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RESEARCH ARTICLE

A STRATEGIC PLAN FOR THE IMPLEMENTATION OF A COMPUTER- ASSISTED HISTORY-TAKING SYSTEM (CAHTS) IN RURAL INDIA

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ABSTRACT

Like many remote areas in the world, the Indian rural population suffers huge disparities and lack of healthcare services, which led to the development of a novel system by Intel health called HxGuide. This paper focuses on assessing HxGuide to serve its mission to minimize the gap in healthcare delivery. The paper consists of a strategic plan with clear identification of internal and external inputs. The plan starts with a description of the target population and the Indian Healthcare system. Like many health care systems, many stakeholders involved in the delivery of health services. The list of stakeholders chosen the ones engaged in the implementation of the system, e.g., community health workers (CHWs), physicians, and Intel health team members. Then, a SWOT (strengths, weaknesses, opportunities, threats) analysis listed, followed by describing the strategic challenges, advantages, success factors, and strategic opportunities for the system. Finally, the paper concludes with a description of some challenges, and the strategy mitigates blind spots. The paper urges a number of steps that could benefit the implementation of the system, including privacy and interoperability sections. These advantageous strategic plans, however, may not be so significant as developing a system that is engaging the communities to build and sustain the system. Subject Area: Digital health (Public health) Keywords: digital health, mHealth, CHATS, computer assisted history taking system.

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INTRODUCTION

This capstone article is about Intelhealth's product HxGuide, which is a digital health system that provides mainly task-shifting of history-taking to provide better health coverage in rural India. The capstone tackles an opportunity to develop a strategic plan for the implementation of the computer-assisted history-taking system (CAHTS) they have developed. Since the project set to extend to other areas in need of such systems, it is necessary to understand the strengths and weakness obtained from this guide to increase the chances of implementation success. ("Products— Intelhealth," n.d.). The term digital health is used now by the WHO to describe the use of digital technologies for health. Digital health defined as: "The use of information and communications technology in support of health and health-related fields". (Agarwal *et al.*, 2016) and a subset of digital health is the mHealth, which can be defined as "the use of mobile wireless technologies for health". (Agarwal *et al.*, 2016) Recently, the term digital health is employed to encompass more recent technologies like big data, artificial intelligence, in addition to mHealth and eHealth.

The theoretical frameworks used in this paper applies several coursework materials from JHSPH and the Johns Hopkins School of Medicine to understand the current plans of an organization and how to improve them. (Olig, 2018) They also include frameworks for understanding clinical decision support types and algorithms. (Lehmann, 2018)

Environmental Scan

The Indian Healthcare System: The Intelhealth organization is grounded in the umbrella of the Indian healthcare system. India has a blended healthcare system, including public and private sectors. In rural regions, the public healthcare infrastructure was created as a three levels system centered on population norms. Fig. 1 summarizes the delivery system for health care and the suggested implementation of Human Resources for Health (HRH) at various levels. ((HLEG), 2011)

Sub -Health Centers (SHCs): These are the first point of contact between the community and the healthcare system. At least one auxiliary nurse midwife operates it, female health worker and one male health worker and services here are provided for maternal and child health, family welfare, nutrition, and immunization. (Chokshi *et al.*, 2016).

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Fig.1 Norms at primary, secondary, and tertiary levels of the Indian healthcare system ((HLEG), 2011)

Primary Health Centers (PHCs): These centers serve as the first contact point between the village community and the medical officer. Primary health centers were designed to deliver services for the cure and prevention of diseases. It's the first place of touch between the villagers and the medical staff. PHC's operations require promoting health care and curative facilities. (Chokshi *et al.*, 2016)

Community Health Centers (CHCs): CHCs operate on doctors in different specialties, dentistry, and several paramedical practices. It acts as a referral center for PHCs and offers facilities for obstetric surgeries and expert consultations. (Chokshi *et al.*, 2016)

Access to healthcare in rural regions is far from satisfactory. In December 2017, the World Bank and the WHO published a global report on tracking universal health coverage (UHC). It demonstrates that at least a quarter of the world's 7.3 billion individuals do not obtain all the essential health services that they need. This study examines how many individuals worldwide neglect access to crucial health facilities and how many are driven into poverty or spend too much of their household budget on health service expenditures. ("WHO Tracking universal health coverage (UHC)," 2019). The well-known problem addressed is the lack of standardization of delivery of health services across rural India, despite government initiatives like the National Rural Health Mission movement launched in 2005. Besides, only 68% of people in rural areas were able to access out-patient facilities, and 37% were able to access health facilities within a 5 km distance. (Kasthuri, 2018). Furthermore, the quality of services at these remote areas is a concern. Some studies revealed that peripheral PCPs lack essential facilities and equipment like beds, electricity, and clean drinking water. (Kasthuri, 2018)

Intelehealth: Intelehealth is a not-for-profit social organization that was founded for the developing, deployment, and management of the Intelehealth platform. The organization started out as a project by graduate students at the Center for Bioengineering Innovation and Design (CBID).

CHATS (HxGuide): The innovative product from Intelehealth (HxGuide) depends on the digital transition. Moving from paper-based to digital system to provide health services relieves a lot on the clerical load from the CHWs. Also, the

digital transition is essential for the continuum of care, and to keep track of patients, facilities, and staff. A lot of countries saw the opportunity in the digital transition and developed a national information system that captures and analyzes data to formulate better policies and outcomes. (Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013). Primary care providers rely on the information provided by patients to make a diagnosis and plan treatment. The interview process yields information to help the physician identify the cause of their medical problems. HxGuide is a digital system that performs history taking used in primary healthcare in low-income countries. Using the system, clinical data is entered in a mobile device by the CHW or nurse to share with other healthcare providers the data of the patients. Data entered includes the patient's history, family history, and medical history allows for the accurate collection of patient data and acts as a starting point for the doctor/patient consultation.

HxGuide falls into the "Client health records" (WHO, 2018) interventions category, and classified as a structured clinical records system that "capture, store, access and share health information on a client or grouping of clients." (WHO, 2012) The system utilized an android device to capture patients' information through a structured survey, then communicate the data collected to an Open Medical Record System (OpenMRS) where the doctor can access the data collected in a web application user interface (UI) as shown in Fig 2.

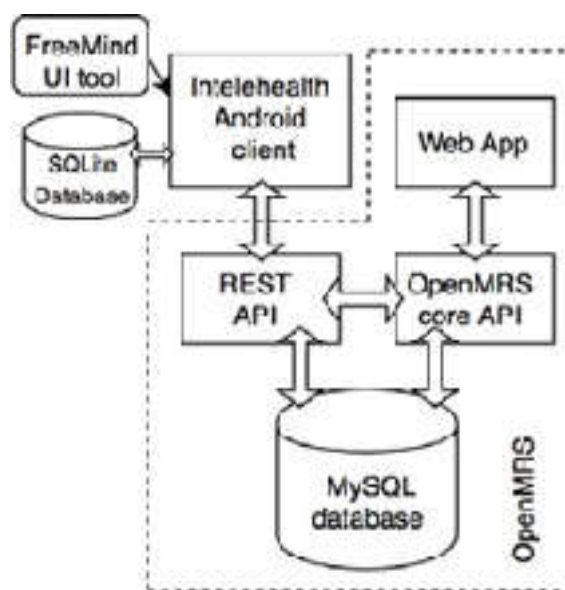


Fig.2 Intelehealth architecture diagram (Goel, Alam, Eggert, & Acharya, 2017)

HxGuide is delivered through a touch screen mobile or tablet interface and gathers information regarding the patient's history of presenting illness, family history, past medical history. When used by a trained CHW, it also encompasses the ability to guide the CHW to perform simple clinical examinations and record the findings.

Problem Statement: The healthcare delivery in the rural areas of developing countries like India faces a lot of challenges; due to geographic hurdles, inadequate resources, and poor quality of consultations. The mean duration for a primary care consultation in India is about 1.5-2.3-minute (Irving *et al.*, 2017), and in quality of information gathered from the patient history taking in comparison to a standard essential checking-

list range from only 16-22 percent (Das, Holla, Mohpal, & Muralidharan, 2016), which creates a huge problem in healthcare delivery, especially with the disparities of care toward communities in rural areas. (Barik & Thorat, 2015)

Goals: To improve healthcare access and quality of care delivered in rural regions of India.

Objectives

To ensure that at least 80% of the essential history taking checklist are met during PHC consultations in rural regions in India by the end of the third year. A Theory of change diagram presents a more comprehensive understanding of the processes of change and mapping the assumptions for the planned intervention linking the inputs, objectives to the desired goal illustrated in Fig. 3. (Breuer, Lee, De Silva, & Lund, 2016)

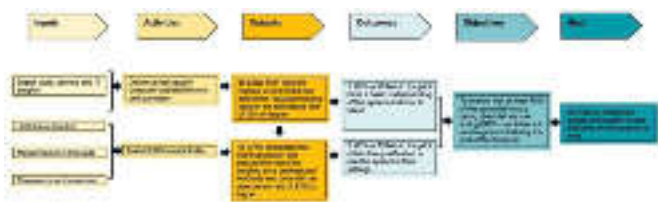


Fig.3 HxGuide Theory of Change (ToC) Diagram

Internal and External Inputs: Strategic planning establishes a direction for solving a problem or is used to achieve the desired goal. (Bryson, Edwards, & Van Slyke, 2018) The first step in strategic planning is to gather the information needed to understand and identify the future direction of the organization. The strategic plan is a coordinated and systematic process used to guide the primary healthcare organization in creating an action plan to support the implementation of the system. (Bryson *et al.*, 2018) The first step in the strategic plan is to identify internal and external inputs. The internal factors that led to the HxGuide exploitation of existing market opportunities include: the team uses technological capacity that already can be applied in any distant settings to deliver the system with the help of their knowledgeable and skilled staff. It also includes IntelHealth's resources, performance, and leadership.

For HxGuide, the system has many internal inputs that contribute to system sustainability and ability to deliver, high-quality rural primary healthcare. (Goel *et al.*, 2017) The organization's strategic actions and planning approaches are internal inputs along with external inputs include the regulatory and policy requirements, locally available healthcare for the rural population, local control of health resources, high levels of community satisfaction, and the application of new technologies and communication developments.

Stakeholder Analysis: The stakeholder analysis is a method used to identify and assess the influence of key people in the healthcare organization that will have an impact on the implementation of the new history digital system (Friedman & Miles, 2006). To successfully implement the system in the healthcare environment, stakeholders must be on board. In the case of the implementation of the new system, stakeholders include CHWs, HxGuide team, management, nurse leaders, physicians/nursing staff, and patients.

The analysis engages stakeholder in the decision-making process (Malfait, Van Hecke, Hellings, De Bodt, & Eeckloo, 2017).

To implement the system, stakeholders include the administration of the healthcare facility. The administration is responsible for conduct a cost/benefit analysis to determine the benefits of implementing the system. The leadership will make a final decision over its use in the clinical environment after reviewing all the available data. The leadership will also be responsible for supporting the implementation of the strategic plan. The management will actively monitor the implementation and application of the system and train staff on its use. They will be responsible for creating and leading the implementation and training team. Physicians and CHWs will be responsible for learning and applying the assisted history clinical system for patients. A champion or a nurse leader will educate and train staff on the use of the system. Finally, the HxGuide team will be responsible for leading the change. A change model will be implemented to guide the change. This includes evaluating the assisted history digital system for its effectiveness.

SWOT Analysis

Strengths <ul style="list-style-type: none"> Physical Assets Special features and tools Highly qualified staff Application of up to date technology 	Weaknesses <ul style="list-style-type: none"> Sources of funds and business model Functional experts Relies on CHWs reporting
Opportunities <ul style="list-style-type: none"> Lack of well-established competitive systems in the market Greater improvements in patient safety and better health outcomes Smoothen task-shift process Availability of telecommunication technologies Big Data and Clinical Research High out-of-pocket expenditures 	Threats <ul style="list-style-type: none"> Regulatory requirements New technological developments Acceptance of new technology by CHWs and doctors

The HxGuide system opportunity to exploit the market is characterized by strengths, weaknesses, opportunities, and threats. The system provides personal navigation easily understood by the user and conveniently deliver the required results. The history-taking system utilizes the latest technology in its design that offers skills and competency in digital history taking. The system also provides a provider-user communication platform to present views and results. Vast exploitable opportunities are present such as reduced competition from competitors due to their old technology application in their systems. (Van Wijngaarden, Scholten, & Van Wijk, 2012). The system's weaknesses encompass lack of a transparent business model. Though the team is passionate about the success, they face functional advisory challenges on strategy implementation. The system based on well-trained CHW reporting assuming that health staff had adequate experience. The threats include obtaining the required regulatory requirements. The policy guarding health system is likely to change in the future and will adversely affect the system full goals realization. The incorporation of internal inputs will cover up the inexperienced stakeholder's weaknesses by learning new business ideas to establish the

HxGuide market position. (Van Wijngaarden *et al.*, 2012) The external inputs will utilize the critical competitor's strategies to overcome an unhealthy competitor's competition.

Limitations for delivery at scale: In rural and distant regions, many CHWs are facing logistical difficulties with digital health systems, including bad communication networks and access to power or paying their mobile phones bills. In some cases, bad communication leads to unhappy customers, as it generates delays to receive services. Health workers want user-friendly, secure, and continuing technical support platform. However, CHWs often report problems of usability and interoperability problems with other digital devices. Although digital health interventions can be crucial to the current healthcare systems, many modifications are required and challenging to accomplish. Health workers may face several issues with user-interface or the system itself— for example, the language, terminology, incorrect local language, tiny displays, and programming limitations. While it is essential to involve CHWs and the customers to participate in the design, preparation, and execution of the digital system, this is not always achieved. Health professionals can be unhappy with digital health if technological modifications are implemented too quickly or their technical requirements are not fulfilled.

Some stakeholders are also worried about medical information privacy and data security. Health care workers can try, particularly in the case of stigmatized circumstances such as sexually transmitted diseases like HIV/AIDS, to safeguard customer data by using digital health encryption and precautions. It can also be challenging to educate the residents in areas with poor fundamental literacy or digital literacy for informed consent and privacy issues. For CHWs adoption, training is essential. While some health employees encounter difficulty knowing and using digital healthcare systems, CHWs and trainers believe that these obstacles can be tackled by training and knowledge. Supporting supervision is also considered essential for the acceptance of the acceptance and the use of the digital system. Digital systems can enable the tracking of CHWs activities, and that can change the way CHWs operate and render their job. It may be beneficial by some health workers but can leave other health care workers with the feeling that they are under constant supervision. Strategic Challenges, Strategic Advantages, Success Factors, and Strategic Opportunity(s)

Strategic challenges: Strategic challenges make-up the external pressures facing the organization. These externally driven challenges affect the organization's future competitive position (Haycock, Cheadle, & Spence Bluestone, 2012). Maintaining a strategic advantage is key to the success of the new assisted history digital system. One challenge is internal expertise. The system will need someone skilled at using the system to train the rest of the users. Functional experts will be required to support the implementation of the new assisted history taking digital system. Another strategic challenge is the creation of consistent language across medical providers to support the successful implementation of the system. Strategic challenges can make it difficult to meet strategic goals. Opportunities and advantages can help address these challenges.

Interoperability: One of the main challenges facing the new system is the ability to communicate with other national and international systems. To the moment, the system has not

adopted any standards in use. The lack of standards use can generate difficulties in analyzing the data or using existing Electronic Health Records (EHRs) records. Also, when Collaboration with other NGOs or governmental organizations, the system has to provide the ability to produce the most reliable data. As suggested in many digital health frameworks, a clear definition of the standard to use is crucial. Interoperability defined as the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged to optimize the health of individuals and populations. (HIMSS, 2018) Interoperability is facilitated by the use of common standards, like the examples shown in Table 1.

Table 1. Common data standards (Aid, 2013)

TYPE OF STANDARD	DESCRIPTION
HL7 (Health Level 7) particularly clinical data ICD-10 (International Classification of Diseases and Related Health Problems)	Interoperability standards that facilitate the exchange of health data. A medical classification list published by WHO and used worldwide as a diagnostic tool and for epidemiologic and health management purposes. A comprehensive collection of clinical terms that provides the basic terminology for electronic health records.
SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms) INN (International Nonproprietary Name) identify pharmaceutical substances and ingredients ISO (International Organization for Standardization)	A set of generic names designated by WHO to An independent entity that publishes worldwide industry standards, including classifications of technology and medical devices.

Fast Healthcare Interoperability Resources (FHIR): Another standard aimed at mHealth systems that can lead to greater interoperability is FHIR, which was created as a web-based, using XLM documents, JSON. This new specification is aimed to make the implementation of the HL7 interoperability standards easier and compatible with mobile standards. (HL7.org, 2018)

Privacy, Confidentiality, Security: Current privacy procedures state that only the members of the study team will have access to the Google Drive folder with the survey data. Using Google drive is not as private as using a local cloud system. Using local private cloud storage can help in securing the data and adhere to a more recognized privacy measure. As for confidentiality, team members will be accountable for information compilation.

Upon closure of information compilation, the participants of the study will be de-identified by removing the name of the patient with a numeric code, and the initial connections between the respondent and the number will be removed. Deleting connections can create a problem for incoming patients who needs follow-ups, blindness can generate on different levels, and only limited members can access the names and information of the patient with a log recording all activities to be used in the case of any data breach. One of the security toolkits that can be used was developed by the Healthcare Information and Management Systems Society (HIMSS), which consist of a comprehensive toolkit that target organizations to deploy in any mobile system. The tool covers all steps of development, including strategy, design, implementation, and support to ensure security and control of data. (HIMSS, 2012)

Strategic advantages: Strategic advantages are the benefits in the market, influencing the decision-making of the organization or the Ministry of Health in India. (Speziale,

2015) To implement the system, the MOH or the private organizations must see the benefits it can provide. For one, the system will simplify the collection of the patient history, empowering the organization to achieve better outcomes to meet with international organizations' goals, and succeeding in more effective patient-doctor consultations. When patients have diagnosed accurately in a more time-efficient process, it reduces healthcare costs. The healthcare system represented by the Indian MOH also has the core competencies to support the implementation of the system. While functional experts are needed, the system is simple enough to allow the CHWs to gain the skills and knowledge to use it, so they will have little trouble adopting the new technology with proper training. When an organization understands its strategic advantages, they can use them to mitigate the challenges.

Success factors: Success factors are the accomplishments of the strategic plan. A successful strategic plan engages the stakeholders, provides insight into challenges, advantages, and opportunities (Esfahani, Mosadeghrad, & Akbarisari, 2018). Effective communication is another success factor. The plan should be communicated to all stakeholders to ensure their support and broaden their knowledge. Lastly, is the application of innovation. By using the system, doctors and patient satisfactory level will increase by improving access to a higher quality, affordable healthcare services. Connecting every patient in rural areas to a digital system to monitor the diagnosis and treatment plan. The new system offers many strategic opportunities for the healthcare organization. A smoother task-shift process will assist healthcare providers in transitioning the care of the patient resulting in more efficient consultations by doctors and a more accurate diagnosis. It will also result in greater patient safety and better quality.

Budget Narrative

- It is anticipated that the following staffing will be needed to accomplish the goals and objectives of the plan.
- Since the headquarter of Intelhealth in Baltimore, Maryland, a fulltime manager, and an assistant to be in charge of the management and leadership.
- A country team will be formed to be in charge of onsite activities. The team consist of a master trainer and a champion.
- **Specialists**
- Two experts will be needed. One to evaluate the training curriculum and the other to conduct the validity of the system study.
- Three programmers are hired to support the system.
- **Transportation**
- Experts and the local team will be issued travel tickets in a round trip from Baltimore, MD. All other fees of visas will be included.
- Public transportation from the airport to the health facilities.
- **Training**
- Any cost related toward venues, materials to conduct training sessions for CHWs.
- **Equipment and Communication**
- Cloud-Based system installation will be needed to be installed in India and obtaining the right to access the system at the headquarter.
- Cell phone sim cards will be given to all participants; the use of those cards is limited to the servers of Intelhealth.

- **Capital cost**
- Android devices will be distributed for the baseline study. After that, global organizations will support the extent of the system.
- **Other Direct Costs**
- To provide the incentives for the participants in the evaluation surveys and the CHWs
- **Indirect Costs**
- The total indirect cost will be estimated to be 15% of the total direct cost.

Benchmark and Measure: Once the system's strategic plan is implemented, it will be evaluated for its success. This process will begin with determining metrics for determining if the plan reached strategic goals. The first metric is the recall and precision rates gathered from the data collected. If the recall and precision rates are up to expectations, then this metric has been met. A second metric is the user knowledge, which is here the CHW or nurse assigned to use the system. If the plan is working, the CHW can do workshops to train others, which will increase the knowledge sharing and the continuity of the plan and ensure sustainability. (Bryson *et al.*, 2018) The last metric is the user feedback and satisfactory level. For a successful implementation of the system, it must be useable. The growth of three percent or higher would indicate success over the first couple of years. After five years, growth and adaptation should be higher than ten percent.

Strategy Incorporates Innovation: The first new strategy to incorporate innovation by the application of digital technologies to implement a smoother more efficient gathering of patient history to enable a fully adoption of electronic health records (EHR) to improve efficiencies and to support the services offered at primary healthcare centers. The second strategy is the fact that the plan supports knowledge and provide resources for successful software conversion. (Pappas *et al.*, 2012) New technologies will be applied to improve access as well as the quality of care. The application of technology helps to disrupt innovation. According to Christenson *et al.* (2000), the use of technology improves products and contributes to meet the needs of patients better. The last strategy is to train CHWs on the application of new technology properly.

Strategy Mitigates Blind Spots: Every implementation plan must avoid blind spots in their decision-making. The first way the system can avoid blind spots is to involve the stakeholders. When the team is asked to give input, they may experience gaps not recognized by the leader (champion/ HxGuide member). CHWs deal with patients daily and will be better equipped to identify blind spots. Secondly, collecting and analyzing data will help the organization identify gaps in services or care that can be addressed in the plan. Through research, the organization makes more informed decisions. Historical data is beneficial for identifying the successes and failures of the past, along with financial data and patient surveys. Data can be collected from both internal and external sources.

Sustainability: To ensure the sustainability of the system, the leadership team should focus on "train the trainer" approach, were CHWs are trained to train other CHWs on how to use the system properly. The training should be performed in CHC facilities, and all providers who pass should be accredited. Also, the publication of outcome data should be done yearly to

show the results of the system. There is an excellent chance that the government will adopt the system to be used at a national level. The best leadership approach to sustainability is through community-based engagement in each step of the process. The system is most successful and suitable when those who reside in rural communities are involved with the implementation process. Another plan to guarantee the progress of the system and ensure the system sustainability is by engaging local people from those rural areas, such as community leaders and key community members to be involved in the advocacy of the new system.

Conclusion

Intelehealth is a successful healthcare organization with visionary leadership. The organization aims to reform the current healthcare system by providing health for all. They offer an innovative digital system. Additionally, HxGuide has a growing presence on the ground, which makes achieving their goals attainable. To achieve the desired outcomes, Intelehealth can adapt this strategic planning to assess the implementation of HxGuide by assigning some of its members to perform this task. Unlike the other systems already in existence, HxGuide has different categories of management features that enable CHW can perform task-shifting, reducing the consultation time, and improving its accuracy. The plan involves stakeholders at all levels to assure the success of the system.

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