHR) system. An EHR is a computerized health information system where providers record detailed patient information such as demographics, visit (also know as encounter) summaries, medical history and lab results.[1] The role of the Capstone team was to evaluate the effectiveness of the WAH EHR software, provide a set of recommendations geared toward the improvement of EHR utilization and effectiveness, and develop a Monitoring and Evaluation (M&E) plan for WAH to utilize going forward.

The NYU Capstone team performed an outcome evaluation of the WAH EHR system to determine its impact of Rural Health Units (RHUs). Surveys, focus group discussions and interviews of doctors, midwives and nurses were conducted during site visits to RHUs utilizing the EHR system in order to evaluate system usability, data quality and providers' perception of patient satisfaction. The information was compiled and analyzed to produce a report of findings and recommendations to assist WAH in identifying factors hindering or facilitating the WAH system's adoption.

Overall, the WAH EHR system was found to have a positive impact on RHUs. Common themes found were that the system is relatively easy to use, makes RHUs and staff more organized and efficient, helps produce more accurate and reliable reporting, and is positively perceived by patients. However, WAH has room for improvement in several areas. The following recommendations provide a solid framework as WAH assesses its internal and external capacity to grow and ability to adhere to the team's recommended M&E plan. The following are the NYU Capstone team's recommendations ranked both in order of importance and according to what the NYU Capstone team feels would have the greatest positive impact on the growth and development of WAH. Areas for improvement include the enhancement of the EHR software,

organizational development, project implementation and strategic growth. Our recommendations are as follows:

1. Make considerable changes to the WAH EHR system template design to achieve balance between customizability, security and functionality.
2. Eliminate the use of family folders in the WAH EHR system and replace it with functionality that allows for patients to be linked through familial relationships but not grouped under one folder.
3. Conduct ongoing training for clinic staff, newly hired providers and create a "how-to" manual that will be kept at RHUs for providers' reference.
4. Conduct a baseline study of where the RHU stands so WAH can track growth.
5. Develop partnerships with various organizations and corporations to secure hardware and human capital.
6. Focus some lobbying efforts on improving the infrastructure surrounding clinics.
7. Invest significant resources in professional development for WAH staff.
8. Extend services to the Barangay level.
9. Provide incentives to end-users who demonstrate mastery of the system.
10. Establish a sturdy and reliable SMS system.
11. Initiate a regular computer maintenance schedule.
12. Hire staff dedicated to data quality checking.

The NYU Capstone team also developed an M&E plan that provides WAH with tools to conduct rapid field assessments of the effectiveness of their EHR system. The M&E plan includes guidelines on how to conduct a literature review of EHR systems around the world, a list of indicators that WAH should measure at each clinic, and descriptions of how to measure pre-program data (as recommended) and post-program implementation outcomes. Finally, the M&E plan contains sample questions for WAH to use in conducting future evaluations.

As mentioned, the NYU Capstone team found that the WAH EHR system has resulted in many positive outcomes for the RHUs. However, there are a number of ways in which WAH can increase its effectiveness. The NYU Capstone team has provided targeted recommendations and an M&E plan for WAH to maintain their positive outcomes as well as for strategic growth

moving forward. Both will prove helpful to WAH as it expands it services and continues its journey towards improving health care services in the Philippines.

INTRODUCTION

The Wireless Access for Health Initiative was the first public-private e-health partnership in the Philippines. Started in 2009, its mission is to improve governance and access to quality data by clinicians, health managers and local governments by providing them with a customized open-source EHR system. WAH also aimed to develop new technology modules such as the Synchronized Patient Alerts via SMS (SPASMS) system, Mobile Midwife Module or 3M and Statistics Aggregator. WAH launched in four pilot clinics located in four Tarlac municipalities in 2010. Since that time, WAH has grown to serve over 56 clinics across the Philippines. WAH's EHR system aims to reduce the time required for recording and reporting health data. In addition, WAH aims to improve data quality and access by health clinicians and key decision-makers by digitizing patient data and allowing for the electronic submission of mandatory government reports. Further, they aim to streamline patient flow and reduce patient wait time in clinics.

The WAH Initiative started as a multi-stakeholder partnership of 11 organizations from the government, private, non-profit and academic sectors. Key stakeholders include The United States Agency for International Development (USAID), Zuellig Family Foundation, the Province of Tarlac, Municipal Departments of Health, Qualcomm Inc., Smart Communications, RTI International, League of Municipalities of Tarlac, University of the Philippines, Manila – National Telehealth Center, Tarlac State University and the Asian Institute of Management. This multi-stakeholder partnership remained in place for four years.

In 2013, WAH began the transition from a public-private initiative to a non-profit NGO. The transition has presented budgetary constraints and operational management challenges. Grant funding is expected to last only through 2014, after which WAH, as an independent non-profit organization, must secure funding to continue operations. Furthermore, WAH has goals to expand the reach of its services beyond Tarlac Province and to spread their mission to improving data quality, patient care, and access to health information.

PROJECT DESCRIPTION

One of the main objectives of the Capstone team was to conduct an outcome evaluation of the impact of the WAH EHR system on RHUs in Tarlac Province, Philippines. Having never undergone a formal evaluation process to assess the effects of its health information platform in the RHUs, WAH has been unable to measure results in the areas of health records improvement, data entry error reduction, health measurement outcome tracking, patient satisfaction and site operations improvement. The Capstone project investigated these areas and identified factors that hinder or enhance the impacts of WAH EHR software.

In addition, the team was responsible for developing an M&E plan to provide tools for WAH to use as a basis for evaluating its activities and effectiveness. These new tools will be piloted at a select group of representative clinics in the field and will help WAH with strategic planning, future expansion and program development. Finally, the Capstone team identified areas of improvement and made recommendations for WAH to manage their internal and external capacity to grow, as well as their ability to execute and adhere to the M&E plan.

The Capstone team traveled to the Philippines and administered surveys, conducted interviews and focus group discussions in 20 RHUs at different levels of WAH EHR implementation. The team also conducted desk research on comparable e-health models and best practices around the world. Based on findings from the literature review and field research, the team developed a set of tiered recommendations. These recommendations are intended to assist WAH in strategically mitigating challenges related to future growth, development and desired program outcomes.

LITERATURE REVIEW

Definitions and Significance:

An EHR is a computerized health information system in which providers record detailed patient information such as demographics, encounter summaries, medical history and lab results.[2] It is also defined as the longitudinal collection of electronic health information that

provides immediate, authorized access to person and population level data in order to support efficient health service delivery processes. EHR systems have proven to be crucial in improving healthcare delivery. They have proven to be revolutionary in the delivery of patient care around the globe.[3]

An important function of an EHR is improving the legibility of clinical notes.[4] An EHR provides documentation in a computerized format that allows for data or records to be printed in text form rather than hand written. Additionally, EHR systems have the ability to make spelling, validity and range checks, which prompt users when data entry errors are detected. An EHR also increases the efficiency of healthcare providers' workflow. Thus, data entered into an EHR can be used to refer a patient to a specialist. Also, epidemiologists, researchers, physicians and other clinicians can extract information from EHRs to protect and promote the health of the population through efficient surveillance, investigation, prevention and control of communicable diseases that are of public health importance.

An EHR also provides healthcare practitioners with an opportunity to obtain a total view of a patient's health status. For example, by creating shortcuts to documents warning about abnormal laboratory test results, prescriptions and drug administration, physicians are able to quickly provide feedback to patients. Other benefits of EHRs include data accessibility by multiple users, continuous data processing, automatic data backup, and data storage at locations outside of the hospital or clinic. Data storage and backup can be especially helpful in the case of, for example, natural disasters, because patient paper records will not be lost or destroyed.

Selected guidelines for EHR development and implementation:

In 2006, the World Health Organization (WHO) developed a manual for the development and implementation of EHRs in developing countries.[5] This manual was designed with the following persons in mind: Ministry of Health staff at national and provincial or district health center levels involved in the development of electronic health records, people who do not have an in-depth knowledge of EHRs, and health record managers/administrators who are responsible for the health record services at primary and secondary levels of care in developing countries.

The manual developed by WHO provides a general overview, some basic definitions and examples of EHR practices. Also discussed are points for consideration when moving towards the introduction of an EHR system. These points are: preparing a report outlining the perceived benefits of a system change, outlining how existing data and security standards will be adopted, preparing a statement on privacy, consent, and other medical-legal issues, and emphasizing how the privacy and security of patient healthcare information will be maintained. The WHO manual also discusses some issues and challenges that may need to be addressed as well as possible strategies. Some of the challenges include: clinical data entry issues, lack of standard terminology, resistance to computer technology, lack of computer literacy, strong resistance to change by many healthcare providers, high cost of computers and computer systems, and concern by providers as to whether information will be available on request. Lastly, the report suggests some steps and activities regarding implementation. There is a particular focus on setting goals, revising policies, developing an action plan and outlining implementation procedures.

Examples of EHR Initiatives and Best Practices in Developing Countries:

EHRs provide a wide range of advantages to healthcare providers. These include: improvement of medical record legibility, drug ordering, patient and staff satisfaction, data quality and reporting. Mobile EHR applications with GPS technology can facilitate real-time identification of disease trends and their source to help prevent the spread of disease. [6] While EHR systems are increasingly being used in developing countries to improve quality of care and increase efficiency, there is limited evidence on the cost effectiveness of these systems. Also many developing countries face limited or weak infrastructure such as limited access to electricity, internet, human expertise, and financial resources. These limitations negatively affect the implementation of EHRs in developing countries. Evidence shows that, as a result, many health workers resist these systems and prefer the standard paper based system.[7]

The Kenyan Division of Health Information Systems in the Ministry, National AIDS and STI Control Program, Kenya Bureau of Standards and I-TECH, working through a range of implementing partners, have developed guidelines for EHR implementation. These guidelines

provide a minimum standard for generic EHR systems in developing countries. It is the first attempt in Kenya to ensure that the development of EHRs is well coordinated. The guidelines include: Stakeholder involvement (creating an EHR implementation committee representative of all stakeholders); assessing the existing system for policies and procedures, scope, reporting requirements and human resource needs; needs determination and budgeting; and 'site infrastructure readiness' (ensuring power supply infrastructure to ensure that it can support the hardware to be set up, as well as network and hardware security). Human resource readiness and a change in the management plan are also suggested in this manual. This discussion involves defining roles, determining the required skills, training and sensitization of staff on workflow changes expected with EHR introduction, site visits and demonstrations.[8]

In India, EHR implementation uncovered that some of the more notable challenges faced by hospitals include a user base of EHR skeptics with a history of rejecting EHR systems with limited computer skills. Key to the success of their EHR system was a design strategy that took into account these challenges and integrated critical technical features to support skeptical its user audience. [9] The requirements of EHRs in developing countries can be dramatically different from those of the developed world.[10] For example, EHR systems in developing countries are prone to power outages and require backup systems. Another major barrier is lack of human capital that is able to develop, manage and use such a system, and high staff turnover that impedes ongoing training.[11]

Evidence also shows the importance of collaboration between projects in the development of EHR systems through the use of open source software.[12] The introduction of an integrated EHR has also shown to improve efficiency while maintaining the quality of the patient record. The majority of practitioners in the study felt that the EHR was easier to use and faster with the integrated EHR. The survey data suggested that the efficiency resulted from reduced time for clinical processes other than completion of the clinical information.

Evaluations of EHR Systems Around the World:

E-Health initiatives are being developed across the globe. These projects share a number of elements including the need to standardize eHealth codes and vocabulary, develop interoperable EHR systems, involve patients in the use and documentation of their own health records, and develop the security necessary to protect patient information. The amount and quality of information that the EHR makes available to the medical professionals directly impacts the care of the patient, as this information supports all decision-making.[13]

In their review of the literature, Kristina Hayrinen, Nykanen Nykanen, and Kaija Saranto determine that there is a multitude of EHR evaluation literature that analyzes the completeness of information in EHR systems.[14] They define "completeness" as a measure of the prevalence of missing data. A number of studies show that the use of EHR systems is associated with more complete heath documentation by medical care professionals. Although completeness varies, documentation overall is more detailed. Studies have also shown that systems with structured data entry improve completeness. Additionally, completeness improves over time. Further, studies show that EHRs provide reliable information, but information that is not necessarily consistent. Finally, the most successful EHR systems provided structured questions and were user friendly.

In addition to their overview of the literature, Hayrinen *et al.* also isolate 6 measures of information system success, as dictated by W.H. Delone, E.R. McLean, that are often used to evaluate EHR systems.[15] The measures are:

1. Information quality, a measure of the totality, accuracy, legibility, dependability, and format of the data being entered and produced by the system.
2. System quality, an assessment of the EHR system itself including ease of use and learning.
3. Information use/intent to use, an assessment of the users' consumption of the EHR output such as number of queries.
4. User satisfaction, overall satisfaction of the user, and the user's satisfaction with how the EHR system aids in decision-making.
5. Individual impact, how the EHR system influences the behavior of the end user.
6. Organizational impact, how the EHR system affects organizational performance such as increased work volume and return on investment.

Each of these dimensions is interrelated, and the use of these measures can help determine the organizational impact of an EHR system.

In his article "Documentation and Coding of ED Patient Encounters: an Evaluation of the Accuracy of an Electronic Medical Record," Eric Silfen, M.D. compares a paper-based template-driven medical record system to an electronic medical record system, both of which are used for capturing emergency care clinical information.[16] Silfen argues that a well-structured electronic medical record will provide more benefits than just improved word processing. Silfen evaluates the two systems by measuring completeness of data and discrepancy. Completeness is defined as a measure of the presence of medical history, examination data, and medical decision-making. Discrepancy is defined as the absence of medically necessary elements that depend on textual documentation and reflect quality of care.

After analyzing patient encounter records from two community hospitals, Silfen's determined that "a keystroke-driven, electronic medical record…that incorporates a clinically structured terminology, and administrative coding schemata" provides a clinical picture as accurate as a paper-based, template-driven documentation system. In other words, systems that are structured around and use clinical terminology are as accurate as paper-based template-driven systems. This is true with regard to the presence or absence of medically necessary data, discrete data, and textual documentation-dependent medical decision-making information.

Blaya *et al.* (2010) in their article "E-Health Technologies Show Promise In Developing Countries" explore studies to find whether there is any evidence that EHRs can have a positive impact in developing countries. The authors' found that EHR systems improve communication between institutions, assist in ordering and managing medications, and help monitor and detect patients who might abandon care. Evaluations of personal digital assistants and mobile devices convincingly demonstrate that such devices can be very effective in improving data collection time and quality.[17]

In their survey of studies, the authors included qualitative or quantitative evaluation of information technology affecting health care in developing countries. They also conducted a

worldwide review of the literature and requested submissions from researchers and those implementing e-health in developing countries. The review shows that there are still few scientifically rigorous data sources on the success and cost-effectiveness of e-health systems in developing countries. Further, evaluations have mostly been performed by organizations connected to academic settings and not by other, non-academic public health programs.[18] When looking at the software systems included in the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) Antiretroviral Therapy (ART) Software Inventory Report and EngenderHealth's Open- Society software tools 38 comparisons, only three systems, the Partners in Health - Electronic Medical Record, Electronic Medical Record in Kenya - Mosoriot Medical Record System, and Vista in the U.S. Indian Health Service, have had any formal evaluations performed.[19]

According to Blaya *et al.* (2010) the overall pattern of e-health evaluations in developed countries reflects an initial focus on qualitative evaluations, with an increase in the number of larger and more quantitative evaluations published in the past decade. Developing countries seem to be following this pattern as well. This suggests that as EHR implementations have become more robust in developing countries, hence, we can expect more rigorous studies, such as randomized trials or cost-effectiveness studies. Initial evaluations suggest that the following functions are of positive impact in developing countries:

1. Ability to track patients through the treatment initiation process, monitor adherence, and detect those at risk for loss to follow-up.
2. Tools to decrease communication times of information within and between institutions.
3. Tools to label or register samples and patients.
4. Ability to electronically monitor and remind patients of health care needs or treatment.
5. Collection of clinical or research data using PDA applications.
6. Reductions in errors in laboratory and medication data.[20]

Provider Perception of EHR Systems:

As James Tufano's study titled "Information and Communication Technologies in Patient-Centered Healthcare Redesign: Qualitative Studies of Provider Experience" finds, health

provider perceptions of systems vary widely.[21] This article uses three qualitative observational studies conducted on an EHR system in the Pacific Northwest region of the United States to examine provider perspectives on the roles, importance and effects of EHR systems. Research was conducted using key informant interviews, document sampling and surveys. The research finds that most healthcare providers enjoy the benefits of systems, in particular the organization of patient care and records, improvement in the quality of both record keeping and clinical care, error reduction, improved communication and coordination of care and patient satisfaction.[22] Another benefit enjoyed by physicians is the strengthened relationship between provider and patient, primarily due to patients' easy access to records and other communication tools such as secure email messaging or patient communication portals.[23]

Negative perceptions of EHR systems are centered on physicians' inability to use the system effectively.[24] This can stem from a lack of training and poor implementation to individual levels of comfort with computers and technology in general. The length of time it takes to enter and access information was often cited as the main reason for provider dissatisfaction, and many providers in the study felt that "paper is faster."[25] Since most data entry occurs with the physician facing the computer instead of the patient, distraction and a feeling of "disconnection from the patient" during office visits contributes to provider's negative perceptions.

While the perceptions of systems as they relate to patient care are critically important, there are managerial implications of EHR system implementation that impact provider perceptions. In their article titled "Physicians' and Nurses' Reactions to Electronic Medical Records," Darr *et al.* use interviews of physicians and nurses at five Israeli hospitals and a snowball sampling technique to examine how providers perceive the managerial implications of systems.[26] They group their findings and provider perceptions into six areas of concern. They are as follows:

1. Managerial implications of implementation
2. Limits on professional autonomy
3. Impact on communication with colleagues
4. Facilitation of research
5. Legal defense
6. Influence on the professional hierarchy within the hospital.[27]

In general, the article finds that senior physicians and nurses have a mostly positive perception of EHR systems. There was general consensus amongst both nurses and physicians that EHRs greatly improve coordination and communication and the accuracy and extensiveness of patient data. Nurses related more positively to other implications of EHRs, including their uses in managing patient care, accessing patient records, and improving quality of care. Senior physicians also positively value the improvement that EHRs have made in the ability of and speed at which managers are able to collect payments for services rendered. Support and prevention of malpractice suit losses were also prized, as EHR systems record data in real time with time and date stamps.[28]

Howard L. Bleich and Warner V. Slack tackle the idea of usability in their article "Reflections on Electronic medical Records: When Doctors Will Use Them and When They Will Not." Their article asks two questions. First, 'why have doctors been slow to replace paper records with electronic health records?' and second, 'why are doctors who do have access to electronic health records not interested in using them?' The authors assert that the answer depends on how much the EHR system can translate its use to helping the patient. "The key to enthusiastic acceptance of electronic medical records is computing that is easy to use and helpful to doctors, nurses, and other clinicians in the care of their patients."

Overall, this study found that physicians at Boston's Beth Israel Hospital, and at Brigham and Women's Hospital increasingly used voluntary EHR systems over a five year time period. The EHR system that allowed clinicians to search patient records in a variety of ways (by name, hospital room, social security number, etc.) was favored and easily adapted. This feature was a top priority in the EHR systems used by these two hospitals. Overall physician assessment was positive. "Studies have demonstrated that the time to act on important clinical events, such as critically abnormal laboratory results, is reduced when the clinician is alerted or reminded by the computing system."[29]

Challenges to Effective EHR System Implementation:

Robert H. Miller and Ida Sim (2004) in the article "Physicians' Use Of Electronic Health Records: Barriers And Solutions" also identifies key barriers to physicians' use of systems. One

of the challenges is high initial cost and uncertain financial benefits. The high up-front financial cost of implementing EHRs is a primary barrier to EHR adoption. This barrier is compounded by uncertainty over the size of any financial benefits that may accrue over time.

Technological incompetence is considered a threat in adopting systems. Most respondents to the authors' study considered even highly regarded and industry-leading EHRs to be challenging to use because of the multiplicity of screens, options, and navigational aids. Problems with EHR usability, especially for documenting progress notes, caused physicians to spend extra work time to learn effective ways to use the EHR. These substantial initial time costs are an important barrier to obtaining benefits, as greater burdens on physicians' time decrease their use of EHRs, which lowers the potential for achieving quality improvement.[30]

Difficult complementary changes and inadequate support has also proven to be a challenge. EHR hardware and software cannot simply be used without intense training. Instead, physician practices must carry out many complex, costly, and time-consuming activities to "complement" the EHR product. Across industries, such complementary changes have been found to be critical for generating benefits from new technology. These complementary changes exact a great deal of time from physicians for months or even years after implementation. Another barrier to EHR use is the lack of adequate electronic data exchange between the EHR and other clinical data systems (such as lab, radiology, and referral systems). Having parallel electronic and paper-based systems forced physicians to switch between systems, thereby slowing workflow, requiring more time to manually enter data from external systems, and increasing physicians' resistance to usage.[31]

EHR System Implementation Strategies:

While it might not be possible to resolve all negative provider perceptions of EHR systems, Austin *et al.* lay out strategies that healthcare organizations can adopt that may assist in mitigating negative perceptions of EHR systems and resistance to their adoption in their article titled "The Art of Health IT Transformation."[32] In this article, "change management techniques" employed by several healthcare organizations implementing systems were used to address barriers to acceptance. Because the use of EHRs require a dramatic change to every aspect of

organization and provider workflow, this article stresses the importance of involving different stakeholders, and a strategy for exchanging information to address different needs within organization.[33]

In the article, Harvard's John Kotier identifies key reasons why implementation fails within organizations:

1. A sense of urgency
2. A strong coalition
3. A clear vision
4. Frequent, clear communication
5. Empowerment of staff
6. Creation of short-term "wins" to build momentum for change
7. An anchoring of the changes in culture.[34]

The biggest challenge is that of culture, because the focus has been for organizations to implement sophisticated, complex IT solutions without addressing acceptance of that very system in the organization's culture. In response to this, EHR system providers like General Electric (GE) have put forth the "Three As" approach strategy. This strategy encourages organizational alignment with, acceptance of, and accountability for the proposed solution systems, because EHR systems cannot be implemented successfully without organizational cultural shift and buy-in. Lastly, there is an inherent culture disconnect within healthcare. Most healthcare professionals (nurses, etc.) "work together in groups, tend to avoid conflict, and generally do not take large risks."[35] This is in contrast to physicians who "belong to an expert culture, and tend to be individualistic risk-takers who prize autonomy."[36] Other primary barriers exist in adoption, they are:

- Behavioral: people resist change
- Organizational: The culture of constraint, organizational politics
- Technical: Software and hardware issues or inadequate resources
- Lack of computer expertise: Older physicians do not have the experience and comfort level of younger doctors.
- Lack of confidence in IT: Many clinicians do not believe that HIT will ever replace or be as easy to use as paper.
- Fear of 'Big Brother': Physicians fear that 'Big Brother' is watching and making judgments about their practice patterns.[37]

The article lays out a six-step "HIT Transformation Strategy Roadmap" that is intended to serve as a practical guide to successful adoption of systems:

1. Engage leadership - demonstrate priority; clearly communicate vision; willingness to commit organization resources; select appropriate vendors, plan the implementation, and lobby the support of physicians and staff.
2. Clearly communicate the vision. The vision should define the desired goals, and compare that to the current state of the organization.
3. Identify and analyze stakeholders.
4. Recruit and work with project champions. After the stakeholder analysis, recruit what the article refers to as "the early adopters/supporters" to be the "project champions."
5. Motivate change. Align the vision to individual self-interests and highlight the potential benefits of change, as in improved documentation and accuracy, and highlight and the drawbacks of not adopting the new systems, such as continued risk for medical record errors.
6. Execute Change. Do it in phases and avoid doing everything at once.[38]

Health in the Philippines and the Emergence of EHR Systems:

After a careful analysis of the literature, the Capstone team believes there are some specific areas that require attention and conditions in public health facilities can be improved. The biggest health issues in the Philippines are a result of health inequity and poor access to services.[39] Currently, 10.8 million poor families supported by the Local Government Units (LGU) rely on Barangay health stations for their primary care.[40] Some of the issues that arise in these health clinics include: long queues during consultations, unprofessional handling of medical records, inefficient dispensing of medicines, and poor patient services. According to the WHO, the appropriate number of nurses servicing a population should be anywhere from 2 - 4 per 10,000 patients. The Philippines is falling behind in this area, as they only have an average of one nurse per 20,000 patients.[41] Such conditions can help explain the inadequate service that patients are receiving in public health facilities.

Although some of these issues facing the healthcare system in the Philippines are complex and difficult to control, there are areas in which we can begin to improve. From our research, there has been an overall general consensus that EHRs greatly improve coordination

and communication, as well as the accuracy of patient data. Utilizing EHR systems and making them as efficient and user friendly as possible can help lead to improved patient flow, improved patient provider relations, and improved patient care in the face of human resource deficiencies and lack of access to care.

METHODOLOGY

In order to conduct a thorough evaluation, the Capstone team traveled to the Philippines in January 2014 and visited 20 RHUs at different levels of WAH EHR implementation. A correlational evaluation design was chosen and used by the Capstone team because we were unable to access baseline data in paper records or from field interviews. The correlational design allowed the team to measure the effects of the EHR system only after its implementation. Quantitative analysis of the surveys was conducted using STATA statistical software, while the focus group discussions and interview notes were analyzed using the qualitative analysis software, Dedoose. As mentioned, all RHUs visited were at varying levels of WAH EHR implementation, of which there are three. At level one of WAH EHR implementation, RHUs use the system to admit patients, record demographic information as well as generate reports. At level two of implementation, clinics gain access to the medical record template, Statistical Aggregator (which allows them the generate data about the population they serve) and are able to generate and send electronic reports. At level three of WAH EHR implementation, clinics are able to send Synchronized Patient Alerts, also know as SPASMS to patients via SMS to remind them of upcoming appointments, provide preventative care tips, and to alert them of emerging public health emergencies. The Capstone team visited nine level three clinics, four level two clinics and seven level one clinics.

Clinics were evaluated based on three major themes: data quality, system usability and providers' perception of patient satisfaction. Focus group discussions and interviews were held with nurses, midwives and doctors of the RHUs. During level three site visits, surveys were distributed to all available health professionals. The survey asked targeted questions based on the above-mentioned themes. The focus group, interview, and survey questions administered by the

Capstone team asked the clinic staff to compare the current EHR system to the use of the paper-based medical record system used prior to WAH EHR system adoption.

The Capstone team also conducted a process evaluation of WAH. During the process evaluation, the team attended strategic planning meetings between the client and Mayors of various municipalities and conducted focus group discussions with WAH staff. These observations and discussions were necessary for the Capstone team to further understand the WAH's working relationship with the local government as well as the ways in which WAH implements its programs. During focus group discussions with WAH staff, including supervisors, programmers and IT professionals, we learned that building relationships among the various site clinics is a challenge for WAH. Oftentimes RHUs are resistant to the EHR implementation, especially if it results in extra hours of work for clinic staff who still rely on paper records. Establishing authority is equally as difficult for WAH; an essential element of effective EHR implementation with total clinic participation. Building relationships with the municipalities is therefore a crucial step as they not only act as a liaison to the clinic site, but also validate the WAH system and staff.

System Usability:

System usability is a measure of how effectively clinic professionals are able to use the WAH EHR system for their work based on its design and functionality. While it inherently includes some aspect of 'user-friendliness,' system usability, as defined by the NYU Capstone team, also identifies issues of design and navigation, gaps in system training and the implementation process. The usability of WAH's EHR system was evaluated on the following criteria:

- How consistently the system is used to carry out day-to-day activities, especially those related to patient care;
- Assessment of whether the EHR system enhances or impedes clinic functions and clinic staff's day-to-day activities;
- The end user's ability to navigate the system;
- Ability to identify areas of strength and weakness within the system;
- End-user level of comfort with the system;
- Frequency of encountering technical problems;
- Skills development during training;
- Confidence and autonomy during system use;

- Expression of need for additional training.

Data Quality:

Data quality is a measure of the usability of the data generated and collected by the EMR system. Data quality is measured based on the following:

- Completeness of reports generated by the EMR – the extent of the information that is provided by the EMR.
- Relevancy of the information – how relevant the information collected is to the day-to-day operations of the clinic.
- Accuracy of the information -- number of errors found in the information; How reliable is the information?
- Consistency – are the data always accurate and useful?
- Reliability - are the data always in the system and accessible?

Providers' Perception of Patient Satisfaction:

Providers' perception of patient satisfaction with the EMR system is measured on providers' knowledge on the effectiveness of EHR system to patients, and how EHR system improve patients' quality of care. Providers' perception of patient satisfaction is measured based on the following:

- Patients' EMR perception - How aware are patients of EMR system?
- Patient- provider relationship - How does EMR impact patient- provider relationship in admission, consultation including face-to-face communication?
- SMS efficiency - How significant and reliable is the SMS (SPASMS) service to patients in improving quality of care?
- Data security and confidentiality - What are the patients' views towards security and confidentiality of data/information?

LIMITATIONS OF THE STUDY

The study had several limitations that could not be controlled by the NYU Capstone team, which may have affected key findings. The absence of baseline data on visited sites was one of the main limitations of the study. WAH has never formally evaluated the extent to which the WAH EHR is being utilized by the clinics. Therefore, the team was unable to obtain data and information on the status and function of RHUs before the implementation of WAH EHR system. Baseline data are significant, as they provide a comparison for assessing system outcomes and disclose RHUs performance prior to WAH EHR intervention. The unavailability of these data and information may have deterred the team from realizing the definite outcomes that the EHR system has on RHUs. The team was also unable to visit RHUs that do not use WAH EHR system to assess comparability, which is important in evaluating conditions between RHUs that utilize WAH EHR system with non-WAH operational sites.

Additionally, WAH representatives accompanied the team to all site visits, and representatives were present during some interviews and focus group discussions to assist with translation. This may have affected the sincerity and openness of nurses and midwives in responding to the questions in the presence of WAH staff. WAH staff presence may have prevented the team from obtaining objective data and information. Translation between languages also involves interpretation. Original questions and meanings of terms may be interpreted and conveyed differently to the interviewees or participants of the focus group discussions from what the NYU Capstone team had projected. These conditions can potentially distort the results of the evaluation.

Furthermore, language barriers were encountered throughout this study. English is a second language to most of the interviewees and FGDs participants. It was occasionally difficult for participants to convey complex messages and knowledge and allow a natural flow of communication. Also the language barrier may have presented challenges for survey takers to understand questions. The team witnessed nurses and midwives in some RHUs discussing the surveys, which were designed to be taken anonymously and individually to accurately capture

individuals' perceptions and experiences of the EHR system without the influence of peers, management or WAH staff.

However, despite the limitations, the NYU Capstone team felt that it obtained enough data and information through observations, interviews, focus group discussions and surveys to determine common and consistent themes that are suitable in examining the effectiveness of the WAH EHR system in RHUs.

FINDINGS

Survey Analysis:

In order to analyze the results of our survey, we examined average scores for each question in addition to examining average total scores per section of the survey. Average scores per-section were divided as follows: one overall score was derived for data quality, four separate scores were derived for usability (system usage frequency, user friendliness, technical proficiency, and training and support), and four separate scores were derived for providers' perception of patient satisfaction (patients EHR perception, patient-provider relationship, SMS efficiency, and data security and confidentiality). In addition to examining average scores, we looked at the association between different variables in order to see the impact of one variable on another. If a test statistic of 0.4 or greater was found, it was concluded that there was an association between the two variables. Table 1 shows a breakdown of our survey results:

TABLE 1:

Indicator	Average Score		Maximum Score Possible	
	Percentage	Raw Score	Percentage	Raw Score
Data Quality	87%	13	100%	15
System Usability				
System Usage Frequency	73%	11	100%	15
User Friendliness	67%	6	100%	9
Technical Proficiency	56%	5	100%	9

Training and support	54%	13	100%	24
Providers' Perception of Patient Satisfaction				
Patient Perception	78%	7	100%	9
Patient-Provider Relationship	50%	3	100%	6
SMS Efficiency	66%	2	100%	3
Data Security	100%	3	100%	3

Data Quality:

Our survey found that on average, respondents were pleased with the quality of data in the EHR system. Out of a maximum score of 15, the average score given by respondents for overall data quality was 13. Thirty of 51 respondents gave the system a score of three for reliability and relevancy. Thirty respondents gave a score of three for reliability. Thirty respondents gave a score of three for completeness, and 27 respondents gave the system a score of three for accuracy. Overall respondents gave "agreed" (score of two) or "strongly agreed" (score of three) that the system has improved data quality.

Additionally, we found that data quality is positively associated with certain aspects of usability. Data quality is positively correlated with user friendliness (correlation of 0.7). Data quality is also positively associated with technical proficiency (correlation of 0.6). Finally, we found that, with regard to provider perception of patient satisfaction, data quality is positively associated with providers' report of patient perception of the EHR system (a correlation of 0.4). *These associations show that with every increase in data quality there will likely be an increase in usability and provider perception of patient satisfaction.*

System Usability:

Survey results show that responses varied for the different areas of system usability. The average score given for system usage frequency was 11 out of a maximum score of 15. The average score for user friendliness was a six out of nine. Technical proficiency had an average

score of five out of nine. *Lastly, training and support received and average score of 13 out of 24, the lowest of the three categories.*

When asked about the EHRs effect on patient care effectiveness, 37 respondents gave a score of three. Twenty-two respondents gave a score of three for the ease of finding information in the EHR system. Twenty-two of 51 respondents felt they were at an intermediate level of EHR proficiency. However, 22 respondents felt that they always felt they needed additional EHR training and that they could not adequately troubleshoot problems with the system on their own. Twenty-eight respondents found that the most difficult part of the system was finding editing patient records, and 37 respondents found that fining patient records was the easiest part of the system. *The survey also showed that system usage frequency was positively associated with user friendliness (0.4) as well as with training and support (0.4). We also found that user frequency was associated with total technical proficiency (0.6), and providers' report of patient perception of the EHR system (0.4). Technical proficiency and providers report of patient perception of the EHR system was positively associated as well (0.4). These correlations allow us to pinpoint areas in which the EHR system can improve simultaneously.*

Providers' Perception of Patient Satisfaction:

Respondents gave high scores for the patient satisfaction portion of the survey overall. The average score for providers' report of patients EHR perception was a seven out of nine. Patient provider relationship had an average score of three out of six. Finally, SMS efficiency and data security had average scores of two and three respectively, out of a maximum score of three.

When asked what computers were used for during visits, 31 respondents said they use it to enter notes and show information to patients. 27 respondents gave a score of two when asked if computer use improved patient care. When asked about maintaining face-to-face communication, 36 respondents gave a score of three. In addition, when asked if waiting time had improved, 25 respondents agreed (gave a score of two). When asked if they believed that SMS messages are helpful, 28 respondents strongly agreed (gave a score of three). Finally, when asked about how confident they were in the security of the data in the EMR system, 29

respondents gave a score of three (very confident). *We also found that patient perception is positively associated with SMS efficiency (0.5). Finally, we found a positive association between SMS efficiency and data security (0.6). As previously stated, these correlations allow us to pinpoint areas in which the EHR system can improve simultaneously.*

Focus Group Discussions and Interview Analysis:

To analyze the results of our interviews and FGDs, the team used Dedoose, a web-based software that helps analyze qualitative and mixed methods research. Unedited field notes were analyzed according to data quality, system usability and providers' perception of patient satisfaction. These three areas served as the "parent codes," or the broad themes under which more detailed coding and analysis using "child codes" followed. Each child code contained a positive and negative sub code, which allowed the team to identify strengths and weaknesses in these areas. Every applicable note from the raw transcription of FGD and interview notes was highlighted and coded in Dedoose. General, unclear or irrelevant statements were not coded or included in the analysis. Each interview and FGD transcription was uploaded as a separate document in the software and was assigned a "descriptor," to identify the source of the research data by RHU level (1, 2 or 3) and interviewee type (doctor, nurse and midwives). This provided the team not only with the ability to analyze the coded research findings by clinic level and interviewee type, it allowed us to compare findings across levels, interviewee types, codes, as well as the ability to isolate data.

System Usability Findings:

The team assessed trends amongst different codes in Dedoose. For example, there were a total of 99 excerpts captured under Design (parent code: System Usability), which produced an overwhelmingly positive response among the child codes. Out of 61 excerpts for Layout/Interface, 39 responses were positive and 22 were negative. Similar data were pulled for Navigation with 49 positive responses and 11 negative responses, as well as Templates with 38 positive experiences and 27 negative. The majority of the clinic staff found the system easy to use after the initial training period. Admission and consultation had an overwhelmingly positive response rate, and a nurse commented that the system is easy to navigate, especially for returning patients. A few of the more difficult areas for the clinic staff involved navigating the family

planning folder. One nurse at a level three clinic mentioned that the family planning folder appears whenever one is encoding information on a child. Another midwife commented that transferring patient information from one family to another (ex: when a patient gets married) is difficult. Clinic staff also requested more complete diagnosis lists with more options.

Staff efficiency was another area of System Usability that received more positive responses than negative from the clinic staff. Out of 63 total excerpts for clinic operations, there were 53 positive responses and only 10 negative responses. Reliability of the network, on the other hand, was a problematic area for most of the staff at various clinics. Out of 33 total excerpts for connectivity, only three were positive as most of the clinics experienced trouble with system speed, internet connections and outages.

The team captured data and information on hardware needs, technology literacy rates and WAH customer support. From the 10 excerpts regarding the available CPUs in the clinics, all were negative, and most clinics requested more computers. The CPU literacy rate code resulted in two positive experiences out of 11 total. This included both prior computer experience of the clinic staff as well new skills learned after training. Despite the mostly negative feedback in these areas, WAH customer support resulted in mostly positive feedback, as 11 out of 15 excerpts reflected a positive experience with support.

Data Quality Findings:

Data quality also received variable responses from the clinics. There were 33 negative excerpts associated with discrepancy out of a total of 49 excerpts, mostly relating to the variability of paper-based records verse those through the EHR. Encoding was a problematic area for most clinic staff (23 negative excerpts out of a total of 31), as the staff often encountered mistakes and had difficulty learning this functionality of the system. Reports, on the other hand, resulted in increased positive feedback with 27 positive excerpts out of a total of 41.

Patient Satisfaction Findings:

Similar to System Usability, providers' perception of overall patient satisfaction in the clinics was generally positive. Patient efficiency was the most common code in our data, with 17

total excerpts and 16 of these resulting in positive feedback. Excerpts related to the patient-provider relationship and perceptions of the EHR were favorable, with six out of 10 excerpts being positive. Finally, we were only able to capture 6 total excerpts from SMS efficiency, with only 1 being positive.

OBSERVATIONS

Data Quality:

Based on the analysis of our survey, focus group discussions, and interviews we found a number of recurring themes regarding data quality. Twenty-seven out of 41 of the responses we received regarding reporting were positive. First, providers asserted that reports are easy to run using the system. Second, they reported that that the transition from paper records resulted in "cleaner" and more consolidated reporting. Next, respondents reported that the system caused reporting to be more consistent overall because capturing mistakes is easier than the paper system. One surprising fact we found was that the clinic staff is more honest in their reporting. Prior to the use of the system, some staff would falsify end of the month reports by adding fake names. Electronic reporting under the WAH EHR system makes it easier for public health officers and clinic supervisors to capture and end this practice resulting in more reliable reporting.

Providers also noted that they now have a better ability to review patient records and medical histories. In fact, providers use the data stored in the system for this purpose on a regular basis. This is underscored by survey results indicating that system usability and data quality are positively associated. The data on particular patients is accurate and consistent and, therefore, they feel comfortable using it. Providers' ability to see accurate patient histories has also translated into their belief that they can provide better care to the patient. One provider commented that the EHR system "helps with deciding the most appropriate form of care and what kinds of medication to prescribe." Several providers made similar comments.

While it is clear that the quality of data collected by the WAH EHR system is an improvement from the paper-based system, there are some areas in which WAH can improve. Out of 49 comments made regarding discrepancies in the data, 33 of them were negative. Data from focus group discussions and interviews shows that though the data in the EHR system is more accurate than that of the paper-based system, there are still a number of problems regarding discrepancies in reporting. Many clinics still use paper records due to a lack of computers in the clinics and in the Barangays. A number of providers reported that when they compare the system reports to their paper records the system will sometimes incorrectly tally the amount of patients seen at a clinic even after the patient has been added to the system. In addition, encoding errors, such as spelling mistakes and typos, are common occurrences. In many instances, clinic supervisors (typically nurses) are expected to review the data in the system for errors and correct them. This results in an increased workload as well as less time spent with patients. Providers also noted that they would find it useful to be able to have a system search function that allows for searching by information other than just patient name or family folder.

System Usability:

System Navigation & Layout/Design

In examining how easy it is to navigate the WAH EHR system, we looked for feedback that related to how easy it was for clinic staff members to access and find different areas and features of the system or to find information. Key phrases such as "easy to find" or "system helps you see," or commentary on the ability of the system to help staff access further data on a patient, such as history or lab tests, were coded in Dedoose as positive statements. With the exception of midwives at level 3 and doctors at level 1 RHUs, the consensus was that the WAH EHR system is easy to navigate, especially for the nurses in level 1 and level 2 clinics. The negative feedback about system navigation from level 3 midwives may be attributable to the more detailed system use requirements for midwives at this level, some of which will be discussed in feedback relating to templates but may also be due to the mobile midwife units, which are still undergoing development.

System navigation and layout/design, although closely related, are different. The latter influences the former in that how the system is laid out/designed can impact the ability of the end

user to navigate it. However, in our research, feedback identified as layout/design (versus navigation) was concerned with, for example, size and placement of features, and overall look of system. The results of the research analysis showed that the feedback on system layout and design was evenly distributed between negative and positive, and did not vary widely across levels with the exception of doctors at level 1 clinics. While the data does not point to a specific reason for this, we postulate that it may be due to doctors' very limited usage of the system at level 1 clinics, where nurses and midwives use the WAH EHR software primarily for admission.

Templates

Templates are the digital equivalent of paper forms contained in traditional paper charts. Providers record a patient's medical information, such history, treatment plans, prognosis and test results, etc. into the systems medical record templates. Templates are incorporated under the theme of system usability because they determine functionality as it relates to patient care and directly impact other areas of usability such as navigation and design. Overall, negative and positive feedback regarding templates was evenly distributed, without much variation across clinic levels, with the exception of nurses across all levels. The templates that were the most frequently mentioned were the family planning, maternal care and consultation templates. By far, negative feedback about templates was related to a limitation to one or more template features. For example the inability of the end user to adjust prenatal visit dates in the maternal care template or to record a vasectomy in the family planning template for male patients over the age of 50 were limitations that contributed to the negative feedback. In addition, the limited list of diagnoses in the consultation template was another limitation cited during our research analysis. Yet despite this, the consultation template received most of the positive feedback, with nurses and doctors alike stating that the template is easy to use and made consultations faster.

Reliability & Connectivity

Since we have determined that an aspect of system usability involves how consistently the staff uses the system to carry out day-to-day activities, our research angle was to investigate the limitations to such. Our research found that the biggest barrier to consistent system use are issues concerning connectivity, specifically as they relate to system speed, server issues, loss of electricity, computers freezing and a limited number of computers available for staff members to

use. For both connectivity and availability of computers, the research showed an overwhelmingly large number of negative statements regarding system connectivity, with very few positive statements regarding either identified during the research analysis.

Proficiency, Training & Support

The research found that providers at all levels were satisfied with WAH's customer support post system implementation, especially as it relates to reliability in response time and troubleshooting, in some cases noting "same day service." However, the research did identify gaps in pre system implementation in developing general computer skills and providing adequate training on the system. In analyzing the research, we looked for statements that indicated both the level of knowledge and comfort of the end user. We also aimed to identify if end users were overly reliant on fellow staff members to aid in their use of the system. For example, a statement on the midwives "difficulty in sending reports" but "not knowing much about that," indicated a gap in training of which the onus is on WAH to ensure. Conversely, the identification and appointment of an RHU "super user," a staff member with advanced EHR usage skills, was coded as positive for good training since this was identified as a best practice in our literature review.

Most of the staff's lack of computer literacy was identified by the doctors as problematic. While we identified that general barriers to adequate computer literacy were attributed to age and generational gaps, we did not code these in our research analysis specifically as they are not factors that we feel should impede on the effectiveness of WAH's training. Furthermore, WAH's role in specifically providing general computer literacy training was not directly cited in the research conducted at the RHUs. However, a lack of general computer literacy was correlated with a lack of EHR literacy, and the perception and use of the system as a whole, so a careful consideration of this factor is relevant and important for WAH.

While computer literacy was discussed in broader terms, research on the EHR literacy and proficiency was more specific particularly in relation to the amount of time it takes for patients to be admitted and encoded, and the staff's ability to use the system efficiently. Furthermore, problems with basic yet critical aspects of the system, such as entering names and

dates of birth, searching for patients, and entering patients into family folders were coded as gaps in training in the research analysis.

Impact on Staff Efficiency

The research indicated that the use of the WAH EHR system in the RHUs improves staff efficiency by making them more organized, eliminates the need to search for paper records, allows for easier access to patient historical and test results, saves time by eliminating the need to write in ledgers, shortens patient wait times and allows for a more efficient work flow for RHU staff despite a reported increase in daily patient load. In level 3 clinics, the number of patients seen increased from 10 to 25 patients on average. In some level 1 clinics, the number of patients seen doubled, in one case from 50 to 100. In level 2 clinics, the number of patients seen was reported to have increased by approximately 30 patients. These numbers indicate that the use of the WAH EHR system improves the efficiency of RHU staff as it increases the capacity of the clinics to see more patients on a given day. In clinics where patient load was not increased, staff reported better working conditions in that they were able to take more adequate breaks. Another area of improvement was the enhanced ability of the nurses and doctors to perform follow-up visits, as patient historical information and data from prior visits is "readily accessible" and is "faster than having to search through paper charts."

Providers' Perception of Patient Satisfaction:

Based on the aforementioned measures of patient satisfaction, the NYU Capstone team identified areas where WAH was doing well, as well as areas that WAH could improve. Starting with the triumphs, providers reported that patients overwhelmingly felt that they were receiving exceptional care due to EHR system use. When interviewed, one nurse said, "Patients choose to come here because they perceive our clinic as high tech, they like that we are using a modern computer system that other clinics do not have." Analysis from the surveys on the impact of the EHR system in improving quality of care showed that 27 of 49 respondents gave an average score of 2 which implies that they "agree" with the hypothesis that the use of a computer in a provider's room improves quality of care in RHUs. Furthermore, findings from Dedoose analysis echoed the survey results. Five out of 9 comments made by respondents about patient perception

of EHR and improvement of quality of care were positive. Providers also believed that patients were aware of what information was recorded in the system. As per survey results, 31 out of 49 respondents listed "showing information to patient" as one of the uses of the EHR system, hence solidifying a positive patient awareness of the system.

The WAH EHR system has proven to help RHUs be better organized and improve efficient workflow. Providers felt that after the implementation of the system, patient waiting times at the clinics were reduced tremendously despite an increased number of patients served. When interviewed, one midwife said "We are grateful for WAH because nowadays we don't spend half of our time searching for patients files in the records cabinet before we see them. Now when patients arrive, we search their names on the computer, and with a few clicks we have all of their information." Findings from the surveys revealed that 25 of 49 respondents on the question of reduced waiting time gave a score of 2 as they "agree" that the use of EHR has reduced waiting time at the clinic and, in turn, improved efficiency. Concurrently, Dedoose findings substantiate that patient efficiency is enhanced in RHUs. Sixteen of 17 remarks regarding improved efficiency were positive. Providers strongly felt that there has been an improvement in efficient workflow due to the EHR system.

Overall, the EHR system has triggered marked improvements in the patient service delivery side of RHU operations. Seeing patients is now easier, patient records are easily accessible, getting lab results is faster, and patients can see doctors sooner, which facilitates quicker patient turnaround in RHUs. In addition, there was a question of patient health data security and confidentiality. The NYU Capstone team wanted to measure the level of confidence that providers have in data security and privacy of patient health records. Findings from the surveys results were certainly promising. The average score was 2.5 where the perfect score could have been 3. Twenty-nine out of 50 survey respondents gave a score of 3, which implies that providers are "very confident" in data security and confidentiality of patients' health records.

While there are many areas where WAH is excelling, one of the purposes of this evaluation by the NYU Capstone team was to identify challenging areas where WAH needs to improve. The team identified three bottlenecks pertaining to patients' satisfaction including:

declining patient – provider communication, SMS inefficiency, and increased waiting time due to a learning curve.

Patient-provider communication is affected by the fact that some providers focus more on the computer screen than making eye contact or physical touch while serving patients. It is reported that some patients feel that providers are less attentive because they are typing on their computers most of the time during patients' admission and consultation they do not making eye contact. Also, providers thought that there was an inability to physically touch their patients as much as they used to do before the system was implemented. Face-to-face communication and physical touch are crucial aspects to establishing a healthy patient-provider relationship. During an interview, a doctor from one of the sites said, "It is somehow difficult to physically touch my patients in a focused assessment such as a cardiac exam or when assessing the swelling of tissues, and at the same time be able to record all the information on the computer. Actually some of the patients simply don't understand why the computers are here, some patients think we are playing computer games." This situation creates a disconnection and disrupts the patient-provider relationship.

SMS service is an essential component of WAH EHR system. When functioning properly, SMS service is a great way to communicate with patients to send emergency health alerts, remind provide reminders on follow-up appointments and increase RHU attendance. However, the SMS part of the WAH EHR system experiences some delays and an inability to work properly. Providers reported that occasionally patients show up to the clinic 1 or 2 days late from their assigned appointment date due to the SMS delays. Some RHUs reported that their SMS service is completely unutilized as the result of malfunctions. Findings from the Dedoose analysis revealed that 5 out of 6 remarks from participants of interviews and FGDs on SMS efficiency were negative, they considered SMS service inefficient. Hence, providers did not see the value that SMS component of the EHR system brings. This is something worthy of improvement since according to the survey results, providers do believe that the system itself is helpful.

Lastly, providers reported that some patients waiting time increased in some clinics due to a learning curve. Based on our observations, interviews, and FGDs, some providers lack prior experience using computer especially older generations. This caused difficulties in navigating the system, particularly in the early stages of implementation, which increases waiting time for patients as they wait for nurses or midwives to slowly enter their information in the system. Results for the Dedoose analysis showed that 9 of 11 responses were negative on CPU literacy and 10 out of 13 recorded negative on EHR literacy. This is challenging, as it affects efficiency in clinic operations.

RECOMMENDATIONS

After analyzing the findings regarding data quality, system usability and providers' perception of patient satisfaction, the NYU Capstone team developed several tiered recommendations for how WAH can improve the EHR system at its facilities. These recommendations are ranked both in order of importance and according to what the NYU Capstone team feels would have the greatest positive impact on the growth and development of WAH. They including enhancement in the areas of EHR software enhancement, organizational development, project implementation and strategic growth. While these recommendations are tiered by importance and potential impact, the Capstone team did consider WAH's human resource and financial capacity when ranking them. In implementing these recommendations, WAH should tailor each initiative to fit its needs and requirements, because no single initiative is completely transferable among institutions.

1. WAH should consider making considerable changes to the WAH EHR system template design to achieve balance between customizability, security and functionality. As discussed in the Literature Review and throughout this report, EHRs helps healthcare providers streamline care and ensure consistent data output. Well-designed EHR systems streamline care by having rigidly programmed templates that anticipate or are predictive of the health care practitioner's data entry process, with all possible data entry options coded into the system in a standardized fashion. Typically, this would include design features such as drop-down lists, radio

buttons, or check mark boxes. Well-designed EHR systems use free type or note fields sparingly and typically only in the interest of preserving the health care provider's ability to customize care and avoid over standardization or elimination of pertinent patient health information. To ensure consistent data output, well-designed EHR system templates contain limited standalone free-type or note fields.

While training to use the WAH EHR system, the team found that the template design was overly customizable. For example, in the consultation template, consultation components are in a free-type field for which there is no standardized input of information. End-users have the ability to cut and paste, edit, add or eliminate one or all parts of the consult template components. Furthermore, drop down lists were non-exhaustive and incomplete, such as the diagnosis list in the consultation template. We feel that this approach to template design is will negatively impact consistent care practices and data quality. Furthermore, this design prevents the system from being able to extrapolate information and produce reports from visits. This can impede on the ability of WAH and municipalities to collect information on population health trends, a critical aspect of developing and strengthening public health programs. Using the consultation template as an example, we recommend that WAH eliminate the ability of the end user to delete any part of the template, and instead take the components of the current consultation template and assign them to radio buttons, drop-down lists and checkboxes. Before undertaking this, system programmers should work closely with RHU staff to observe typical visits so that they can make determinations about template field placement, design and requirement rules.

While the team found that some templates in the WAH EHR system were overly customizable, we also found that other templates were too rigid in their requirement fields and were problematic for the clinic staff. For example, the maternal care template contains several data fields that cannot be edited or lock the end user out. In the family planning template, age requirements limiting a nurse/midwife's ability to enter information on, for example, a vasectomy for a male patient over the age of 50 was reported as problematic by system users. Should WAH programmers redesign templates, we recommend research on and examination of popular and well-designed EHR templates in other programs, as well as site visits to collect information from RHU staff on required fields and other measures that limit the flexibility of end

users to enter what would otherwise be important patient data. By understanding the workflow of the staff, collecting information about template needs and incorporating best practices from other EHR systems, we feel that the WAH system can better streamline care, produce consistent data output, and expand the sophistication and usability of its reporting feature.

2. WAH should eliminate the use of family folders in the WAH EHR system and replace it with functionality that allows for patients to be linked through familial relationships. The team's research consistently found that WAH's use of the family folder caused problems for clinic staff. During training, the team itself found the family folder confusing to learn and cumbersome to use because it is not intuitively designed. From a design perspective, entering a patient into a family folder was challenging in that it was not entirely clear where the data was going. The constant checking and searching by name (which is subject to misspellings) and navigation across several similar looking screens of the software was confusing and time consuming. These problems also transferred to the RHUs, as nurses and midwives alike reported difficulty in moving married or relocated patients from one family folder to another, sometimes leading to situations in which patients were entered into the system twice. Overall, the Capstone team found that the use of family folders has a negative impact on usability and potentially data quality.

While we acknowledge the importance of family medicine, and respect the Philippines' cultural focus on the family, patient care at RHUs is provided on an individual basis, and we feel that the system should reflect this. A more intuitive and usable alternative to collect family level data can be accomplished by programming capability into the software that allows end users to simply create relationships between different patients without grouping them under a family folder. We recommend that WAH programmers examine other well-established EHR systems to seek the most appropriate design for this functionality and implement it accordingly.

3. WAH should conduct ongoing training for clinic staff, newly hired providers and create a "how-to" manual that will be kept at RHUs for providers' reference. We feel that having a reference handbook for providers to use when facing difficulties pertaining to system use would strengthen the autonomy and EHR literacy skill of RHU staff. By having a reference

handbook in place, RHU staff can troubleshoot problems without relying on WAH supervisors or technical staff. We recommend that these manuals include narratives and visual aids such as screenshots to assist users with system navigation, template use, how to encode specific information, computer maintenance tips and basic troubleshooting instructions, such as: what to do when the computer freezes or stops responding, and how to fix simple connection problems.

Furthermore, WAH should conduct regular refresher training that aims to recall and reinforce the knowledge gained during the initial EHR system training as well as to review new features, if applicable. Also, there's a need to conduct direct training whenever there is a newly hired staff at the clinic. Through our interviews and FGDs, we learned that newly hired providers in an already established WAH EHR site do not receive direct training from WAH instructors; rather, their colleagues at the RHUs train them. This is a challenge since the third party information/knowledge transfer is often not as effective as knowledge acquired directly from WAH trainers. We feel it is important for WAH to initiate a system in which they receive notice of new hires and follow through to directly manage their training.

4. WAH should conduct a baseline study of where the RHU stands so they can accurately track growth. From our focus group interviews, we were able to gather data on the estimated increase in patients seen before and after the implementation of the EHR but only by word of mouth and the memory of the clinic staff. It would be beneficial for WAH to do a preliminary study when they first implement the EHR at new clinics, as it would provide WAH with a benchmark for comparison over time. This study might include: a) estimated number of patients seen per day and during busy/slow seasons, b) number of staff working during clinic operations, c) average patient wait time and d) prior experience with computers among staff members. Then every few months, or before a new level training, WAH could perform another study to see where the clinic stands against the listed items as a result of the EHR implementation. We will be providing more tools for WAH to use in the Monitoring and Evaluation plan.

5. WAH should garner partnerships with various organizations and corporations to secure hardware and human capital. Interview and FGD analysis showed a high negative

response rate to the number of CPUs available at the clinics; in other words, the clinics have a great need for more computers. In order to combat this, we recommend that WAH actively seek partnerships with one or more technology corporations that would be willing to donate or at least reduce the cost of new hardware for the clinics. We understand that WAH's partnership with Qualcomm is coming to an end this year, so it is especially timely to maintain technological support from another outside company.

Partnerships with other organizations can also help address WAH's own human resource gaps. WAH can turn to universities, local organizations and community groups in order to build an arsenal of volunteers and/or interns to address these needs. All volunteers/interns should be well trained. Well-trained volunteers will allow WAH to better address clinic needs, monitor clinic their progress, and implement new services. WAH can also reach out to professional organizations and businesses in order to obtain professionals from various fields willing to do pro-bono work.

6. WAH should focus some of its lobbying efforts on improving the infrastructure surrounding clinics currently using the EHR system. This is necessary in order to ensure that these clinics get the best of the system. In addition, this should be conducted before expanding to more clinics or moving clinics to a higher level. This recommendation stems from our finding that many of the clinics experience no internet connection or a slow internet connection, preventing them from sending SMS messages to clinics. In addition, as previously stated, providers report that occasionally patients show up to the clinic 1 or 2 days late from their assigned appointment date due to the SMS delays. Lobbying politicians to invest in infrastructure can go beyond the municipality level and extend to higher levels of politics. WAH can also partner with other organizations in order to lobby for more infrastructure. In doing so they gain more resources, strength in numbers, and expertise in areas adjacent to its scope of work.

7. WAH should invest significant resources in professional development for WAH staff. We feel that WAH's investment in professional development for staff will improve the outcomes of the WAH's EHR use in RHUs. It will significantly improve the implementation process and resolve gaps in training, computer and EHR literacy and promote stronger

relationships with RHUs and staff. The first area that we feel WAH can invest in professional development for staff is in enhancing communication skills, specifically on how to motivate users. We feel that the implementation process would be greatly enhanced if WAH staff had tangible tools for motivating end-users when they are implementing such large changes to their workflow. Investing in public speaking resources would also support the second layer of this recommendation, which is training on building relationships with RHU staff. Lastly, the third layer of this recommendation is to use the aforementioned skills development to standardize the implementation training process to have a high set of standards and protocols that are used on an organization wide basis. By doing this, all RHUs, regardless of staff assignment, will get the same high level of training and support. Along with this standardization should be the creation of a training manual for staff to use as a reference and guide on an ongoing basis to assist them in technical training and relationship building.

8. WAH should extend its services to the Barangay level, beginning with the Barangays associated with the clinics WAH currently serves. WAH can provide tablets or computers in the Barangays so that the midwives that serve them can record patient information without having to revert to paper records. This information can be saved on a flash drive, external hard drive, or internet storage space. This will eliminate the need for midwives who travel to Barangays to manually record their records and then enter then into the EHR system at a later date. In addition, it will allow midwives who travel long distances to the Barangays they serve to update data in a timely manner. Finally, this will allow staff that are not often in the clinics become more accustomed to the WAH EHR system.

9. WAH should provide incentives to end-users that demonstrate mastery of the system. As it stands, there are some staff members that are more comfortable with the system than others. We noticed that some of the older midwives that have little or no prior experience with computers have little incentive to learn the new system. What we recommend is to provide the clinic staff with certain incentives to learn the EHR system more effectively. The WAH staff can come in and do occasional "usability studies" with the system to assess the clinic staff's mastery of the system. Incentives can be phone credits or other small gifts that would encourage and incentivize the staff to improve their computer and EHR literacy skills.

10. WAH should establish a sturdy and reliable SMS system. WAH should ensure that the SMS service works efficiently and consistently. The survey findings reveal that providers clearly see the optimal potential contribution that SMS can have in enhancing RHU operations. In the SMS usefulness question on the survey, 28 of 50 respondents gave a highest score of 3 and therefore said that SMS is "very helpful" to patients in improving quality of care. WAH should ensure that hardware is appropriately installed and troubleshooting is provided in a timely manner. This involves incorporating SMS service efficiency in part of routine WAH supervisors' assessment, as currently the SMS system supervision seems to have been somewhat neglected. Fixing the system to ensure preventative care and public health crisis messages reach patients on time and to remind patients about their follow-up/outpatient appointments would not only improve RHU operations, but would also help to improve public health as the SPASMS system originally intended.

11. WAH should initiate a regular computer maintenance schedule. Proper maintenance of the computers for the WAH EHR system use is a great way to facilitate an effective EHR system. This will involve maintenance activities such as: keeping computers physically clean, clearing-out the unnecessary files in the software system, resolving and preventing viruses, frequent file back up and the installation of security features that prevent personal computer use. These simple measures will ensure that computers remain functioning properly, enhance their performance and prevent the need for expensive repairs.

12. WAH should hire staff dedicated to data quality checks only. As it stands, WAH supervisors complete data quality checking. However, the Capstone team found that the WAH staff is not sufficiently trained to evaluate the quality of EHR data, as their main function is to act as trainers and support for clinic staff. In addition, it is a conflict of interest for WAH supervisors to check the data of the clinics they themselves serve. By hiring specific personnel to perform data quality checks, WAH can better ensure more accurate results as this person should have a background in using data and will be trained by WAH for this purpose only. WAH can also better ensure unbiased results. Alternately, WAH can eliminate data quality checking from its function as an organization entirely. Data quality checking is outside of the scope of WAH

mission, and it would be wise to allocate resources more efficiently. Finally, as a second alternative, WAH can create an auditing tool within the WAH EHR system that captures errors in reporting.

MONITORING AND EVALUATION PLAN

A Monitoring and Evaluation (M&E) plan is important in identifying program goals, objectives, key indicators, and clearly articulating the associated intended outcomes. The plan provided in this report is crucial in assessing the usage of the WAH EHR system by providers as well as its impact on patient experience and health outcomes. It is a mixed methods approach that requires WAH representatives to collect quantitative data through the use of surveys, and qualitative data by conducting interviews and focus group discussions. This plan includes a guide to conducting a literature review as well as a guide to capturing pre and post program data. Finally, it includes a description of indicators that should be prioritized, as well as a list of sample questions associated with each indicator. In addition to the indicators listed, WAH should collect basic demographic information about each clinic including number of staff, number of computers available at each clinic, and the organizational structure of each clinic. These tools should be used as a roadmap to successful implementation and validation of the WAH EHR system's effectiveness in RHUs.

Literature Review:

As EHR systems become more popular around the world, demonstrations of their effectiveness are becoming more essential. In addition, the trend of demonstrated impact in the non-profit sector has taken hold. In order to secure funding, trust and increased notoriety, it is important to adequately and consistently measure the outcomes and impacts of programming. Therefore, it is critical to keep up-to-date sources and knowledge of the industry at hand.

In order to prioritize the continued review of its programs, WAH should maintain a literature review of the current dialogue surrounding EHR systems and their implementation. WAH can do this through ongoing desk research, attending conferences e-health software, and

investing in memberships with organizations that share their mission and values. This should include examples and lessons learned from EHRs in developing countries as well as developed countries. In addition, WAH should explore the literature surrounding EHR system innovations. Finally, WAH should maintain an arsenal of literature on how EHRs are evaluated. This information is not only valuable for WAH's growth, but can aid WAH in understanding best practices and making important resource allocation decisions.

Capturing Baseline and Post Program Data:

Capturing baseline data is important in providing a comparison to evaluate WAH EHR system effectiveness and to provide a better understanding of clinic performance and activities prior to the implementation of the EHR system. In carrying out this M&E plan, baseline data should be used to compare information collected after EHR system implementation to answer two key questions. The first is to determine whether the program is making a difference to RHU operations and the delivery of patient care and the second question is to what extent that difference is being made. Without baseline data, an accurate comparison cannot be made, as there will be no picture of the condition of RHUs prior to implementation.

Collecting post program data will be significant when making comparisons between clinics that implement WAH EHR system to non-WAH operational sites, in particular as it relates to measuring the level of impact or extent of difference. Collecting post program data also allows for identification of implementation gaps or process issues that directly impact the ability of the program to make a difference and to what extent.

Indicators:

1. **Data Quality -** How useful the data generated and collected by the EMR system is to clinic operations. This indicator should be measured at every level, to varying degrees, in order to determine the progression of data quality over time. Key aspects of this indicator include:
    a. Reliability - Is the data in the system always accessible for provider use and reporting?
    b. Timeliness (Level 2 and 3) - Are reports sent and received on time?

c. Completeness - Are patient files comprehensive or is there missing information?
d. Relevancy - Is the data that is being input into the EHR relevant to achieve desired health outcomes?
e. Accuracy - Is the data in the EHR system a precise account of patient health status and history?
f. Consistency - Is the data always accurate and useful?

2. **System Usability** - A measure of how effectively clinic professionals are able to use the system for their work based on its design, function and gaps in training and implementation. This indicator should be measured at every level, to varying degrees, in order to determine the progression of data quality over time. Key aspects of this indicator include:
    a. System Usage Frequency - How often and for how long is the system used on average.
    b. User Friendliness - Do providers find the system easy to use/learn.
    c. Technical Proficiency - How familiar are staff with the EHR system.
    d. Training and Support - Do staff feel they have adequate training and support and how often is it necessary.

3. **Patient Satisfaction -** This is a measure of patient attitudes towards the newly adopted EHR system. It also measures how the EHR system has impacted the patient's experience at the clinic as well as their health outcomes.
    a. Efficiency in service delivery - Has the implementation if the EHR significantly impacted service delivery at the clinic?
    b. Improved Health outcomes (Level 3 only) - Has your quality of health improved as a result of new services brought to by the EHR system?
    c. Patient EHR Perception - Are patients aware of the use of the EHR system? What do patients think about the EHR system?
    d. Patient-Provider Relationship - How has the patient provider relationship changed?

e. SMS Efficiency (Level 3 only) - How often is this function used, and is it successful.

4. **Computer Literacy -** This is a measure of how providers' knowledge and understanding of computers as a result of learning the WAH-EHR system. This measure should be measured at level one and two clinics.

Sample Questions

1. **Sample questions to be administered at baseline:**
    a. **Data Quality**
        i. How on average long does it take to send reports?
        ii. On a scale of 1-5 (5 being the highest), to what extent do you think paper reports are accurate?
        iii. How often are there errors in paper records?
        iv. To what extent do you readily have access to paper records for all patients?
        v. To what extent are there inconsistencies in paper reports?
        vi. On average, how long do you spend creating reports?
        vii. How often do you use patient records to determine health trends?
        viii. To what extent do you use patient records to determine health needs in your community?
        ix. How often are reports sent in late?
        x. To what extent do you refer to the information found in patient records?
        xi. What do you use patient records for?
        xii. To what extent is the data found in patient records used for day-to-day clinic operations?
        xiii. To what extent do you find that patient records are missing information pertinent to follow-up visits?
        xiv. To what extent do you find that patient records are missing information necessary to provide well-informed treatment plans?

b. **Paper System Usability**

i. How long do you spend finding a patient's medical record?
ii. How long do you spend reviewing a patient's medical history in a paper chart?
iii. How well can you read the information contained in a paper record?
iv. How much time is spent on organizing, storing and maintaining paper charts?
v. Do you feel that patient records are secure?
vi. How well do you feel you understand your paper charting method?

c. Patient Satisfaction

i. How long on average do you wait for provider to search for your paper file before admission process starts?
ii. How long on average do you spend at the clinic?
iii. Are you satisfied with the amount of time you spend with the provider?
iv. How is your relationship with a provider?
v. Does the provider maintain face-to-face communication with you during visit?
vi. Are you confident with data security of confidentiality of the information recorded by the providers on papers?
vii. How often do you return for your follow-up appointment?

d. **Computer Literacy**

i. How often do you use a computer?
ii. Do you own a personal computer?
iii. Have you taken any computer training courses?
iv. To what extent are you knowledgeable about using the computer?
v. Do you feel comfortable using a computer?
vi. What do you find to be the most difficult aspect of using a computer?
vii. What do you find to be the easiest aspect of using a computer?
viii. Have you ever used a computer?

2. **Sample questions to be administered post-implementation:**
    a. **<u>Data Quality</u>**
        i. How long, on average, does it take to send reports?
        ii. On a scale of 1-5 (5 being the highest), to what extent do you think EHR reports are accurate?
        iii. How often do you find errors in the EHR?
        iv. To what extent do you readily have access to records for all patients?
        v. How long does it take to access a patient's file in the EHR system?
        vi. To what extent do you find inconsistencies in the EHR?
        vii. On average, how long do you spend creating and sending reports?
        viii. How often do you generate statistics using the EHR system?
        ix. To what extent do you review EHR records to determine health needs in your community?
        x. How often are reports sent late?
        xi. To what extent do you refer to the EHR in order to use the information found in patient records during consultation?
        xii. What do you use patient records for?
        xiii. To what extent is the data found in the EHR system used for day-to-day clinic operations?
        xiv. To what extent do you find that patient records are missing information pertinent to follow-up visits?
        xv. To what extent do you find that patient records are missing information necessary to provide well-informed treatment plans?
        xvi. To what extent has the accuracy of information improved as a result of the EHR system?

    b. **<u>System Usability</u>**
        i. How frequently do you use the system to conduct patient care activities?
        ii. Did you find the system easy to learn?
        iii. Do you find the system easy to use?

iv. On a scale of 1-5, how well do you feel you know how to use the system?
v. How often do you feel you need help navigating the system?
vi. How often do you need help entering data into the system?
vii. How often do you feel like you can troubleshoot problems on your own?
viii. How often does the EHR system make your patient care activities more effective when the patient is present?

c. <u>Patient Satisfaction</u>

i. Do you find EHR system helpful?
ii. Do you agree that the computer use in the provider's room improve quality of care?
iii. How often does a provider focus on the computer during visit?
iv. How often does a provider maintain face-to-face communication with you?
v. Do you agree that provider spend less time talking to you because the computer use?
vi. Are you satisfied with the amount of time spent with a provider?
vii. Do you agree that EHR system has reduced waiting time at the clinic?
viii. Do you find SMS system helpful?
ix. How often do you receive SMS reminder/information from the clinic?
x. Are you confident with data security and confidentiality of your health records?

d. **<u>Computer Literacy:</u>**

i. Do you prefer using a computer system instead of a paper system?
ii. Have your computer skills improved as a result of using the WAH EHR system?
iii. Did you receive training on general computer use?
iv. Do you feel that your computer training was extensive enough?
v. What do you find difficult about using the computer?
vi. What do you find easy about using the computer?

vii. Have you become more comfortable using computers as a result of the WAH EHR system?

viii. Do you own a personal computer?

CONCLUSION

Since its establishment in 2009, WAH has made great strides in the use of EHR system in the Philippines. It has extended the usage of its EHR system from 4 pilot clinics in four municipalities in 2010 to over 56 clinics in 2014. As a result of the extended reach, the WAH EHR system has brought some remarkable changes to RHU operations. The system in general has proven to be relatively easy for health providers with little or no computer skills to learn and use. RHUs reported that WAH EHR system has helped them to be better organized in their daily activities starting with admission and accessing patient records, and consultation, including the easier creation of the patient treatment plans. The EHR system has also helped improve patient follow-up appointment turnout, enhanced RHU reporting systems and led to an overall improvement of RHU operations.

However, there are a number of ways in which WAH can improve its EHR system effectiveness and reach its full potential. These include improving infrastructure to make sure that clinics get the best of the system before expanding to more clinics or move clinics to a higher implementation level, conducting ongoing training for clinic staff and newly hired providers, the creation of a "how-to" manual for RHUs to reference, improving the system template design, and providing incentives to end-user that demonstrate mastery of the system. These practices will maximize the impact of WAH EHR system in RHUs and enable WAH to fulfill its mission of improving governance and access to better quality data by clinicians, health managers, and local governments.

APPENDIX

List of Acronyms & Terminology:

EHR - Electronic Health Record also know as an Electronic Medical Record (EMR)
WAH - Wireless Access for Health
M&E - Monitoring and Evaluation
LGU - Local Government Units
RHUs - Rural Health Units
WHO - World Health Organization
DQC - Data Quality Check
FGD - Focus Group Discussion
NYU - New York University
SPASMS - Synchronized Patient Alerts via SMS
SMS – Short Messaging System (Refers to the Synchronized Patient Alerts)
CPU – Computer
Barangay Health Unit – A health unit that serves the smallest administrative division in the Philippines (Barangay) and is typically much smaller than the RHUs.

Table 1:

Examples of EHRs in Developing Countries

EHR	Country	Description	Specifications	Lessons learned
Zambia Electronic Perinatal Record System (ZEPRS) Developed by RTI	Zambia	The ZEPRS project's primary goal was to develop a perinatal electronic medical record system that could be used by 24 clinics, UTH, the Central Board of Health (CBOH), the Lusaka Urban Health District Management Team (LUDHMT), and CIDRZ. It was the first electronic-first perinatal referral system in sub- Saharan Africa and enabled users to enter patient data in real time.	Important features of the design included the following; 1) centralized authentication and authorization scheme 2) notification to referral clinic or to UTH of incoming patients, 3) provision of critical information to prepare for patients' arrival, 4) notification to referring clinic and UTH about patient status, and 5) record management of all patient referrals.	This perinatal patient referral system was built around two key concepts: The first is user-driven development, with involvement by all relevant stakeholders. The second is local use of information from the electronic records system as a key driver in the adoption of such a system.
Partners in Health	Haiti	PIH develops web-based EHR to support their work, and to track patients, treatment regimens and pharmaceutical needs at their sites around the world. This particular EHR technology was developed in Haiti and provides a central repository of information about patients and medications.	Log in page: Depending on the user's account specifications, the system will open in French, English, or Creole. Every user must select a location within the hospital in order to log in, which helps the team understand what is happening at each department and narrows down information for clinical quality assessments. Doctors scan a patient's barcodes, so they can see details of the in-progress visit.	The PIH model supports large numbers of patients who are served by community health workers working with doctors, nurses, social workers, and pharmacists to support the patients' needs. Patient data collected can be viewed from mobile devices.

The HIV-EHR system	Haiti	Since 1999, PIH has run a community- based HIV treatment program in Haiti, expanding to seven public health clinics in an area with virtually no roads, electricity or telephone service. Design: Based on the PIH-EHR. Satellite-based internet access at each site supports email and web communication.	Design: Open source web system backed by an Oracle database (the same as the PIH-EHR) with an additional offline client for data entry and review. Bilingual English and French. An offline component of the EHR was developed to overcome unreliable internet communications in some sites. This allows data entry and case viewing when the network is down, and has proven to be reliable and popular with clinical staff.	The HIV-EHR shows the feasibility of implementing a medical record system in remote clinics in a remote area with virtually no infrastructure and limited technical expertise.

Administered Survey Questions

Instructions:

The purpose of this study is to measure how *you* feel about the Wireless Access for Health Electronic Medical Record System and how it has impacted your work. Please circle only one answer that describes your evaluation of the factor being assessed.

-Data Quality-

1) How reliable is the output information of the WAH EMR system?

a. extremely reliable
b. quite reliable
c. slightly reliable
d. not reliable at all

2) How relevant is the output information of the WAH EMR system?

a. extremely relevant
b. quite relevant
c. slightly relevant
d. not relevant at all

3) How accurate is the output information of the WAH EMR system?

a. extremely accurate
b. quite accurate
c. slightly accurate
d. not accurate at all

4) How consistent is the output information of the WAH EMR system?

a. extremely consistent
b. quite consistent
c. slightly consistent
d. not consistent at all

5) How complete is the output information of the WAH EMR system?

a. extremely sufficient
b. quite sufficient
c. slightly sufficient
d. insufficient

-System Usability-

1) How often do you use the EMR system for patient care activities when the patient is present?

a. Always
b. Often
c. Rarely
d. Never

2) How often do you use the EMR system for patient care activities when the patient is not present?

a. Always
b. Often
c. Rarely
d. Never

3) In your opinion, how often does the EMR system make your patient care activities more effective when the patient is present?

a. Always
b. Often
c. Rarely
d. Never

4) In your opinion, how often does the EMR system make your patient care activities more effective when the patient is <u>not</u> present?

a. Always
b. Often
c. Rarely
d. Never

5) How many hours per day do you spend using the EMR system on patient care related activities?

a. 8 or more
b. 5 or more
c. 3 or more
d. less than 3 hours

6) How would you describe the ease at which information can be entered into the EMR system?

a. Very easy
b. Easy
c. Moderately easy/some difficulty
d. Not easy at all

7) How would you describe the ease at which you can find information in the EMR system?

a. Very easy
b. Easy
c. Moderately easy/some difficulty
d. Not easy at all

8) How would you describe the ease at which you navigate the EMR system overall?

a. Very easy
b. Easy
c. Moderately easy/some difficulty
d. Not easy at all

9) How would you rate your proficiency with the EMR system ONLY?

a. Expert proficiency
b. Intermediate Proficiency
c. Basic Proficiency
d. Not proficient at all

10) How would you rate your general computer use proficiency?

a. Expert proficiency
b. Intermediate Proficiency
c. Basic Proficiency
d. Not proficient at all

11) Which aspect of the EMR system do you find most challenging?

a. Finding patient records/information
b. Reviewing medical history
c. Placing lab and pharmacy orders
d. Editing/changing patient records, information, medical history or lab/pharmacy orders

11b) Which aspect of the EMR system do you find most effective/easy to use?

a. Finding patient records/information
b. Reviewing medical history
c. Placing lab and pharmacy orders
d. Editing/changing patient records, information, medical history or lab/pharmacy orders

12) How often do software related issues (database crash, freezing, slow navigation) affect your ability to use the EMR system?

a. Always
b. Often
c. Rarely
d. Never

13) How often do hardware related issues (frozen computer, loss of electricity, computer portability/placement, network connectivity) affect your ability to use the EMR system?

a. Always
b. Often
c. Rarely
d. Never

14) How often do you need technical assistance from a fellow staff member to troubleshoot or use the EMR system?

a. Always
b. Often
c. Rarely
d. Never

15) How often do you need technical assistance from an IT professional to troubleshoot or use the EMR system?

e. Always
f. Often
g. Rarely
h. Never

16) How often do you feel that you can adequately troubleshoot problems that you encounter with the EMR system without any assistance from a fellow staff member or IT professional?

a. Always
b. Often
c. Rarely
d. Never

17) How often do your colleagues or IT professionals solve your problem?

a. Always
b. Often
c. Rarely
d. Never

18) How often do your colleagues and/or IT professionals show you how to approach the problem on your own?

a. Always
b. Often
c. Rarely
d. Never

19) In your opinion, how often do you feel that the EMR system training you've received has prepared you to use and/or troubleshoot the system?

a. Always
b. Often
c. Rarely
d. Never

20) In your opinion, how often do you feel that you need additional EMR system training so that you can more effectively use and/or troubleshoot the system?

a. Always
b. Often
c. Rarely
d. Never

-Providers' Perception of Patient Satisfaction with the EMR System- [1]

1) How helpful is the EMR use to patients?

a. Very helpful
b. Somewhat helpful
c. Somewhat not helpful
d. Not helpful

2) Do you agree that Computer use in provider's room improve quality of care?

a. Strongly agree
b. Agree
c. Disagree
d. Strongly disagree

3) What does a provider use a computer for during visit? Choose all the apply.

a. Enter notes
b. Show information to patient
c. Look up test results and other information
d. Provide printed health-related materials

4) How often does a provider focus on a computer during visit?

a. Always
b. Often
c. Rarely
d. Never

5) How often does a provider maintain face-to-face communication with patients?

a. Always
b. Often
c. Rarely
d. Never

[1] Questions 6, 7, and 9 were omitted during survey analysis.

6) Do you agree that a provider spends less time talking to you because of computer use?

a. Strongly Agree
b. Agree
c. Disagree
d. Strongly disagree

7) Are you satisfied with the amount of time spent with a provider?

a. Very satisfied
b. Somewhat satisfied
c. Somewhat dissatisfied
d. Dissatisfied

8) Do you agree that the use of EMR has reduced waiting time at the clinic?

a. Strongly Agree
b. Agree
c. Disagree
d. Strongly disagree

9) How often do you receive SMS reminders/information from the clinic?

a. Always
b. Often
c. Rarely
d. Never

10) How helpful is the SMS service to patients in improving quality of care?

a. Very helpful
b. Somewhat helpful
c. Somewhat not helpful
d. Not helpful

11) How confident are you in confidentiality of patients' medical records?

a. Very confident
b. Confident
b. Somewhat confident
c. Not confident

<u>Administered Focus Group Questions</u>:

3-5 people
20-minute discussion

1. When was the EMR system implemented at the clinic?

2. How long did it take you to learn the system?

3. What was the easiest part to learn? The most difficult?

4. Can you describe the type of information that you are recording?
5. Can you describe the types of issues you run into with the system? (ex: slow navigation, connectivity, database crashes, computer freezing)
6. Are your colleagues able to assist you when you run into issues?
7. Give us an example of an issue you encountered with the system that you were able to fix? That you were unable to fix?
8. Does WAH provide customer support? Are they reliable?
9. If you could change one thing about the EMR system, what would it be?
10. Are you confident with the accuracy of the EMR output information? Levels 2&3
11. Are there areas that are more accurate or consistent than others? Which ones? L 2&3
12. Can you provide us with an example of when the data was not accurate? Were there any steps taken to correct the issues? Levels 2&3
13. Do you find that patient flow has improved with the EMR system?
14. Are there any bottlenecks in patient flow since implementation? Levels 2&3
15. What are 3 areas that have improved in the clinic because of the EMR system?

Administered Interview Questions:

20-minute discussion

Same questions as Administrative Staff focus group, as well as:

1. Do you use the EMR system when the patient is present?
2. How has the EMR system improved or hindered your experience with patients?

Table 2:

Survey Scores by Indicator

Indicator	Average Score		Maximum Score Possible	
	Percentage	Raw Score	Percentage	Raw Score
Data Quality	87%	13	100%	15
System Usability				
System Usage Frequency	73%	11	100%	15
User Friendliness	67%	6	100%	9
Technical Proficiency	56%	5	100%	9
Training and support	54%	13	100%	24
Providers' Perception of Patient Satisfaction				
Patient Perception	78%	7	100%	9
Patient-Provider Relationship	50%	3	100%	6
SMS Efficiency	66%	2	100%	3
Data Security	100%	3	100%	3

Table 3:

Focus Group and Interview Results by Indicator

	Positive	Negative	Total Responses
Data quality			
Discrepancy	33%	67%	49
Encoding	26%	74%	31
Reports	66%	34%	41
Usage	67%	33%	15
Patient satisfaction			
Patient efficiency	94%	6%	17
Patient provider relationship	60%	40%	10
Perception of EHR	56%	44%	9
SMS efficiency	17%	83%	6
System usability			
Clinic operations	84%	16%	63
Design			
Layout/Interface	64%	36%	61
Navigation	82%	18%	60
Templates	58%	42%	65
Reliability			
Connectivity	9%	91%	33
Error frequency	25%	75%	4
Training and support			
Available CPUs	0%	100%	10
CPU literacy	18%	82%	11
EHR literacy	23%	77%	13
WAH customer support	73%	27%	15

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