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The Mission System: An Electronic Health Record for Medical Treatment in Guatemala

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Abstract

Problem: The introduction of an electronic health record (EHR) system has become an essential component in monitoring and tracking patient information in most developed countries but are difficult to implement in underdeveloped countries. Guatemala is a country with poor health care and limited resources for patient tracking and monitoring. An organization in Guatemala, Nursing Heart Inc. (NHI), provides care to over 40 underserved rural communities but lacks the ability to monitor and track patient information. In order for NHI to properly monitor and evaluate their programs and track patients' continuity of care, the introduction of an EHR system is necessary.

Methods: A system development framework was used to help identify the elements necessary for successful EHR workflow development for NHI. Focused interviews were conducted using structured interview guides with questions targeted towards EHR system design from first-hand observation from volunteers and staff members.

Results: All the participants agreed that an EHR system would benefit NHI and will provide the ability to monitor patient trends over time, but will need to be simple, and have the ability to use in areas with no Wi-Fi.

Implications for Practice: Using the information obtained from the structured interview guides, first-hand observation, aggregate data from NHI, and IT considerations, a set of elements and data were identified, and a series of recommendations established for a more streamlined method of collecting patient data for NHI.

Keywords: Electronic health records, implementation, undeveloped countries, Guatemala, health information technology, Indigenous populations

Introduction

The introduction of electronic health record (EHR) systems have become a fundamental part of patient care in many developed countries and have the potential of improving quality of care, patient outcomes, disease prevention and management, and improving the reporting of systematic data on population health statistics (Shuaib et al., 2016). Unfortunately, EHRs are difficult to implement in underdeveloped or low-middle-income countries (LMICs) due to lack of funding, infrastructure, training, knowledge, accessibility, and other limitations (Aldredge et al., 2020). The result of these limitations creates challenges within the health care system. According to Kumar & Mostafa (2019), there is a global consensus that EHRs can facilitate and capture data to utilize for population and patient-centered health care delivery.

Guatemala is a country that lacks universal health coverage, policies, and strategies for improvement in population health. Compared to other Latin American countries, Guatemala is one with the poorest health and financial indicators (Aldredge et al., 2020). According to Aldredge et al., (2020), there are 16.58 million people living in Guatemala, with 59.3% living in poverty and 8.7% living below low-middle-income (as defined by the gross domestic product per capita, 8.3 Guatemalan quetzal or $ 5.5 in US per day) with disparities continuing among the different ethnic groups and geographic regions. Nearly half the population in Guatemala identify as Indigenous and are among some of the most underserved, with 80% living in poverty and living with chronic malnutrition (United States Agency of International Development [USAID], 2021). These Indigenous people encounter unequal access to healthcare, food, employment, and to an education (USAID, 2021). An organization in Guatemala, Nursing Heart Inc.

(NHI), (n.d.), was founded in 2011 by a nurse who had the desire and inspiration to care for others and assist fellow nurses in keeping their "hearts in the work of caring for others" (Founder's Message section). They partner with nursing programs and universities across the U.S. and provide a global health experience for students and educators. NHIs, (n.d.) mission is to *improve the health of underserved communities in Guatemala and develop nurses to face global public health challenges by personalizing programs through trusted partnerships* (Mission, Vision & Values section). They provide clinics in general wellness, women's health, acute care, school wellness, diabetes and HTN clinics. They also provide public health construction and Chapina stoves for safer and more efficient cooking (NHI, n.d.). Since 2011, NHI, (n.d.) has seen over 10,500 general clinic patients, over 3,500 cervical cancer screenings have been completed, and over 6,500 primary school wellness patients have been seen.

Since the Covid pandemic, NHI, (n.d) has started an online global health program for universities that are unable to have an in-person immersion experience into the Guatemalan culture. They have also partnered with the Ministry of Health, local non-profits, and communities to start a Community Health Worker Program which consists of training "Community Health Monitors" (CHM) who are "native to and residents of rural, marginalized communities so that they can carry out health promotion and prevention activities, provide primary care, and orient the inhabitants towards health services to improve their quality of life in the medium-long term" (Community Health Worker Program section).

NHI provides healthcare to over 40 underserved rural communities in Guatemala by collaborating with volunteers that visit these communities annually. These

communities do not have access to other regular healthcare services. There are hundreds of individuals, within these communities, who are diagnosed and treated for various health conditions during these visits, however, there is no process for monitoring or evaluating their programs through any data analysis or information system. By utilizing an EHR system, NHI will capture data to evaluate the impact of these programs for future health needs, development, and monitoring. The absence of a process for monitoring and capturing data for services provided to the underserved rural communities in Guatemala, served by the NHI, results in the inability to track both individual and population health needs and treatments within these communities. An EHR system will support the NHI in tracking this information and providing appropriate healthcare for the future.

The purpose of this project is to work with NHI on establishing the key elements and workflow necessary in a point of care EHR based system for their organization. These components could assist in promoting a systematic approach in collecting data at the individual and community level and could be used to improve tracking, monitoring, and evaluating individual focused care provided by community health programs. Establishing these key elements and workflow could support future health care service development and the ability to secure funding to provide services in the communities that NHI serves.

Literature Review

A search of the literature was conducted to identify the research on the challenges, benefits, and key elements necessary for implementing an EHR system in undeveloped regions (Appendix A). A database search using the Cochrane library and an advanced search with limiters of articles from January 2015 to January 2021, searching all word

variations and title abstract keywords of *electronic health record, underserved, implementation, villages, NGOs, undeveloped countries, developing countries,* and *data collection,* which yielded 3,556 results. The key terms were finally defined to "electronic health record" AND "implementation" AND "developing countries" which yielded 3 Cochrane reviews and 33 trials. The search produced 3 relevant journal articles with 1 article selected for final inclusion.

An additional database search using the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Medline was used with an advanced search using English language, dates including January 2015 to January 2021, and Boolean/phrase of the keywords *Electronic health record, Indigenous people, implementation, NGO, data collection, development, Guatemala, monitoring, evaluation, villages, Indigenous, rural communities, countries, Central America, rural villages, computer software development, rural areas, data elements, healthcare, health information technology, elements, Indigenous populations, developing countries, successful implementation,* and *health information systems.* The first search using the key term "electronic health record" yielded 36,089 journal articles. To limit these articles, a search of "electronic health record" AND "Indigenous people" AND "implementation" yielded 4 journal articles, in which 2 articles were selected for final inclusion. The search of additional key terms "electronic health record" AND "data" AND "NGO" yielded 16 journal articles, a search of "electronic health record" AND "development" AND "Guatemala" yielded 11 journal articles, "electronic health record" AND "data collection" AND "Guatemala" yielded 6 journal articles, "electronic health record" AND "development" AND "implementation" AND "countries" yielded 79 journal articles in which duplicates were removed to yield

16 journal articles. Of these additional searches, 7 articles were selected for inclusion. After reviewing the articles, 10 were selected for the final inclusion of this literature review (Appendix A). Exclusion criteria included studies prior to 2015, any studies that did not include key terms used in the search, articles that included disease processes or in relation to the studies of these, articles that did not include information on implementation or strategies of EHR systems or related terms.

Adopting an EHR or electronic medical record (EMR) in lower income countries has been a slow progress but has been accomplished in some resource limited areas (Aldredge et al., 2020). In order to study the benefits and challenges of EMR implementation and ways to overcome them in an emergency department setting in Totonicapán, Guatemala, the University of Virginia-Guatemala Initiative (UVA-GI) developed and implemented a Spanish-language point of care EMR system, SABER (Simple, Accesible, Básico, Electronic Record) (Aldredge et al., 2020). This study was conducted in a small hospital in the Western highlands of Guatemala, in a city with 500,000 people, 97% of which identify as Indigenous, with 40% living in extreme poverty and a mortality rate of 13.5% by age 15 years. This Totonicapán hospital has approximately 94 beds and cares for 2,000 – 5,000 patients annually, with 28 doctors on staff. The SABER program implementation was conducted in multiple phases and collected data including patient information, triage, initial evaluation, review of systems, physical exam, and plan. This case study used a voluntary 5-point Likert scale survey to evaluate provider perceptions of the SABER EMR, a 7-point survey to evaluate self-reported proficiency of the program and focus group interviews using 10 scripted open-ended questions lasting approximately 30 – 60 minutes. The results concluded that 94%

of medical students and 100% of physicians would recommend SABER to another healthcare provider and none of the participants were unsatisfied with the SABER system (Aldredge et al., 2020).

A study by Uc et al., (2020), implemented an EHR system in a rural area of Campeche, Mexico to contribute to healthcare expansion in areas of difficult access to medical care. Their purpose was to state the results of the EHR implementation and present the components that are integrated into the EHR system to produce a complete system (Hardware, software, telecommunications, & medical equipment). There are 105 medical units in the State of Campeche where the EHR implementation was conducted in stages by units and based on the Project Management Method (PMM). The results showed an increased number of consults from 2012 (14,021) to 2019 (34,751), the most common treated diseases in the region were hypertension (17,632) and diabetes (13,156), and the best results were obtained in the Nutrition (20.61%) and clinical psychology services (16.67%), with worst levels in patients admitted in less than 30 minutes for pediatric (1.59%) and surgical oncology (1.97%) services. This study showed that with the correct implementation of EHR systems, quality healthcare can be extended to other areas of the country and could benefit the entire population in this region (Uc et al., 2020).

A systematic review of the literature was conducted by Aliabadi et al., (2020), to identify the challenges and solutions of implementing an EHR-based surveillance system. The review was conducted on published articles up to October 31, 2019 in six electronic databases (Pro-Quest, PubMed, Web of Science, Cochrane Library, Embase, & Scopus) with unpublished studies including thesis and the gray literature searched in Google

Scholar and Google with keywords *electronic health record, EHR, surveillance systems, registry system, population health,* and *public health,* and utilizing the inclusion and exclusion criteria to classify and identify the solutions and challenges. There were 50 studies included, with 52 solutions and 47 challenges that were organized into 6 main themes (policy, regulatory, technical, management, standardization, financial, & data quality), with results indicating that although EHR systems play an important role in disease surveillance, there are many challenges and issues to the development and implementation of EHR systems with some of the most common challenges including; Time and resources, data quality, analyzing, cleaning, & accessing unstructured data, privacy & security, & lack of interoperability standards. The most common solutions were using language processing & algorithms for unstructured data, technical solutions for data retrieval, collaboration of departments to access the data, standardizing content, & using unique health identifiers (Aliabadi et al., 2020).

Kumar & Mostafa, (2019), stated "integration of EHRs in the national health care system of low-and middle-income countries (LMICs) is vital for achieving the United Nations Sustainable Development Goal of ensuring healthy lives and promoting well-being for all people of all ages" (p. e1016). Kumar & Mostafa, (2019), conducted a literature review to identify the strategies for successful integration of EHRs in LMICs. Four databases were searched (PubMed, Web of Science, SCOPUS, & Global Health), with the search terms *delivery of health care, healthcare delivery, healthcare system, hospital, electronic health record, medical records system, medical informatics, personnel health record, hospital information system, EHR, EMR, PHR, computerized medical record, developing country, developing countries, low resource, limited*

resource, and *low resources.* The search yielded 25 total studies that were included, and results identified a lack of evidence on EHR system integration strategies and difficulties integrating EHRs in LMICs unless identification of evidence-based strategies are applied (Kumar & Mostafa, 2019).

A quantitative user survey by Liang et al., (2018), describes the challenges and opportunities of EHR development and implementation of Stre@mline, an EHR developed by clinicians and engineers in Southwestern Uganda, and how this system has enhanced the care of over 60,000 patients in rural Uganda. The survey consisted of 33 questions that focused on usability and performance of the Stre@mline system and was conducted in one of the poorest regions in rural Southwestern Uganda at Kisiizi Hospital. A paper-based survey between January and June 2017 was utilized by purposive sampling with 30 users identified and 28 completing the survey of Likert scales with values ranging from strongly agree to strongly disagree and analysis performed through descriptive statistics using Microsoft Excel. The results showed that the Stre@mline system could be utilized in other countries as a model for development in technologies for the future by enhancing and improving patient care with 96% (27/28) of users finding it easy to learn and 100% (28/28) finding the system easy to use (Liang et al., 2018).

To identify collaborative eHealth and Randomized Clinical Trial (RCT) research practices that are culturally safe for Indigenous communities, Maar et al., (2019), performed a secondary analysis of a randomized clinical trial of DREAM-GLOBAL (Diagnosing Hypertension-Engaging Action and Management in Getting Lower Blood Pressure in Indigenous Peoples and Low-and Middle- Income Countries) over a five-year period. Survey responses from a total of 34 interviews and 12 focus group discussions

and a total of 142 participants using qualitative interview/focus group data was analyzed over a five-year period in six different Indigenous Canadian communities during the DREAM-GLOBAL trial. The results indicated that eHealth research on Indigenous communities can be successful but requires a focus on cultural safety in; building and maintaining respectful relationships, communication, and support from the local team during the RCT, support for timely implementation, team task shifting support, commitment to innovations, and reflecting on any mistakes or lessons learned that need improvement (Maar et al., 2019).

To achieve success in EHR implementation, Merhi, (2015), presented a process model with 4 primary goals and 3 stages that were developed based on the previous EHR implementation literature. The 3 stages (Pre-implementation, implementation, & post-implementation) are based on the system development life cycle theory, general systems theory, and the contingency model and 3 sub-categories (human resources, technology, & management) all of which contain factors that demonstrate implementation of a successful EHR system (Merhi, 2015).

EHR systems can be expensive and inaccessible for many developing countries but creating an Open EHR Platform can allow for the development of eHealth and EHRs in places that lack the resources (Pazos Gutiérrez, 2015). To introduce main elements of an EHR platform and how to minimize cost, Pazos Gutiérrez, (2015), wrote a vison paper on “the conception of a new kind of EHR system” (p, 45), to understand the problem, create a solution, and validate against a functional EHR platform. An EHR platform was proposed which included an extensive list of core components to allow EHR systems to be shared in many regions.

EMRs have the potential to improve healthcare, quality of patient care, and efficiency in practice, but implementing EMRs can be challenging especially in developing countries (Shuaib et al., 2016). A pilot investigation by Shuaib et al., (2016), was conducted to enhance EMR usage by rural physicians using randomized control of 6 towns selected as investigation sites in Bonao County of the Dominican Republic based on gender, age, and population distribution with 2 bordering local health stations (LHS) from each town (one randomly selected to the intervention group & the other to the control group). Village physicians in the intervention group were provided with a structured on-site intervention for 7 months and results showed that the percent of households with complete records increased, and the percent of complete clinic medical records increased from 2% to 14% ($p = <0.05$) and complete child vaccinations increased from 10% to 23% ($p = 0.05$. The study demonstrated the correlation between education, supervision, and technical support to improvement in EMR use and the actions to enhance sustainability of EMR implementation (Shuaib et al., 2016).

The Indigenous people of Canada experience a disparate affliction of poor health and significant gaps in health data availability due to a lack of clear government accountability of healthcare, which has resulted in a disconnected system (Wilkinson et al., 2020). The best practices EHR Implementation Framework (EHRIF) was established to promote the success of information system implementation and contains 18 success factors deemed essential in EHR implementation (Wilkinson et al., 2020). A retrospective mixed methods study was conducted to identify EHR implementation success factors at a First Nation (FN) Health Center in British Columbia (BC), Canada (Wilkinson et al., 2020). This study used purposive and snowball sampling to recruit participants who

participated in the implementation or planning of the EHR, which consisted of 6 female participants representing 5/7 groups involved in the EHR implementation. The data collection began 8 months after the EHR was initiated and the data was analyzed using descriptive statistics. The participants completed a demographic and success factor importance questionnaire (5-point Likert scale), and a telephone interview with semi-structured & open-ended questions which were transcribed electronically and coded using the EHRIF success factors to identify the presence or absence of each factor. The results showed that EHRIF was valid in EHR implementation with 14 of the 17 success factors present and rated as important. It also found that confidentiality, privacy, and collaboration with multiple stakeholders are critical components of EHR implementation (Wilkinson et al., 2020).

This literature search identified many challenges of EHR implementation in LMIC and underserved areas, but all agreed that implementing an EHR, or other form of health information system (HIS), could improve the quality of surveillance, patient care, efficiency, and overall population health in these regions. The common theme of cost and resources were among the most challenging aspects of implementing a HIS. A few articles addressed these challenges by implementing a HIS specifically developed for their resource-limited region, but some of the same challenges pursued, along with other limitations to implementation (time, quality, access, security, language processing, data retrieval, standardization, regulations, management, teaching, speed, & efficiency of system). Improving the care in LMIC and other underserved or rural areas by implementing an EHR or HIS will be challenging but strategies can be successful if identified and applied during development.

An exhaustive search for a model or framework was completed to assist in guiding this project. After this extensive evaluation of the literature, three models were discovered: the waterfall model (McGonigle & Mastrian, 2018), the evaluation framework (Kaufman et al., 2006), and elements of the program development and evaluation process model (Hickey & Brosnan, 2017). These models illustrate stages and factors to consider in the development process.

The waterfall model (McGonigle & Mastrian, 2018) illustrates a sequential systems development process working through six phases from feasibility through implementation in a linear order. This project will focus on the analysis (second phase) and design (third phase) of this model. The analysis phase focuses on the requirements and needs of the system by examining workflows and business practices of the organization. The design phase focuses on stakeholders identifying the data that is required or essential to the organization. These phases are critical in the development of information system design (McGonigle & Mastrian, 2018).

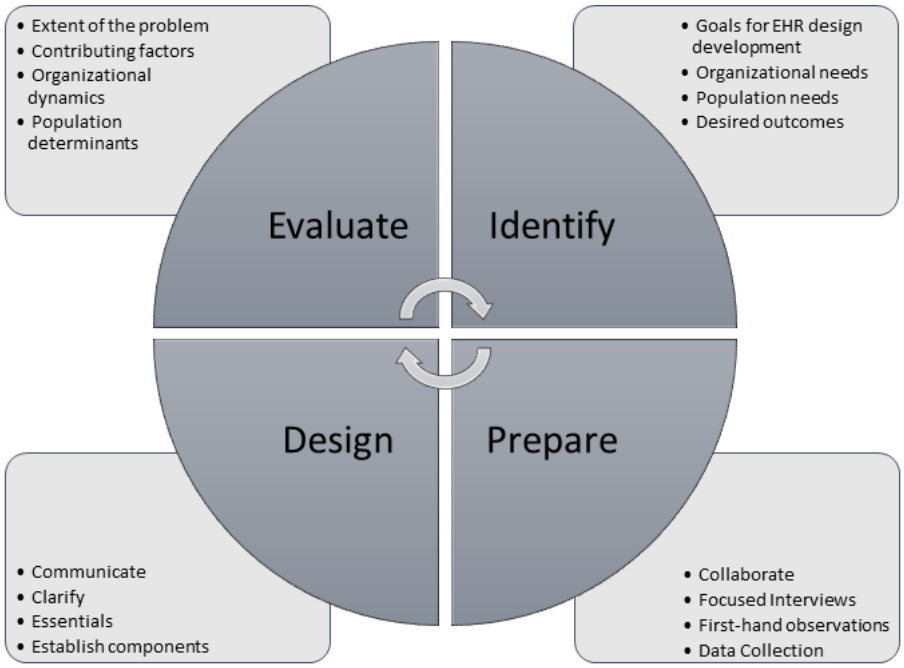
The evaluation framework by Kaufman et al., (2006), illustrates a framework for informatics application that represents the design, development, and implementation of health information technology. The principle of this framework is identifying the stage of system development and its correlation with the level of system evaluation. Evaluation is essential to each of the five stages and each level should be matched to the development stage. The development stages correspond to a software design life cycle beginning with system specification and ending with routine use. This project focused on stage one (specify needs) of the evaluation framework. During this stage, specification of needs and work to be performed is matched with evaluating the methods to define the problem

(Kaufman et al., 2006). The elements of the program development and evaluation process (Hickey & Brosnan, 2017) model depicts an overview of evaluating population health outcomes by planning and implementing new programs and interventions to improve the health status of populations that organizations serve. This model illustrates an ongoing circular process involving the assessment, planning, implementation, and evaluation of program development (Hickey & Brosnan, 2017). This project adapted this model and its elements by reconstructing the process to fit within the needs of the NHI organization.

While the first two models illustrate stages in the development of health information systems, the third model represents elements of program development and evaluation. By incorporating these three models, a framework was developed to identify the elements necessary for successful EHR workflow development for NHI (Figure 1).

Figure 1

NHIs Mission System Development Process



Developed by Tawniece M. Curry BSN, RN, EMT-P with adaptations from Hickey & Brosnan, (2017).

Methods

This project presented the components meant to define the proposed EHR workflow for NHI by utilizing a program development framework adopted and reconstructed based on Hickey & Brosnan, (2017) program development and evaluation model, with elements acquired from the waterfall model by McGonigle & Mastrian, (2018), and the evaluation framework by Kaufman et al., (2006). Figure 1 represents the design model that was used to help guide the NHIs Mission System Development Process. How each of the four components of the model – Evaluate, Identify, Prepare, and Design were used are described.

Evaluate

The first phase of the NHIs Mission System Development Process framework was to *evaluate*. This phase evaluated the extent of the problem, the contributing factors, organizational dynamics, and the population determinants that have influenced the limitations in tracking significant health information in the villages that NHI serves. The factors supporting the need for the development of a point of care EHR were identified through first-hand observations from a study abroad global immersion experience in 2020, interviews from volunteers and staff using structured interview guides, and through discussions with the Executive Director of NHI.

Extent of the Problem

NHI lacks a process for monitoring and evaluating their programs through any data analysis or information system resulting in the inability to track both individual and population health needs. Their current process of capturing data relies on material from paper forms with a limited amount of information available that is not captured in a way

that would allow aggregation of data that can be easily tracked. The paper form information is eventually disposed of with limited to no ability to evaluate or compare the data for future analysis and tracking.

Contributing Factors

NHI is a small organization within a large population of underserved indigenous communities. The ability to track information for future determinants of health requires manpower and monetary demands that NHI is unable to establish. Volunteers make up most of the organization's workforce, with a small number of permanent staff employed by the organization. There is limited internet access and a lack of knowledge of technology in some of the villages that NHI serve.

Organizational Dynamics

This organization consists of only a few main staff members, a board of directors, volunteers from the community, local non-profits, the health sector, and partnered universities. Through the global health programs at NHI, universities from around the U.S. can provide care and treatment to each of the villages annually, while providing an enriched experience for the nursing students delivering care. With their new community health worker programs, NHI is empowering individuals and the communities to become their own healthcare advocates (NHI, n.d.).

Population Determinants

NHI serves over 40 communities in underserved areas in Guatemala. These marginalized communities have no access to regular healthcare and rely on the medical care that NHI provides. NHI, (n.d.), has provided medical care to over 30,000 individuals since 2011 and will continue to provide care with the support of their volunteers,

contributors, university partnerships, and others. Cervical cancer is the number one killer of woman in Guatemala. Since the foundation of NHI (n.d.), over 3,500 cervical cancer screenings have been completed with over 150 women with pre-cancerous or cancerous symptoms that have been treated or referred (Impact section). Through NHIs chronic illness clinics, patients receive medications and treatment for their diabetes and hypertension. NHIs school wellness clinics provide anti-parasite medications and preventative dental care to school children in the villages they serve (NHI, n.d.).

Identify

The second phase of the NHIs Mission System Development Process framework was to *identify* the goals for EHR design development, the organizational needs, population needs, and the desired outcomes for expanding health information system technology for the NHI organization. This phase of the project examined and identified areas that will support the goals, needs, and desired outcomes for supporting EHR design for NHI in conjunction with the Executive Director of NHI and first-hand observation.

Goals for EHR Design Development

This included identifying the elements needed for NHI to capture patient information to assist in the data collection needed for organizational evaluation and improvement, as well as population health needs and delivery of effective healthcare. Establishing these key elements are necessary to track care over time in these limited resource villages and is critical to designing a system that incorporates those elements deemed essential by the stakeholders of NHI.

Organizational Needs

Focused interviews were conducted with selected university partners that have visited the villages that NHI serves, and with volunteers and staff members per the recommendation of NHIs Executive Director. Student volunteers were also personally contacted via phone and focused interviews were conducted via a group zoom session. These interviews focused on using first-hand observation, from previous visits with NHI, and recalling the patient interviews, structure, time, and resources used during patient care to help identify the key elements that would be needed for an EHR based system for NHI.

Population Needs

The communities that NHI visit suffer from a variety of acute and chronic illnesses including dental, GYN, psychological, cardiovascular, endocrine, respiratory, skin, musculoskeletal, digestive, ophthalmologic, and congenital problems. Without the dedication and commitment of NHI, these communities would not receive any form of healthcare needs. By utilizing the current NHI statistics collected from information obtained during previous patient interviews, a community assessment was generated to provide design elements essential for those communities.

Desired Outcomes

The primary outcomes for this project were to identify the key elements to include and design an effective EHR workflow that will facilitate efficiency in patient information & data collection that supports organizational needs. Developing a more efficient process for collecting data that can be analyzed by community, time, clinic, group, and diagnosis and will aid in the ability to capture the continuity of care and the impact that NHI has in each of the communities they serve.

Prepare

The third phase of the NHIs Mission System Development Process framework is to *prepare* by collaborating, using focused interviews and first-hand observations in the development of design elements for the NHI system. This phase was completed between the beginning of March and mid-April of 2022.

Collaborate

An introduction of the proposed plan to NHI and other stakeholders was necessary to inform and to clarify the purpose of this project. Coordinating with the NHI Executive Director on establishing the universities, staff, volunteers, and any other individuals that were willing to participate in focused interviews and collaborate on the development of this project occurred. An exchange of information with NHI staff to utilize current NHI statistical data to form workflow requirements was made, along with communication and engagement with IT professionals for input on workflow development and establishing a system that will function in limited access areas with the ability to upload information when access is available.

Focused Interviews

Focused interviews were completed utilizing Zoom/and via phone (based on content expert's availability) with NHI staff, volunteers, and partnered universities from the beginning of March to mid-April 2022, using structured interview guides (Appendices B & C) with targeted questions towards EHR elements and design to examine the most significant information necessary in NHI system design. The selected lead volunteers were identified by the Executive Director of NHI based on their content expertise in having experience providing services through NHI and their first-hand

observations of the elements that should be included in the EHR. Student volunteers were also personally contacted via phone and focused interviews were conducted via a group zoom session. These interviews asked the content experts for their opinions regarding the components of patient interviews and care (key elements to include) that should be captured in the point of care EHR and for recommendations on structure, time, and resources that should be considered in designing the EHR and workflow from their own experiences providing care in these communities that NHI serve. The interviews were conducted, and information obtained by the project director. A total of 14 individuals were interviewed, 3 staff members and 11 volunteers. Based on these focused interview questions, a development of EHR elements were formulated to fit the needs of NHI.

First-hand Observations

Contributing my own experiences and interactions from a study abroad global immersion experience in 2020 assisted in establishing workflow needs during development and conducting interviews with 4 other fellow colleagues (that experienced the same study abroad global immersion experience in 2020) utilizing the structured interview guide (Appendix C) on their first-hand observations during their study abroad global immersion identified unique perspectives on potential workflow design.

Data Collection

An assessment of current aggregate community level NHI data was included to assist with identifying priority needs of the populations served to identify key elements that should be included in the point of care EHR. NHI does not collect individual data, but instead, has aggregated anonymous data on indicators such as number of individuals seen in each clinic, and broad categories of problems (Cervical cancer screening,

hypertension, etc.). Only aggregate data, which is currently available through the NHI, was used to assist in identification of priority population health areas that should be included in the EHR. No health data on individuals was collected or used in this project.

Design

The final phase in NHIs Mission System Development Process framework was to *design* the elements necessary by clarifying the essentials that have been recognized by key stakeholders during the interview processes, first-hand observations, and by utilizing current NHI data to establish these components based the information obtained. Communication with IT professionals on workflow design considerations was also conducted. The final elements of the point of care EHR workflow design were determined based on the data required, essentials of day-to-day function, fit for the NHI organization, and the ability to monitor the health status of the communities that NHI serve.

Communicate

IT professionals were contacted in-person and via email to communicate workflow design considerations. This information assisted in determining the final design and workflow of EHR elements for the NHI organization.

Clarify

Determine that the elements and workflow design, which were established using the structured interview guides (Appendices B & C), are clarified with IT professionals to confirm that these are the essentials for an EHR based system for the NHI organization.

Essentials

The data elements found to be essential for the NHI organization to function on a day-to-day basis were established and this information will be useful in monitoring the health status of the communities that NHI visits annually. These essentials were finalized, and the components were established to design *The Mission System* for the NHI organization.

Establish Components

The final design and workflow of EHR elements were determined by establishing which programs are needed and will work (McGonigle & Mastrian, 2018) for NHI. The workflow design and elements developed for NHI will give this organization the ability to obtain the fundamentals necessary to track the health status of the individuals and communities that they serve.

Approval Processes

This project was approved by the NHI Executive Director. The University of Missouri – St. Louis Institutional Review Board reviewed the project and determined that it was a quality improvement activity not requiring IRB review.

Results

Demographics

The sample of participants utilized during the structured interviews included 14 individuals. These participants comprised a combination of volunteers and staff. There were 6 students that had previously experienced a study abroad global immersion with NHI, 3 professors from universities around the United States, 2 independent volunteers that have dedicated their services to NHI and other NGOs in Guatemala numerous times,

and 3 staff members from NHI. There were 4 male and 10 female participants. Their years of experience with NHI ranged from 1 – 12 years. There were 9 participants with 1 – 4 years of experience with NHI, 3 participants with 5 – 8 years of experience, and 2 participants with 9 – 12 years of experience. There were 7 participants who were affiliated with a graduate program, 1 affiliated with an undergraduate program, 1 participant who was affiliated with both undergraduate and graduate programs, and 5 participants who were not affiliated with a university. There were 5 participants who were able to speak Spanish and 9 who could not speak any Spanish. There were 11 participants who had used some type of EHR previously. Data for previous EHR use was not collected for the 3 staff members.

Interview Findings

A summary of the responses from the structured interview guides can be found in Tables 1 and 2 and are also summarized below.

Volunteer Interview Findings

There were 11 student, professor, and independent volunteers interviewed, all providing primary, pediatric, and woman's care in different clinics within villages and schools that NHI serves. Some of these volunteers were also part of a group that installed Chapina stoves in private homes in the villages. The average amount of patients seen daily were approximately 20 – 200 depending on the clinic or village. The average length of time spent with each patient was approximately 5 – 60 minutes and depended on the complexity, student comfortability, translation, and if they were caring for an individual or an entire family. Translators were necessary for most of the visits, even if the volunteer spoke Spanish, because many of the villages speak with multiple dialects. The

volunteers collected patient information verbally and with the paper forms provided by NHI. The biggest challenge collecting patient information was the language barrier. Other challenges were getting an accurate description of the patients' problems because many times the patient would describe multiple issues, having no past medical history or any information for any of the patients seen annually and having to start this process over each time, lack of knowledge diagnosing patients, lack of resources, time constraints, and difficulty with the flow of the paper forms.

All the volunteers that were interviewed agreed that an EHR system would benefit NHI, and this would allow the organization to be able to track patients and data over time, allow for easy access and storage of patient information, and overall better continuity of care. Benefits from former use of EHR systems gave volunteers ease of finding information, immediate access ability, tracking trends, and information storing. Some of the challenges with these systems were the flow of information, too many boxes or information to click on, difficulty in navigating, lack of communication with other systems, and slowing things down.

The elements/data that the volunteers would consider most important for an EHR based system for NHI would be something simple, bilingual, with the most important immediate needs addressed. These included the basics of any patient chart; demographics (village, date of birth, gender), vital signs, height, weight, allergies, medications, past medical history, surgeries, labs, referrals, follow-ups, immunizations, treatments, physical exam, cervical screenings, sexually transmitted infection (STI) history, pregnancies, imaging, a notes section for providers and translators, and the ability to upload a patients' picture for identification.

Although all the volunteers agreed that an EHR system would benefit NHI, some had concerns with the accessibility of patient information due to limited Wi-Fi, ability to scan documents, data safety, storage space, system updates, funding for laptops/iPads, and training for system use.

Table 1

Summary of Structured Interview Guide Responses from NHI Volunteers & Partnered Universities

Questions	Summary of Responses
Where did you provide care while with NHI?	Many different villages, schools, homes, & clinics
What type of care/assistance did you provide while working with NHI?	Assessments, full patient care, primary care visits, cervical cancer screening, well visits/woman's health clinics, pediatric care, installing stoves in homes, fluoride treatments, & teaching
How many patients did you see daily?	Depended on the clinic/village. Average patients seen daily ranged from 20 - 200
What was the average length of time with each patient?	The average range of time spent with each patient was between 5 – 60 minutes and depended on the clinic, if it was an individual or family, the complexity of the patient, student comfortability, and translation
Did you use translators during your visit?	Yes. Translators were also used when the respondent spoke Spanish because of the different dialects in each village/area served
How did you collect patient information?	Verbal/Paper forms
Did you experience any challenges with collecting patient information?	Language barrier was the biggest challenge. There are different communities that speak with multiple dialects. Getting an accurate description of the patient's problems or they would describe multiple problems. Paper forms did not flow well and not enough room for information. Lack of knowledge diagnosing patients. Limited resources. Relying a lot on assessments because could not get a good history. No previous history for any patients
How could NHI improve their collection of patient information/data?	Having an EMR or database to collect information and to have some continuity of care, past medical history, medications prescribed, patient background, family situation, and the ability to track each patient from visit to visit
Do you believe that an EHR/HIS would benefit NHI? Why or why not?	Yes. NHI visits the same villages annually. An EHR would provide the ability to monitor trends/data over time. Will save time compared to paper charting
Have you had any experience with any type of EHR/HIS? If so, what was your experience? Any challenges/benefits?	Yes – Most had experience with many different EHR/EMR systems Benefits – Instant information. Ability to see previous visits, history, treatments, labs, x-rays, and medication use. Ability to track trends. Information storing Challenges – Too much clicking. Some systems do not flow well. Difficult to navigate. Not able to communicate with other systems. Can slow things down
What elements/data would you consider to be the most important to include in an EHR/HIS?	Demographics, gender, race, height, weight, sex, history, labs, vital signs, physical exam, interventions, medications, surgeries, follow-ups, imaging, allergies, and a notes section
What elements/data should be included in an EHR/HIS for NHI?	The same elements/data from previous question. A simple system with only the most pertinent information. A system that is bilingual. Something that is easy to use and fast. Village or location where patient was seen. Prior visit information. Referrals, and follow-ups. Woman's health – pap smear history, cervical screenings, STI history and treatments, birth, and pregnancy history. Ability to upload information into the system (Papers from other providers/hospitals) A picture of the patient to upload into the system A system that can connect with other NGOs in the area

Staff Interview Findings

There were 3 staff members from NHI interviewed via phone and Zoom. These staff members comprised 3 of the 4 full-time employees of NHI. These staff members all agreed that an EHR based system would benefit their organization. Some of the main challenges for obtaining patient information currently is using paper forms that can be lost, retrieving accurate history and information from patients, lack of resources, lack of communication with referrals, and having no well-defined way to gather data or to prove that it is making a difference. The information is currently collected on paper forms and then placed in a google document on a google drive. The medications that are currently prescribed are written on a piece of paper and the data is also placed in the google doc on a google drive and the paper form is then filed. No patient identifiers are recorded in the google document.

The universities that normally volunteer with NHI are currently on hold because of Covid, but they have 10 solid relationships with universities. There are no government restrictions or safety concerns regarding the use of an EHR for NHI because it is a private organization. The average length of time with each patient depends per clinic and per activity. Nurse practitioner and group clinics average approximately 20 -60 minutes depending on individual or family visit. Diabetic patients average 5 – 10 minutes per patient, and woman's clinic visits average approximately 15 – 20 minutes per patient.

Some of the data/elements they would like to capture would be the complete package of all the general elements/data but basic with general data and bilingual. This will include the geographical location of where the patients are from, along with all the

basics, including age, gender, symptoms, diagnosis, vital signs, treatments, medications, and follow-ups.

These NHI staff members believes that an EHR system would benefit NHI dramatically and will allow for better control of diagnosis, prescriptions, monitoring, evaluation, collecting and analyzing data, guiding evaluation of operations, directing care and practices, allow for program design, specific needs per community, and an overall impact on how the organization operates. It will also allow for NHI to invest time and resources accurately and in areas that are most needed, time reduction, ability to see patients quickly and easily, reduce errors, and allow for ease of follow-up for patients.

NHI has no concerns for training on an EHR usability and believe it will just take practice. Concerns for EHR are Wi-Fi access and difficultly updating in the moment.

Table 2

Summary of Structured Interview Guide Responses from NHI Staff

Questions	Summary of Responses
What are some of the main challenges for obtaining patient data?	Not having an electronic system in place. Everything is manual/handwritten notes. No well-defined way to gather data or to prove that it is making a difference. Information has been lost due to using paper forms. Difficulty collecting patient information. Lack of resources. No communication after most of the referrals. Paper forms are difficult to read and do not provide much data. No individual patient data and only have a rough estimate of ages or ranges. Do not have a good data analysis or monitoring process for any of their programs. No WIFI in many of the areas that they serve
How do you currently track your patient's continuity of care?	Everything is placed in a google document on a google drive.
How do you currently track medications given/prescribed?	In the clinics they are written on a piece of paper, so any patient data that they have starts as a handwritten note and that data is placed in a google drive and the handwritten note is just filed
How would an EHR/HIS benefit the NHI organization?	Greatly. It will allow for better control of diagnoses and prescriptions, monitoring, and evaluation, collecting and analyzing data, and will help with guiding and evaluating operations because they will be able to see if patients are benefiting from their care. It would allow NHI to direct and guide their care and practices to villages and areas with conditions that are most common. It will have a huge overall impact on how the organization operates and for program design. It will assist in designing a program around specific needs per community and not just a one size fits all. Assist in time reduction and ease of follow-up. Allow quick and easy access to patient information, instead of flipping through hours of paperwork. Will reduce errors. Overall, it will make NHI more impactful and allow the organization to invest time and resources accurately and in areas that are most needed
What are your current/future goals for obtaining patient data through an EHR/HIS?	Same as previous question. Allow NHI to track data in each community that they serve. More accurate with treatments and the services needed in each individual community. Monitoring processes and tracking individual patient health over time
Are there any government restrictions/safety concerns regarding EHR/HIS development in your region?	No. It is a private organization, so no problem. Internet access is poor and will be difficult to update in the moment
What is the average length of time with each patient?	Depends on the patient and if an entire family visit. It also depends per clinic and per activity. NP clinics and group clinics approx. 20 min per patient. Diabetes patient approx. 5 – 10 min per patient. Woman's clinic approx. 15 – 20 min per patient. Average per patient is approx. 20 min
What data/elements would you like to capture?	Needs to be basic. Geographical location of where the patients are from. General data. Age, gender, symptoms, diagnosis, vital signs, treatments, follow-up. Really would like a complete package. Like for it to be bilingual
How many universities are currently associated with NHI? Volunteers? Current staff members?	10 solid relationships with universities. No current volunteers due to Covid. 4 current staff members
Do you have any concerns on training for EHR/HIS usability?	Not many. Will have to practice. It will need to be bilingual.

Discussion

All the participants agreed that an EHR system would benefit NHI. A few themes that were noticed during the structured interview guides included language barrier as one of the biggest challenges in collecting patient information, EHR would provide the ability to monitoring patient trends over time, the paper forms currently used are not easy to follow, bilingual, ability to use with limited or no Wi-Fi, and the system will need to be simple and easy to use.

Limitations

The questions formulated for the structured interview guides could have been formulated differently and more specific. Questions were added during the interviews that were not on the original interview guide. Some of the questions were not relevant to the overall purpose of this project. Other questions should have been written differently or combined. An IT perspective on questions asked would have proved beneficial when creating the structured interview guides. Other limitations included a small number of participants, limited IT expert consultation, and expertise on the subject.

Recommendations

An assessment of the key elements/data to include in NHIs future EHR based system have been compiled from the interviews with the volunteers and staff that have had first-hand experience in collecting patient information during their visits to the communities that NHI serve (Table 3).

Table 3

Key Elements/Data to Include from Interviews with NHI Staff & Volunteers

Data/Elements	
Name	Chief Complaint
DOB	Physical Exam
Age	Treatments
Gender	Cervical cancer screening
Community	Immunizations
Vital Signs	Pregnancies
Past Medical History	Diagnosis
Height	Referrals
Weight	Follow-ups
Medications	Notes section
Labs	Preferred language
Patient picture	Imaging

There will be limitations to what we can do in Guatemala due to their infrastructure including limited Wi-Fi availability and updating information on supported devices. Having a small, portable application that can record data and then upload to a database when available will be vital. The application will also need to be bilingual and have the ability to capture the vital information required for their exams and share that information into a report that can be accessed by the user application or via email. The user interface will be simple and built for mobile devices for users to capture and report data on. At this point we will not have customizable templating for reporting but will have a template for users to input pertinent information. To make this solution scalable we can build on the framework recommended and then add features including HL7, server redundancy, and a secure login. Table 4 includes the concerns and functionality needs from the interviews with NHI staff and volunteers.

Table 4

Concerns & Functionality Needs from Interviews with NHI Staff & Volunteers

Functionality Needs	Concerns
Simple to use Quick Bilingual Scanning of documents Uploading pictures Track trends	Wi-Fi access Funding Training Electronic device Updates Security Backup Storage space

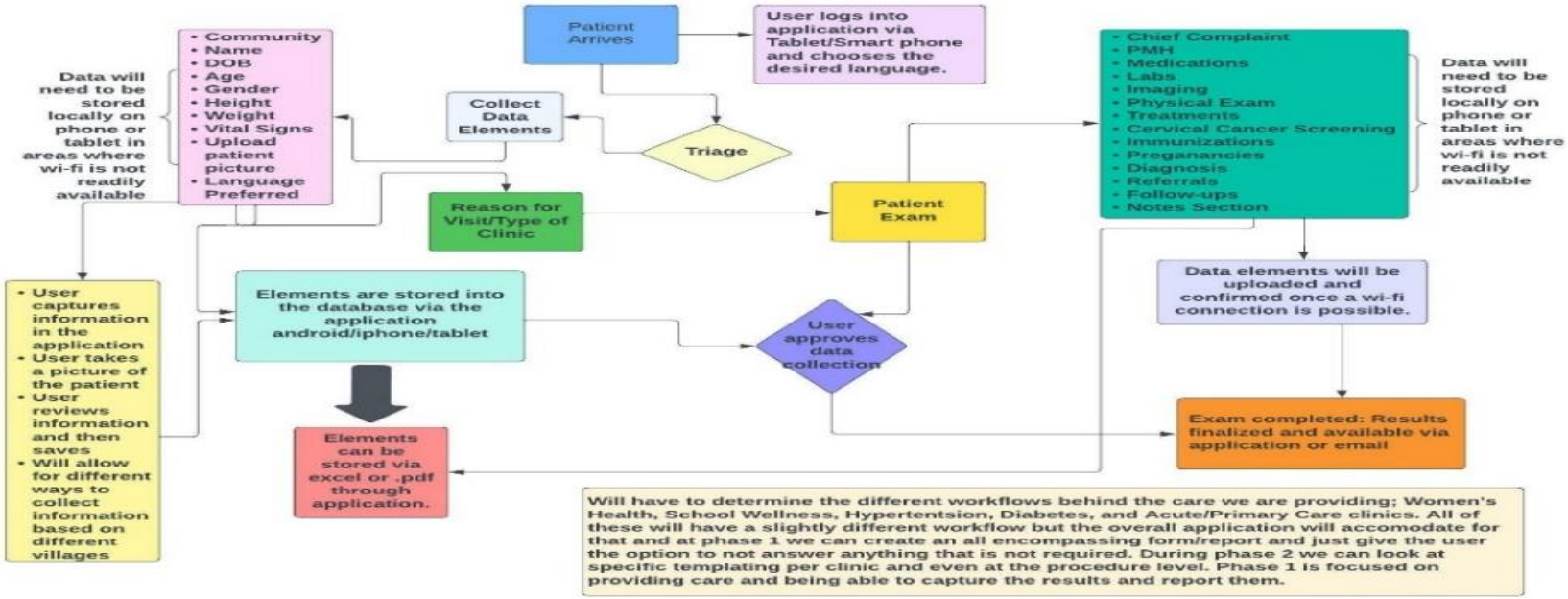
To accomplish these goals, we will need to develop an application to capture the following: username/password, preferred language, intakes required, vital information, examination performed, results captured, results finalized, results saved, and availability to anyone with access to the application and email. The email will have a .pdf attached of the order information and the results/interpretations. This plan will require application development as well as back-end server development to store and distribute information. But with products like Microsoft Azure and Amazon AWS (Cloud services), the cost of back-end infrastructure will be significantly reduced.

A patient database workflow was generated (Figure 2) to display the operation from the time the patient arrives to a clinic until the finalization of the patient exam. This information will be captured locally within the application due to lack of Wi-Fi access. When Wi-Fi is available, this data will then be uploaded into the server and will be available to any users with access to this application. After the patient arrives at the clinic, they will begin in a triage area, where the user will log into the application via Tablet/Smart phone and will choose the desired language from a drop-down menu. The

user will then collect the initial patient information including the community where the patient is from, patients name, date of birth, age, gender, height, weight, vital signs, the language preferred, and the user will be able to take a picture of the patient to upload into the system. The patient exam and assessment will be performed by the clinician and will include the data elements considered most important during the structured interviews with NHI volunteers and staff (Table 3). The elements will be stored into the database via the application or into an excel or .pdf if application is inaccessible. Field mapping will be used to ensure that the correct data elements are secured into the appropriate areas if using excel or .pdf. This information will be stored and uploaded upon access to Wi-Fi.

Figure 2

Patient Database Workflow



Created by Tawniece Curry & Paul McNamara (2022)

IT Summation:

The next step in the development of this project would be the identification of an IT contractor to work on the development of the application necessary for the EHR. With every development of any application, the first thing is to develop the scope of the project. This determines the man (person) hours and the cost of the project. This starts with the requirements necessary to make the project complete and associate hours to each requirement so that cost can be determined (Table 5).

Table 5

Example of Project Requirements

Requirement	Output	Hours
1: The application should be available on iPhone, Android, and Tablet platforms.	The application should be able to be installed on iPhone, Android, and Tablet platforms. This will also require registering the applications on the appropriate platforms that distribute this software. i.e., Apple App Store.	25 hours
2: The application needs to be bi-lingual, English, and Spanish.	Add a drop-down box at login to choose the language required. A language pack will be added to accommodate Spanish.	20 hours
3: Create a unique identifier to distinguish patients.	Use a number wheel in the application to automatically create a new number and associate them to the patient.	10 hours
4: Transport method for getting information into a simple database.	The user interface will be based on the "The Mission System" diagram. It will be stored locally until the user is near wi-fi and then they will have the ability to upload to the cloud.	20 hours
5: The application should have a storage system.	After looking at the storage options, Microsoft Azure is the best option at $152.57 a month. But there are other costs like licensing SQL, but that is a one-time cost.	5 hours

This does not contain all the requirements. There will need to be a fully vetted requirement document. Once that is in place and the hours are known, it will be possible to ascertain the projected costs for development of the application. Once a signed

requirements document and funding is in place, developers can be assigned to develop the application and that may require purchasing software for them to achieve that.

It is recommended that development for this project be “agile,” meaning that everything is assessed throughout the development process, and potential fixes are made along the way. This is opposed to the “waterfall” method of waiting to the end and potentially finding something wrong.

Development of a funding strategy would be required to proceed with IT development. Consideration should be given to philanthropic organizations with an interest in healthcare and international work as well as crowd funding or other fund-raising methods.

IT Summary

1. Create Requirements document
2. Determine monetary amount
3. Acquire financing
4. Acquire resources
5. Determine timeline
6. Conduct end testing prior to release
7. Register application and distribute
8. Train end users on the application

Conclusions

An EHR for NHI will have to be simple. and in such, will not contain a robust database or high-speed internet. It will require a system for creating a unique identifier,

input for creating demographics and orders (app, Excel). It will also require a transport method to get that information into a simple database, an interface or input to capture results (xml drop, Excel, Word), and a way to format the results (PDF, Word). This system will also require a storage method for future results and interpretation, and a way to transmit and access using a secure link or email login. Other considerations are for funding of an app or software, testing of system, and training. Further input on IT related concerns will be addressed with additional information from NHI.

This project offers insight on the data elements and concerns from the end user's perspective on EHR system development in an NGO in Guatemala. Establishing an EHR system for NHI will be challenging but can be accomplished. The primary conclusions were that participants agreed that an EHR system would benefit NHI and will provide the ability to monitor patient trends over time, but will need to be bilingual, with the ability to use in limited Wi-Fi areas. The data and elements desired were formulated from the structured interview guides (Appendices B &C) used during the interview process. An assessment data/elements and concerns and functionality of the EHR system (Tables 3 & 4) were also formulated during the interview process and IT considerations were mapped into a an EHR workflow (Figure 2) and project requirements (Table 5).

Summary

The workflow and elements designed for this project will allow for a more streamlined method in collecting individual and community data to assist the NHI with their continued efforts in guiding these communities to improved health. The information collected from this project may also serve as the basis for seeking funding to create the program that will be needed to implement an EHR for NHI.

Personal Message

My own personal experience, with NHI and the communities they serve, was one of the most enlightening and influential experiences of my life. I have never met such compassionate, exceptional, and completely humble people. The experience empowered me to continue serving these communities by assisting in creating components for an EHR system to support the needs of the organization and the communities they serve.

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Appendix A

Literature Review: Identifying the research on the challenges, benefits, and key elements necessary for implementing an EHR system at the point of care in undeveloped regions

CITATION	**PURPOSE / BACKGROUND**	**PARTICIPANTS / SETTING**	**METHODS / DESIGN**	**RESULTS / LIMITATIONS / RECOMMENDATIONS**
Author(s), Date, Title, Journal Information, doi	Purpose & Outcome Measures or Goals (Aims)	Sample & Setting	Study Design & Interventions	Results, Strengths/Weaknesses, Limitations, & Recommendations
Aldredge, N. H., Rodriguez, D., González, J., & Burt, D. R. (2020). A Case Study of a Point-of-Care Electronic Medical Record [SABER] in Totonicapán, Guatemala: Benefits, Challenges, and Future Directions. *Annals of Global Health*, *86*(1), 122. https://doi.org/10.5334/aogh.3041	Electronic medical records (EMRs) progress slowly in low-income countries but have been successful in many resource-limited countries To address the needs of a Totonicapán Hospital Emergency Department (ED), the University of Virginia-Guatemala Initiative (UVA-GI) developed and implemented a point of care EMR called SABER (Simple, Accesible, Básico, Electronic Record) in 2015 Evaluate the benefits of EMR implementation Identify challenges to the implementation of an EMR and ways to overcome them in this setting	Hospital Nacional José Felipe Flores (Totonicapán Hospital) in the western highlands of Guatemala Totonicapán is a city of 500,000 people 97% of the population identify as indigenous In 2014, 40% classified as living in extreme poverty, compared to national average of 23.4% Mortality rate by age 15 years is 13.5% Only 44.5% of the population reach age 65 years Totonicapán Hospital has approximately 94 beds The hospital cares for approximately 2,000 – 5,000 patients annually and employs 28 doctors The survey was administered in Spanish	Level IV – Case study Implementation of the SABER program conducted in multiple phases: 1,) Conducted a mixed methods needs assessment with physicians, medical students, & hospital administration to determine feasibility of an EMR system at Totonicapán Hospital 2.) Based on insight from previous research groups, an EMR SABER 1.0 was developed by two local Guatemalan UVA-GI programmers in 2015 3.) UVG-GI purchased a local Guatemalan internet connection for the program in the Totonicapán ED SABER collects data including: - Patient information - Triage - Initial evaluation - Review of systems - Physical exam - Evaluation - Plan Generates a PDF file based upon data entered the form Information collected consistent with requirements per Guatemalan Ministry of Health (GMH) A 5-point Likert survey was used to evaluate provider perceptions of the SABER EMR	26 out of 31 (84%) of medical students agree or strongly agree that the UVA-GI provided continuous and appropriate support to use SABER and 24 out of 31 (78%) agree or strongly agree that UVA-GI provided the training necessary to use SABER 4 out 6 (66%) of physicians agreed or strongly agreed that the support provided by UVA-GI for SABER was appropriate 30 of 32 (94%) of medical students and 6 out of 6 physicians said they would recommend the use of SABER to another healthcare provider Zero medical students or physicians reported on the survey that they were unsatisfied with the SABER system Positive aspects identified by staff included: - Ease of use - Quick data entry - Potential for large data set research Limitations: - Small sample size - Investigation did not include nurses or other healthcare personnel - Specific setting used Remaining challenges include:

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS / SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
		to 31 medical students on clinical rotations between fourth and sixth year and to six physicians in the Totonicapán ED (n = 37) respondents Physicians (n = 6) Male = 4 Female = 2 Medical students (n = 31) Male = 10 Female = 21	A 7-point survey was used to evaluate their self-reported proficiency with the program to distinguish differences among computer skills Participation was voluntary A series of four focus group interviews in Spanish were also conducted consisting of 4 – 6 individuals each of either physicians or medical students Focus group interviews conducted using a series of 10 scripted open-ended questions and lasted approximately 30 – 60 minutes	- Incorporating electronic nursing orders & lab results - Trouble-shooting technology problems (i.e., printer difficulties, lack of electronic signature capability, & lack of integration with the rest of the hospital) Research opportunities for future consideration that could improve quality of care and quality of data including: 1.) Expansion of SABER to include pharmacy data 2.) Increasing provider education with development of an online & in-person trouble-shooting handbook 3.) Integration with waiting room triage procedure 4.) Correlation of SABER metadata to patient outcomes 5.) Potential for mobile health expansion
Aliabadi, A., Sheikhtaheri, A., & Ansari, H. (2020). Electronic health record-based disease surveillance systems: A systematic literature review on challenges and solutions. *Journal of the American Medical Informatics Association: JAMIA*, *27*(12), 1977–1986. https://doi.org/10.1093/jamia/ocaa186	To review recent studies in the literature to identify challenges and solutions of implementing EHR-based disease surveillance systems EHRs can provide up-to-date, standard, and low-cost data for disease surveillance and are being developed in different countries but are still in their infancy	No specific Participants or setting A systematic review conducted as part of a PhD dissertation supported by Iran University of Medical Sciences with ethical approval granted by Iran University of Medical Sciences	Level I – Systematic Review Conducted review using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Review conducted on published articles in the literature up to October 31, 2019 Six electronic databases used to include: - Pro-Quest - PubMed - Web of Science - Cochrane Library - Embase - Scopus Unpublished studies including theses and the gray literature were also searched in Google Scholar and Google with the first 100 results included in the review	Identified 145 challenges and 130 solutions that were organized into 6 main themes: 1.) Policy and regulatory 2.) Technical 3.) Management 4.) Standardization 5.) Financial 6.) Data quality 99 unique subthemes (47 challenges and 52 solutions) - Challenges and solutions related to policy and regulations issues (14 challenges and 12 solutions) - Technical (8 challenges and 12 solutions) - Management (9 challenges and 11 solutions)

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS / SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
			References of the selected articles also reviewed, and authors of the selected articles were contacted for the full text of the articles when necessary Keywords Used: - Electronic health record - EHR - Surveillance systems - Registry system - Population health - Public health Inclusion Criteria: - Articles published in peer-reviewed journals and conferences - Articles published in the English language - Articles with available full text - Articles that discussed the proposed solutions or challenges Exclusion Criteria: - Publication type such as symposiums, posters, abstract-only articles - Papers unrelated to EHR-DS - Articles exclusively devoted to architectural design or technical aspects of EHR-DS and articles did not have sufficient information regarding the solutions or challenges Records identified through database searching (N = 16602) Web of Sciences: N = 2158 Embase: N = 4110 PubMed: N = 2759 Scopus: N = 4937 Cochrane: N = 249 ProQuest: N = 2389	Results indicate that due to the multiple challenges, implementation of EHR-DS is not low cost or easy to implement and requires a variety of interventions Most common challenges include: - The need to invest significant time & resources - The poor data quality in EHRs - Difficulty in analyzing, cleaning, & accessing unstructured data - Data privacy & security - Lack of interoperability standards Most common solutions: - Use of natural language processing & machine learning algorithms for unstructured data - Use of appropriate technical solutions for data retrieval, extraction, identification, & visualization - The collaboration of health & clinical departments to access the data - Standardizing EHR content for public health - Using a unique health identifier for individuals EHR systems could improve the quality of surveillance systems but the challenges facing the development and implementation need to be addressed appropriately

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			Records after duplicates removed (n = 8878) Records screened (n = 8878) Records were excluded based on title/abstract (Title n = 3124) (Abstract n = 5679) Full-Text articles assessed for eligibility (n = 75) Total included studies (n = 50)	
Kumar, M., & Mostafa, J. (2019). Research evidence on strategies enabling integration of electronic health records in the health care systems of low- and middle-income countries: A literature review. *The International Journal of Health Planning and Management*, *34*(2), e1016–e1025. https://doi.org/10.1002/hpm.2754	The integration of EHRs in the national health care system of low- and middle-income countries (LMICs) is vital for achieving the United Nations Sustainable Development Goal of ensuring healthy lives and promoting the well-being of all people but there is limited research evidence on successful integration strategies of national EHRs in LMICs. To fill this evidence gap, a literature review was conducted	No specific participants or setting A literature review conducted by Kumar, M., & Mostafa, J. with assistance from Health Sciences Librarian at UNC, InterAmerican Development Bank, Asian Development Bank, & the USAID-funded MEASURE Evaluation	Level V – Literature Review The Mendeley reference management system was used to organize and remove duplicate publications during the search A two-pronged strategy was adopted to conduct a comprehensive and focused literature search from November 10 to 15, 2018 Four databases used: - PubMed - Web of Science - SCOPUS - Global Health Search terms used: - Delivery of health care - Healthcare delivery - Healthcare system - Hospital - Electronic health record - Medical records system - Medical informatics - Personnel health record	Lack of evidence on strategies for integrating EHR systems Enough evidence on implementation challenges and relevance of EHRs to vertical disease programs The findings describe: - A narrow focus of EHR implementation - Prominence of vertical disease programs in EHR adoption - Testing of theoretical and conceptual models for EHR implementation and success - Strategies for EHR implementation Limitations: - Peer-reviewed publications written in English & indexed in scientific databases - Researchers from LMICs have limited access to high-impact and/or subscription-based journals

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			- Medical informatics - Hospital information system - EHR - EMR - PHR - Computerized medical record - Developing country - Developing countries - Low resource - Limited resource - Low resources Publications focused on strategies for integrating EHR in health care systems in LMICs were included for title and abstract screening All non-English-language papers and those describing the developed country context were excluded Search results: SCOPUS: N = 112 Web of Science N = 67 PubMed N = 157 Global Health N = 21 357 publications identified 14 publications recommended by expert & one from WHO website 372 references imported for screening 38 duplicates removed 334 studies screened using title & abstract 262 studies excluded 72 studies assessed for full-text eligibility 47 studies excluded 25 total studies included	- Some publications may have been missed after the electronic search was completed - A wide range of terms used in LMICs to refer to EHRs but difficult to capture in a search and meanings based on country context Integration of national EHRs in LMICs are difficult and unless evidence-based strategies are identified and applied

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Liang, L., Wiens, M. O., Lubega, P., Spillman, I., & Mugisha, S. (2018). A Locally Developed Electronic Health Platform in Uganda: Development and Implementation of Stre@mline. *JMIR Formative Research*, *2*(2), e20. https://doi.org/10.2196/formative.9658	EHRs are important in low-resource areas but there is a lack of affordable and practical EHR solutions Stre@mline is an EHR platform that was developed by Ugandan clinicians and engineers to improve the care of over 60,000 vulnerable patients in a rural region of Southwestern Uganda Describe the opportunities and challenges in EHR development and summarize the development and implementation of Stre@mline	Sub-Saharan Africa Kisiizi a rural region of Southwestern Uganda Kisiizi Hospital Currently 1.5 million people living with HIV/AIDS in Uganda and 79,000 new cases of active tuberculosis every year 50% of essential drugs not available at public hospitals Shortage of qualified health workers 0.12 physicians and 1.3 nurses per 1000 people One of the poorest countries in the world One-third of Ugandans living on less than $1.90 US per day A quantitative user survey conducted at Kisiizi Hospital 30 users identified to complete the survey In total, 28 users (6 doctors, 3 clinical officers, 6 nurses, 4 other health professionals, 6	Level IV – Quantitative user survey Quantitative user survey conducted at the Kisiizi Hospital by a master's student at the Mbarara University of Science and Technology, who is not affiliated with istreams Between January and June 2017 Paper-based survey Consisted of a set of 33 questions on usability and performance conducted at Kisiizi Hospital Users responded to each question through a Likert scale with the values strongly disagree, disagree, agree, and strongly agree Purposive sampling with 30 users identified and 28 users completed the survey Analysis of survey data performed primarily through descriptive statistics using Microsoft Excel	Results showed that users were generally very satisfied with the ease of use of Stre@mline 96% (27/28) finding Stre@mline easy to learn 100% (28/28) finding it easy to use 80% (8/20) agree that it allows them to see more patients in a day 100% (20/20) agree that it has improved decision making 96% of clinicians agree that it provides a better mechanism for drug availability 100% agree that it has led to safer and more reliable prescriptions Stre@mline platform has addressed many problems at the hospital: - Allowed physicians at Kisiizi Hospital to reliably access patients past medical records - Increased workflow efficiency - Increased trust in physicians by patients - Improved patient care - Improved resource planning Limitations: - Lack of data portability between different hospitals because of data stored on local area networks - Costs may prohibit small hospitals and clinics within Uganda and African countries - Need quantitative data on cost savings and patient safety Stre@mline has currently been implemented in 2 hospitals in

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		administrative staff, and 3 support staff) Partnership between istreams and Kisiizi Hospital initiated in 2013 and Stre@mline was developed by Ugandan software developers at a technology startup named istreams and a team of physicians from the Kisiizi Hospital, a non-for-profit hospital Development cost for Stre@mline was funded by a National Science & Technology improvement Grant (NSTIP) from Uganda National Council for Science & Technology (UNCST) and the Kisiizi Hospital		Southwestern Uganda and used for over 60,000 patients The system is being set up in 3 additional hospitals in the region Istreams hopes to expand the system in 50 hospitals in Uganda over the next few years Stre@mline could serve as a model for the development of future technologies in other countries
Maar, M. A., Beaudin, V., Yeates, K., Boesch, L., Liu, P., Madjedi, K., Perkins, N., Hua-Stewart, D., Beaudin, F., Wabano, M. J., & Tobe, S. W. (2019). Wise Practices for Cultural Safety in Electronic Health Research and Clinical Trials With Indigenous People: Secondary Analysis of a Randomized Clinical Trial. *Journal of Medical Internet Research, 21*(11), e14203. https://doi.org/10.2196/14203	Indigenous people are underrepresented in RCTs, and this lack of data can create new methods of therapy that could be extrapolated based on research with other populations which can involve eHealth implementation The information on indigenous communities with utilization of an eHealth or health app is scarce but the need for this research to develop these technologies is emerging and pivotal to its future in these communities Researchers must first understand the indigenous populations determinants	Data collected over a 5-year period in 6 culturally diverse indigenous communities in Canada The 6 First Nations communities: - Cree - Anishinabek (Odawa, Ojibwa, and Potawatomi) - Mi'kmaq These communities are in the remote northern rural locations of 3 Canadian provinces	Level I – Secondary analysis of a randomized clinical trial Analyzed survey responses and qualitative interview/focus groups data collected over 5 years in 6 culturally diverse indigenous communities in Canada during an evaluation of the clinical trial DREAM-GLOBAL Established themes for culturally safe approaches to research then developed practices for culturally safe research in eHealth research Over 5 years, the research team collected interview and focus group data	Based on the analysis, successful eHealth research with indigenous communities requires focus on cultural safety and includes: - Building a respectful relationship - Maintaining a respectful relationship - Good communication and support during the RCT from local team - Timely implementation support - Commitment to co-designing the innovations - Supporting local team task shifting

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	of health and include the harmful consequences of colonization and how this could affect the research process Given the lack of guidelines for conducting RCTs with these communities, an analysis of a large data set collected in the Diagnosing Hypertension-Engaging Action and Management in Getting Lower Blood Pressure in Indigenous -and Peoples and Low-and Middle-Income Countries (DREAM-GLOBAL) trial over a 5-year period was conducted The goal was to identify practices for culturally safe and collaborative eHealth and RCT research with indigenous communities	Trial participants identified as indigenous and as First Nations with legal Indian status A total of 34 interviews and 12 focus group discussions with a total of 142 participants held in 6 communities over a period of 5 years RCT completed December 2017	- Data collection began with community engagement work discussions establishing principles for research - Followed by formative research to develop intervention - And a process evaluation of the RCT implementation - Then exit interviews and focus groups were transcribed Field notes kept on informal discussions A participation satisfaction survey was also conducted A total of 34 interviews and 12 focus group discussions with a total of 142 participants held in 6 communities over the 5-year period	- Reflecting on mistakes and lessons learned and areas that may need improvement Limitations: - Limited to 6 First Nation communities Based on the data there were important cultural safety considerations in indigenous eHealth research Cultural safety in eHealth research is dependent on the themes from the analysis above
Merhi, M. I. (2015). A process model leading to successful implementation of electronic health record systems. *International Journal of Electronic Healthcare*, *8*(2–4), 185–201. https://doi.org/10.1504/IJEH.2015.075355	Implementing EHR systems is challenging for practitioners There are no studies that examined these challenges from an information systems perspective To achieve success in EHR implementation, this study presents a model with 4 primary goals 1.) Identify the factors that impact the implementation of EHR systems and present them into an integrated model 2.) Present a process model comprised of 3 major stages: pre-implementation, implementation, and post-implementation 3.) Validate the model using well-established theories: system development life	No specific Participants or setting	Level VII – a process model developed based on previous literature in EHR implementation This article proposes a process model of factors leading to successful implementation of an EHR system in 3 stages: - Pre-implementation - Implementation - Post-implementation Stages based on system development life cycle theory, general systems theory, and the contingency model and these theories are used to validate the model A quantitative tool based on maximized expected payoffs utilized to assess the model and demonstrate usefulness in practice Pre-implementation includes the preparation and assessment of the current state of the institution	Provides a practical model and process for successful implementation of an EHR system The model presents a systematic framework that incorporates many factors that influence EHR implementation Implementation of an EHR system is challenging and requires many resources, time, and effort but it is critical to achieve success in adopting an EHR throughout institutions

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	cycle theory, the general systems theory, and contingency theory 4.) Present an example demonstrating the model and how it can be measured and applied to practice This framework can be used for assessing the success of EHR implementation		- Implementation based on this assessment Pre-implementation consists of 2 elements: - Goal setting - Readiness assessment Implementation includes the decision makers deciding to start the project and consists of 3 categories: - Management - Human resources - Technology Post-implementation includes identifying whether they have achieved expected outcomes and includes monitoring and feedback	
Pazos Gutiérrez, P. (2015). Towards the Implementation of an openEHR-based Open Source EHR Platform (a vision paper). *Studies in Health Technology and Informatics*, *216*, 45–49.	EMR/EHR systems are currently being utilized in many places around the world but for some developing countries, they are expensive and inaccessible This article is about the vision and conception of a new kind of EHR system to understand the problem, create a solution, and validate this against a functional EHR platform This article explains the main elements of an EHR platform and how to minimize its cost for expanded use	No specific sample or setting	Level VII – a vision paper on the conception of a new kind of EHR system This article presents the core components of a proposed EHR platform and includes: - Design principles of the Open EHR platform - Knowledge management - Open EHR Platform architecture - Services - Customization and extension - Deployment - Developing applications - Validation of the proposed architecture	Creating an Open EHR Platform will enable e-Health development and EHR projects that may not be possible due to lack of resources New designs and tools will be developed and will be compatible with openEHR-based applications and other platforms This will allow for shared EHR systems in many regions
Shuaib, W., Suarez, J. M., Romero, J. D., Pamello, C. D., Alweis, R., Khan, A. A., Shah, S. R., Shahid, H., PierreCharles, S. B., & Sanchez, L. R. (2016). Transforming patient care by introducing an electronic medical records	EMRs have great potential of improving healthcare, quality of patient care, and practice efficiency but implementing an EMR can be a challenge Introducing an EMR into patient care for developed countries is a priority	6 towns in Bonao County of the Dominican Republic selected as investigation sites based on gender, age, and population distribution with 2 bordering local health stations (LHS) from each town	Level II - Pilot investigation of an intervention conducted to enhance EMR usage by rural physicians using randomized control 1 randomly given to an intervention group and the other to a control group	Experimental group: - % Of individual residents' records with complete basic personal information increased from 4 to 38% ($p < 0.05$) after intervention - % Of complete health examination records increased from 30 to 46% ($p < 0.05$)

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initiative in a developing country. *Health Informatics Journal*, 975–983. https://doi.org/10.1177/1460458215589204	but there are many challenges for the adoption in these regions In 2010, the Regional Health Commission (RHC) of Bonao County in the Dominican Republic started a countrywide EMR initiative to improve access, quality, cost-effectiveness, and collaboration Goal to establish EMR usage in 30% of rural medical facilities and in 50% of urban medical facilities by the end of 2012 with long-term goals of establishing cohesive, effective, and high-quality EMR systems in the region The main goal of this study was to define and assess the efficiency of a personalized intervention on village physicians use of EMRs in rural underprivileged communities	18 families' EMRs from each LHS selected by random sampling Family members (1385 residents at baseline and 1461 residents at follow-up) Survey conducted in October 2011 Final evaluation conducted in April 2012 Each LHS had at least 1 physician 7 male and 3 female physicians in both experimental and control groups Mean age of the physicians was 41.0 and 35.2 years 700 and 685 residents selected with average age of 36.9 and 36.8 years in both groups After experiment, 732 and 729 residents selected with mean age of 37,7 and 38.1 years No significant difference in gender between groups	Control group not subjected to intervention but observed simultaneously Structured on-site intervention provided to village physicians in the intervention group for 7 months Information on family members was gathered online using a structured data extraction form by investigators Data extraction sheet determined the entirety of the records in the EMR with the following information: - Personal health - Health examinations - Health education - Child health and immunization - Management of elderly - Basic clinic care Assessment of indicators based on integrity of the file records at time of last entry - If record was $\geq$ 75% complete, categorized as complete - If $\leq$ 74% categorized as partially complete - No information categorized as absent Pre-and post- use of EMR evaluated to assess whether on-site education, supervision, and technical support for individual needs had an impact and improve EMR use Analysis using R-free software for statistical computing and graphics Chi-square tests used to estimate differences of gender and age of physicians between experimental and control groups	- % Of complete health education records increased from 2 to 3% ($p < 0.05$) - % Of complete residents' medical records increased from 2 to 14.1% ($p < 0.05$) - % Of complete child vaccination records increased from 10 to 23% ($p = 0.05$) - Increase in completeness of records of health management of the elderly patient population (0% - 31%, $p = <0.05$) Control group: - % Of individual residents' records with complete basic personal information with small change (0% - 1%, $p = 0.015$) - % Of complete health examination records increased from 15 to 37% ($p < 0.05$) - No complete health education records before or after the intervention - % Of complete residents' medical records with no significant change (10% - 15%, $p = 0.298$) - % Of complete child vaccination records with no observed change (21% - 18%, $p = 0.712$) - % Of completeness of records of health management of the elderly patient population (0% - 41%, $p = <0.05$) before and after the intervention Limitations: - Small sample size - Not all participants willing to share information

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			Mann-Whitney U tests used to evaluate difference in completeness of public and basic health records Significance level of $\alpha = 0.05$ used for all comparisons	- Relying on an online access control system is limiting Would be ideal to include needs assessment and education and training for the workforce The intervention led to improved public health and basic clinic records and increase village physicians use of EMR in their practice The investigation also demonstrated education, supervision, and technical support improves the use of EMR
Uc, B. M., Castillo-Sánchez, G., Marques, G., Arambarri, J., & de la Torre-Díez, I. (2020). An Experience of Electronic Health Records Implementation in a Mexican Region. *Journal of Medical Systems*, *44*(6), 1–8. https://doi.org/10.1007/s10916-020-01575-w	EHR implementation promotes the progress of healthcare in many areas This article presents the components that are integrated into the EHR system to produce a complete system: - Hardware - Software - Telecommunications - Medical equipment EHR implementation will contribute to healthcare expansion in areas of difficult access to medical care This article's main purpose is to state the results of the EHR system implementation in Mexico	Rural area of Campeche. Mexico 105 medical units in the State of Campeche Most common diseases treated in this region are hypertension and diabetes Total of 122 people trained	Level IV – Implementation of an EHR system in Mexico The EHR implemented in a total of 20 units of the municipality of Campeche (18 units) and the municipality of Tenabo (2 units) These units are distributed between health centers, hospitals, high specialty units, and will be incorporated into 7 mobile units The second stage the rest of the units of the sanitary jurisdiction 1(37 units) are distributed in the municipalities of Calkini, Champoton, Hecelchakan In the third stage, the EHR will implemented throughout the rest of the state The EHR implementation based on the Project Management Method (PMM) Implementation consists of acquisition and installation of computer equipment and software to conduct integration of the EHR	Total number of consults increased from 2012 (14021) to 2019 (34751) The number increases from 2012 (14021) to 2013 (50334) Decrease in 2014 (43289) and increases up to 2018 (64931) In 2019 the total number of consults decreased to 34,751 Most significant numbers reported from 2012 to 2013 The most relevant decrease reported in 2018 to 2019 Most treated diseases in this region are hypertension (17632) and diabetes (13156) Best results obtained in nutrition (20.61%) and clinical psychology services (16.67% Worst levels in pediatric and surgical oncology 1.59% and 1.97%

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				The EHR allows for generation of reports automatically to improve information control Limitations: - The software company is now currently bankrupt and the EHR system was abandoned - System cannot be updated to comply with current regulations When implementing new technology, it must be modified with the flow of the patient care process and how health services are provided to improve care The EHR implementation in Mexico offered a relevant dataset to promote efficiency in the decision making in healthcare management and this implementation is critical to support and promote public health
Wilkinson, S., Borycki, E., & Kushniruk, A. (2020). Best practices for EHR implementation: A BC First Nations community's experience. *Healthcare Management Forum*, *33*(1), 39–46. https://doi.org/10.1177/0840470419860863	To validate the best practices EHR Implementation Framework (EHRIF) in implementation of a British Columbia (BC) First Nation (FN) community and answer the questions: - Which success factors were present and missing in the pre-implementation and implementation? phases - How do the team members rate the importance of the success factors in the implementation? The indigenous people of Canada have experienced disproportionate burden of poor health and there are significant gaps in health data availability	FN community territory is adjacent to two cities with populations 33,000 and 9,000 Most of the FN community's 1,000 members live within 4 km of the larger city The FN health team consists of 8 part-time staff and 1 health director Health services focused on: - Home care - Child - Family	Level IV – retrospective, mixed methods study conducted to identify success factors in an EMR implementation at an FN Health Centre in BC, Canada Participants provided written consent to participate Participants completed: - A demographic questionnaire - Success factor importance questionnaire - A telephone interview with semi-structured & open-ended questions Participants asked open-ended questions to identify the presence or absence of success factors from the pre-	14 of the 17 success factors from EHRIF were present and rated as important in this EMR implementation A Likert scale used with 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree) Success factors rated: - Governance - Project leadership - Involving stakeholders - Choosing software - Selling benefits - Data preload and integration - Early planning - Privacy and confidentiality - Technology usability factors - Workflow redesign

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	Lack of clear government accountability of healthcare services for indigenous people in Canada and has resulted in a disconnected system The best practices EHRIF was developed to promote success in information system implementation by integration of many well-established information system implementation theories from information technology, business, and organizational development literature The First Nations Health Governance Centre was formed in 2010 to support the development of information governance at the community level to improve the health and wellness of FN people in 634 communities in Canada The BC First Nations Health Council and First Nations Health Directors Association identified the need for EMR implementation to assist in FN reporting, access to services, and address issues of fragmented health records and are working with the BC Ministry of Health and Regional Health Authorities in 198 FN communities in BC	- Youth - Chronic disease - Substance use - Crisis intervention - Communicable disease Study used purposive and snowball sampling to recruit participants who participated in the planning or implementation of the EMR Ethics approval granted by the University of Victoria's Human Research Ethics Board 6 participants represented 5/7 groups involved in the EMR implementation 6 participants were female Most of the participants reported using an EMR and experience varied from less than 1 year to more than 5	implementation and implementation phases of the EHRIF Data collection began 8 months after the EHR go-live date to promote good participant recall Data analyzed using descriptive statistics Audio data and notes from participant interviews were transcribed electronically and coded using the EHRIF success factors to identify the presence or absence of each success factor	- Implementation assistance - Training - Feedback and dialogue - Incentives Limitations: - Participants may have had different perspectives on what constituted a successful EMR implementation - Governing leadership was not represented in the study participant group - Key perspectives may be missing - Researcher bias may have been introduced into the findings because the audiotapes and notes were transcribed and coded by a single individual The study found that EHRIF was valid in EMR implementation in a FN community and that privacy and confidentiality issues are critical in EMR implementation to proceed and collaboration of multiple parties is necessary for EMR implementation to occur

Appendix B

Structured Interview Guide: NHI Staff Specific Questions

Date:	Name:	Title:	Roles/Responsibilities:	# yrs. w/NHI:

Questions	**Responses**
What are some main challenges for obtaining patient data?	
How do you currently track your patient's continuity of care?	
How do you currently track medications given/prescribed?	
How would an EHR/HIS benefit the NHI organization?	
What are your current/future goals for obtaining patient data through an EHR/HIS?	
Are there any government restrictions/safety concerns regarding EHR/HIS development in your region?	
What is the average length of time with each patient?	
What data/elements would you like to capture?	
How many universities are currently associated with NHI? Volunteers? Current staff members?	
Do you have any concerns on training for EHR/HIS usability?	

Appendix C

Structured Interview Guide: NHI Volunteers & Partnered Universities

Date:	Name:	Volunteer/University:	# yrs. Exp. w/NHI:
Questions		**Responses**	
What is your current/past experience with NHI?			
Are/were you a student/or teacher? Undergraduate/or Graduate program?			
Where did you provide care while with NHI? (i.e., villages, clinics, schools, hospitals, homes, etc.)			
What type of care/assistance did/do you provide while working with NHI?			
How many patients did/do you see daily?			
What is/was the average length of time with each patient?			
Did/do you use translators during your visit?			
How did/do you collect patient information?			
Did/do you experience any challenges with collecting patient information?			
How could NHI improve their collection of patient information/data?			
Do you believe that an EHR/HIS would benefit NHI? Why or why not?			
Have you had/have any experience with any type of EHR/HIS? If so, what is/was your experience? Any challenges/benefits?			
What elements/data would you consider to be the most important to include in an EHR/HIS?			
What elements/data should be included in an EHR/HIS for NHI?			