Implementing an Electronic Medical Record System in Developing Nations

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Experience at Oak Street Health in Chicago, at Praava Health in Bangladesh, and at the University Teaching Hospital of Kigali (CHUK) in Rwanda have illustrated the value of electronic medical records (EMR) in patient care. Unlike Oak Street Health, Praava Health had insufficient models to make much use of EMR. CHUK had no EMR for surgical procedures; all patient information was in paper records. EMR can improve care quality and resource efficiency, yet in many low- and middle-income countries, implementation is insufficient.

EMR systems cover a wide range of applications that influence a patient's experience, understanding, and health within the complex health management system. Relative to paper records, EMR can prevent errors, improve patient safety and outcomes, and reduce costs (Retchin, 1999). EMR systems' primary goal is to improve care. They can also prevent medical errors, manage revenue streams, improve communication and information exchange, and support analysis (Ayatollahi, 2014). The first EMR, developed in 1972, served developing countries. Omar (2019) found that hospitals with EMR had better quality of care. From 2010 to 2015, world implementation of EMR rose 46 percent, but adoption in lower-middle income countries lagged (at 35 percent); for low-income countries the rate was 15 percent (WHO, 2020). In developing countries, EMR systems could offer profound improvements in care quality and cost efficacy, yet initial costs and deficient digital infrastructure have limited implementation.

Review of Research

To work, EMR depends upon both technology and people: providers, staff, and administrators. According to Williams (2008), converting from paper records to an EMR system

is a demanding paradigm shift for physicians and staff. Before EMR can improve care, operations, and billing, hospitals and clinics must also manage political barriers, corruption, and budget constraints (Kiri, 2021).

Nevertheless, Tierney (2002) finds that even 20 years ago, EMR systems were already improving healthcare in developing countries. An EMR system in Cameroon reduced coding and consultation time, improved patient management, and promoted best practices, care reminders, and data accessibility (Kamadjeu, 2005). An EMR implementation in Haiti demonstrated its efficacy in impoverished rural areas (Rotich, 2003). An EMR implementation in Liberia facilitates fast registration and efficient access to medical records, creating integrated primary care (Partners In Health, 2021). EMR systems in Kerry Town and Sierra Leone Ebola Treatment Centers record patient data and communicate it between the infectious and non-infectious zones, enabling maximum usability of protective equipment (Jazayeri, 2015). In Rwanda, South Africa, and Lesotho, EMR systems support HIV care, including reporting, clinic and pharmacy support, and database synchronization; similar efforts are reaching Tanzania and Uganda. In a cross-sectional study of four primary hospitals of Ethiopia, however, Awol (2020) found insufficient knowledge of EMR and limited computer skills.

Interactive Sociotechnical Analysis (ISTA) can reveal the social factors in EMR implementation. ISTA guides the classification and interpretation of practitioners' reports.

Sociotechnical Analysis of Digital Medical Records

EMR yields digital medical records, which can have unintended consequences for hospitals and patients. Harrison (2007) investigated the social, technological, and organizational

components of healthcare. ISTA evaluates the effects of Human Information Technologies (HIT), not the intentions of HIT's developers. ISTA applies at five stages of HIT (Harrison, 2007):

1. the HIT innovation
2. the infrastructure response
3. the social system response
4. the effect on the wider social system, and
5. subsequent HIT redesign (Harrison, 2007).

Unintended consequences may arise at any of these stages. The ISTA framework can be applied to digitizing intraoperative surgical flowsheets (DISF).

In hospitals, both time and personnel are limited, constraining digitization. In a busy and understaffed hospital, digitization may be impractical. Hospital staff place a patient record on a special lightbox and digitally photograph it with a phone; the image is then sent to a computer. It is then uploaded with the associated patient medical record number. The process is time consuming, and may divert staff from patient care. The pandemic has exacerbated constraints on staff time (Louis, 2020).

Amoroso (2010) evaluated an EMR system introduced in rural Rwanda in 2005. It was implemented by Partners In Health for HIV clinics. The method of accessing the internet proved critical. For internet access, Eastern Province uses a local server. In Northern Province, only the district hospital has internet access. Data officers travel to the district hospital to enter data into a shared database, returning with printouts of upcoming consultations. This took time and required paper. At both settings, an EMR system improved patient care by managing patients' clinical profiles, alerting doctors to missed appointments, and identifying at-risk patients (Amoroso,

2010). Within 5 years, 93.5 percent of patients were receiving EMR-supported care. A review of 33 studies of clinics elsewhere in Africa found a median retention rate of 70 percent at the three-year mark (Partners In Health, 2012). The Rwandan patients received continual treatment for viral suppression.

ISTA considers the infrastructure HIT requires, including the paper records to be digitized. In CHUK, methods of marking surgical sheets vary, risking inaccuracies in data extraction. Checkboxes may be checked, filled in, circled, or marked with a word.

ISTA also considers social systems that mediates HIT implementation. Busy physicians may enter data incorrectly or may be reluctant to substitute typing for handwriting. In DISF, some doctors wrote checkmarks to the right of the word instead of in the checkbox to the left. In Kigali, local interpretations of paper patient records can be distinctive, complicating the application of record digitization techniques developed elsewhere.

ISTA takes into account HIT's social implications. HIT implementation can disrupt balances of power, compromise physician autonomy, or foster system dependency; these in turn can necessitate additional support. ISTA recognizes that an EMR system must be maintained (Harrison, 2007). EMR integration can complicate workflows and exacerbate inconsistencies between cultural practices and technological systems.

The Sociotechnical System in Which EMR Is a Component

Biases and structural barriers influence a sociotechnical system composed of people (patients, providers, administrations, payers, and government agencies) and infrastructure (hardware, software, networks), and practices. Sylvana Quader Sinha, founder, chairman, and

CEO of Praava Health in Bangladesh, explained EMR systems' value for patients and providers. In 2004, when it was founded, Praava brought Bangladesh its first fully integrated health information system, including EMR. Because Bangladesh has no third-party payer, Praava can advise, bill, and care for the patient, improving providers' access to information. The EMR system manages current and historical patient information. Health professionals can use it to predict outcomes and improve preventive care, thereby reducing hospitalizations. According to Sinha, an optimal EMR system helps caregivers offer patients a more inviting experience (S. Sinha, personal communication, Feb. 16, 2021). Bangladesh began an electronic health initiative in 1998 when the Ministry of Health & Family Welfare undertook the Health & Population Sector programs to enhance their health systems' efficiency and implementation. Strategy Plan 13 of the Bangladesh Health Policy 2000 states that the government will establish a computer-based 'Integrated Management Information System' to help implement health programs, introduce further strategic plans, and monitor the national health system. In 2011, the Bandgadeshi Health Policy of 2000 was amended, declaring healthcare to be an individual human right (Islam, 2009). The new policy focused on three objectives: ensure primary and emergency healthcare, expand the availability of equity-based health services, and encourage people to care given their health and disease protection rights (Karim, 2020). In 2012, the government established a Management Information System Department under the Directorate General of Health Services (DGHS) of Bangladesh, which directed the business requirements of the Health Information Systems Registry, a building block for the Bangladesh eHealth Architecture (Government of the People's Republic of Bangladesh Ministry of Health & Family Welfare, 2012). This implementation of the health information system is fragmented given a lack

of funding and IT knowledge as well as the separation between public and private health systems and data generation across multiple ministries (Karim, 2020).

With an EMR system, health professionals have remote access to information, including risk scores and patient trends. To Dr. Christian Nbaribitse, an MD and Senior Resident in the primary teaching hospital of Kigali (CHUK), EMR systems improve care if the necessary resources are available. But EMR systems at CHUK now only record laboratory reports, outpatient consultations, and billing; all other patient records are on paper. Dr. Nbaribitse favors committing resources to expand the EMR system. Dr. Marcel Duriex, MD, Ph.D., who has vast experience assisting Rwanda's Department of Anesthesia and academic development, defines EMRs as the electronic version of patient documentation. CHUK's providers use surgical charts for high-risk patients or when data are extensive, as in surgical and intensive care units. Otherwise providers record patient information in a binder of blank paper. EMR implementation influences individual patient care, patient population programs, and the entire medical organization. EMR systems can make the greatest difference, according to Dr. Durieux, when patient care evolves over multiple visits. With EMR systems, providers can retrieve patient charts anywhere in the hospital. With more accessible patient records, health professionals in Rwanda's operating rooms can more easily calculate and track a surgical risk score. Analysis can reveal health trends in patient populations and inform clinical decisions. The consequent cost efficacy gains can save money and time. As Dr. Dureiux explains, to work, EMR systems depend upon the support of medical personnel.

In 2011, the Rwandan Ministry of Health developed an oncology-specific EMR system at the Butaro Cancer Center of Excellence (BCCOE) based on AMPATH's HIV medical record

system to improve cancer care and outcomes (Tierney, 2002). Within the first year, outpatient visits rose from 17,895 to 20,235, while patients seen for cancer-related evaluation or care increased from 21 to 1,144. In 2012, BCCOE saw half of Rwanda's breast cancer cases based on the World Health Organization's global cancer estimates (Fraizer, 2005). Strengthening Rwanda's cancer registry enables a more accurate understanding of cancer distributions, enabling effective resource allocation (Jawhari, 2016).

According to Drs. Chrisitan and Durieux, insufficient hardware, software, and IT support have impeded EMR implementation (C. Nbaribitse, personal communication, Feb. 17, 2021). Scanning and uploading old patient data can be prohibitively labor intensive. Therefore, every initial encounter with a patient following EMR implementation may require inputting patient data, costing time at the point of care. Dr. Durieux estimates that time-consuming training and process changes are the greatest impediments to EMR implementation in the University of Virginia (UVA) School of Medicine and at CHUK. Providers must perceive EMR systems as valuable before they will support EMR implementation. In low- and middle-income countries, some providers may not value metrics such as diabetes incidence, while a public health agency may value them highly. According to Durieux, care providers are far less likely to support an EMR system when they are less the beneficiaries of the system than data entry personnel who serve it (M. Durieux, personal communication, Feb. 16, 2021).

Dorian Rodríguez, UVA-Guatemala Initiative Project Coordinator, has been important to project SABER, the first EMR platform implemented in a Guatemalan public hospital. After many failed attempts to replace paper records, Rodriguez's EMR system, consisting of modules for nurses, patients, and administration, now serves an emergency room. His team is currently

developing similar systems for other floors and the walk-in clinic. Starting simple, much like the Systems Engineering Capstone goal in CHUK, the first objective was to copy patients' paper sheets to electronic sheets. Rodriguez explains the benefits for providers, patients, and administration. Providers can access patient information anywhere, any time. Multiple providers can retrieve patient charts, promoting efficiency and collaboration. Paper record entry required about 20 minutes per patient; an EMR takes approximately 7. Administrators can automatically disaggregate data, such as incidence of cough among children.

Dr. Wilson Wang is founder and CEO of Walking Doctors, an electronic health system that can prevent medical errors and improve care in low- and middle-income countries. Dr. Wang is experienced in international healthcare delivery, health policy, and medical practice. According to Wang, in the U.S., 40 percent medical protocols are not followed; the rate is 80 percent abroad. Wang says that when he was a 16-year-old ice cream scooper, he was more closely observed for safe and effective work performance that he has been in 20 years of clinical practice. In EMR systems, checklists can guide clinical decisions, but their application is scarce. Information within EMR systems varies across patient types (all patients or specified subset), data specified (electronically allowable inputs), access (patient identification and providers' accessibility), and clinical use (leveraging records to inform care) (World Health Organization, 2006).

NGOs could better support healthcare delivery in low-income countries with an EMR system that could assess and monitor quality of care. EPIC, the largest EMR software in the U.S., serves over 250 million people. It schedules and bills patients but was not intended to evaluate or guide patient care. It promotes upcoding rather than quality-of-care metrics (Mark,

2021). "Everyone hates it," Dr. Wang remarks. Yet even Wang's intuitive, easy-to-use, checklist-based EMR system faces resistance. Eighty-four percent of the 2,488 EHR users in a 2020 Black Book Research survey are dissatisfied with the technical service and basic software account support from their EHR and HIT vendors (Jason, 2020). A study published in the Journal of the American Medical Informatics Association found patient satisfaction to decrease significantly after switching EHR systems (Frederick, 2020).

Sustainable Implementation of EMRs

The benefits of EMR systems in developing nations are shown through improvement in legibility of clinical notes (Douglas, 2003), decision support for drug ordering (Hunt, 1998), reminders to prescribe drugs and administer vaccines, warnings for abnormal laboratory results (Safran, 1995), support for programme monitoring (Vranken, 2002), support for clinical research (United Nations, 2002), and management of chronic diseases such as diabetes, hypertension and heart failure (Chadwick, 2002)

EMR systems require investments in hardware, software, retraining, and IT support. Explaining the advantages of the EMR system to providers who have used paper charts for decades may be the greatest obstacle to implementation. Why is this system needed? Whom will it benefit? How does this system ensure safety? Continuous technology support must follow, addressing procedural questions about computer operation, information entry and access, corrections, and applications. EMR systems offer automated alerts, remote access, and data analysis.

In 2012, UNICEF's analysis in Laos highlighted the need for more timely quality information and removal of bottlenecks preventing monitoring and access. The study identified significant capacity gaps at the subnational level in data analysis and in use of programming information. UNICEF aims to strengthen health information systems by improving the use of data in planning and management and bolstering accountability mechanisms within governments and communities (Hipgrave, 2016).

UNICEF strengthened health systems helping local health professionals build, access, use, and enhance data enabling practitioners to manage local health resources better and develop solutions that improve national policy quality of care metrics. They have implemented these changes in 25 countries across Africa, the Middle East, and Asia, supporting reproductive, maternal, newborn, child, and adolescent health, nutrition outcomes, and the prevention and treatment of HIV and AIDS (Hipgrave, 2016).

EMR system costs include software, hardware, implementation, training, initial diversion of productivity, support, and maintenance (Wang, 2003). According to a survey, purchase cost is the highest barrier to EMR implementation for 51 percent of adopters and to 74 percent of nonadopters (Jamoom, 2014). Nevertheless, long-term cost savings can quickly recoup initial costs. Where political administrations change frequently, as in Guatemala, long-term public commitments can be difficult to secure.

In developed countries, EMR systems are typically implemented institution-wide. Dr. Durieux recommends smaller implementations in high-risk, data-dense areas, as for example in the EMR implementation in rural Rwanda for HIV care. This approach can simplify implementation where resources are limited. CAREWare is a free EMR system deployed to

support HIV treatment for hundreds of patients in Africa (Milberg, 2003) and thousands in the US (Ryan White HIV/AIDS Program, 2016). In Guatemala, digitizing entire hospitals has failed, but hospitals have gradually adopted EMR floor by floor and clinic by clinic.

In 1996, Partners In Health implemented an EMR system for drug-resistant tuberculosis patients in Lima, Peru. This system reached 4,200 patients across three sites in Peru and one site in The Philippines. Dependent on internet connectivity, the EMR system recorded patient information, including medical history, physical examination notes, laboratory results, and medications for all patients receiving individualized treatment, enabling doctors to more easily record, monitor, and analyze patient data (Fraser, 2002).

EMR systems must balance patient and provider needs within the limits of business and political imperatives. While the primary goal of EMR systems is to improve quality of care, the incentives for building such a system include reducing medical errors, managing revenue streams, providing an effective means of communication, sharing information between healthcare providers, and collecting health information for institutional, educational, and research purposes (Ayatollahi, 2014). The World Health Organization encourages buy-in from healthcare practitioners due to EMRs' ability to:

1. Improve the accuracy and quality of data recorded in a health record
2. Enhance healthcare practitioners' access to a patient's healthcare information, enabling it to be shared between parties for ongoing care
3. Improve the quality of care as a result of having health information immediately available at all times
4. Improve the efficiency of the health record service

5. Reduce healthcare costs (WHO, 2006)

Each of these criteria aid in improving day-to-day trust, user participation and involvement, and technical system performance. These benefits can be coupled with long-term education, training, management involvement, and surveillance of system effectiveness (Rahimi, 2009).

Conclusion

In developing countries, EMR implementation is complicated by financial, procedural, cultural, and political barriers. Through ISTA, the unintended consequences of EMR systems and problems of implementation can be studied. Experienced users, practitioners, and implementers of EMR systems in Bangladesh, Indonesia, Rwanda, Guatemala, and Liberia shed light on effective EMR implementations. Implementers must explain EMR systems' value, align systems with patient outcomes, and support infrastructure, personnel, and processes. Implementation must be guided above all by commitment to quality of care.

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