

## A Workflow Solution for Electronic Health Records to Improve Healthcare Delivery Efficiency in Rural India

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### Abstract

*Use of Information Technology in Healthcare, especially Electronic Health Records (EHRs), can potentially improve healthcare. However, worldwide usage of EHRs is limited and studies in developed countries like USA have shown that electronic record systems have been slow to become part of the practices of the physicians. According to these studies, there could be a possible high failure rate for electronic health record implementation because of the complexity of usage of these EHR systems. In India, there have been no definitive national studies that provide estimates on the use of electronic health records. To gain insight into the functioning of the healthcare centers in rural India with respect to use of information technology and their effectiveness in healthcare delivery a survey was done. From the results of the survey it is evident that the quality of healthcare delivery in rural India can be improved by using information technology. The patient records used in most of the healthcare centers were poorly maintained and had minimal data to help doctors treat the patient effectively. The usage of medical records was also very minimal thus leading to reduction in effectiveness of healthcare delivery. The patient referrals from one healthcare center to another were done mostly by paper documents and telephonic talk. As there were no facilities to accurately track patients history, the quality of referrals and hence the quality of healthcare delivery suffered. The investigation revealed that the operating efficiency of the healthcare centers could be improved by employing EHRs that suit the rural environment. Fully functional EHRs are very elaborate and cumbersome to use in the rural context and they do not incentivize the doctors to use them. An Employable Electronic Health Record (EEHR) that has basic functionality and adequate information for the purpose of rural patients can motivate the doctors to use the EHR system. It will be simple to use and pragmatic for implementation. An*

*EEHR Workflow Solution (WebEHR) is proposed for effective and improved healthcare delivery.*

### 1. Introduction

Healthcare Delivery Systems are the key to a prosperous India of the future. Bringing in new leadership in the complex and changing environment, organizational excellence and designing new service delivery models will help India reach this objective. In India, the size of Healthcare industry is about Rs 850 billion for the year 2007 with an estimated growth rate of 13 % year on year over the next five years. The central and state governments are responsible for the provision of primary healthcare in the country. A spending of 1% of the GDP (effectively about Rs 1050 per capita) on public health is not only dismally low but most of the expenditure is on staff salaries leaving little or nothing for facilities, drugs and other consumables. This is very low compared to countries like US - 16%, UK - 7.8%, Germany - 10.8%, France - 10.4% and Japan - 8% [1]. Though there is a large network of public primary care facilities in India for the healthcare delivery with numerous secondary and tertiary care facilities, the effectiveness of healthcare delivery is very questionable in the public primary care facilities.

Use of Information Technology in Healthcare, especially electronic health records, can potentially improve healthcare [2][3][4]. However, worldwide the usage of EHRs is limited and studies in developed countries like US have shown that electronic records systems have been slow to become part of the practices of the physicians [5][6]. According to these studies, there could be a possible high failure rate for electronic health record implementation because of the complexity of usage of these EHR systems [7].

Healthcare Information and Management Systems Society (HIMSS) under the aegis of its Global Enterprise Task force headed by Dr. Steve Arnold was asked to investigate efforts to implement the EHR in a host of countries around the world [10]. The countries covered by this study were Netherlands, Greece, England, Wales, Denmark, Norway, India, New Zealand, Malaysia, Hong Kong, Singapore, Israel, Canada and USA. According to this study local and nationwide efforts to realize EHR systems were intermittently reported. In India, the IT adoption in Healthcare is estimated to be only five percent [10] and EHR adoption in government healthcare facilities is very slow or almost non-existent but the private sector is aggressive in their plans. To gain insight into the functioning of the healthcare centers with respect to use of information technology and their effectiveness in healthcare delivery, a survey was done. This survey was undertaken in five *taluks* (A *taluk* is a town that serves as headquarters for several villages and possibly additional towns) of Gadag district and six *taluks* of Bagalkot district to assess the ground realities in healthcare centers by evaluating various parameters that would influence the quality of healthcare delivery system in these districts.

## 2. Material and Methods

The details of the district healthcare facilities - the District Hospitals (DH), Taluk Hospitals (TH), Community Healthcare Centers (CHC), Primary Healthcare Centers (PHC), Primary Healthcare Units and National Leprosy Control Center (NLCC) - were obtained from the District Health Department. Out of the total 107 facilities, 83 facilities participated in the assessment that accounts to 77.6 % of assessment coverage.

A questionnaire consisting of a set of 86 questions related to patient load, medical record formats, hospital infrastructure and staffing information was used for this assessment. Responses to the questionnaire were tabulated. The responses were used to depict the results and draw inferences.

On an average 70 patients per day use the healthcare centers. The variance in this number is significant with some interior HCs having less than 10 patients per day visiting them and more than 100 patients per day visiting the THs. The average Inpatient to Outpatient ratio is 1:10, with the average duration of stay of inpatients being 2-3 days. The hospitals surveyed had an average of 10 beds for inpatients in the hospital. Each HC, on an average has two full-time doctors and between 11-20 additional

employees. The average age range of full time doctors working in these HC is 30-35 years. HCs reportedly have an average of 15 paramedical staff. Quality of healthcare depends on the efficiency of the doctors as they have to attend to at least 35 patients on an average daily. Use of health information technologies like EHRs has the potential to improve.

## 3. Patient Records

The Medical Records Department (MRD) stores files for an average of 5 years. Data recorded regarding patients information in the Medical Records (MR) includes Name, Age, Sex, Date of Birth, Occupation, Diagnosis and Treatment. In some cases, additional information like allergies, and food habits were also recorded. 20 HCs reported that the hospital pharmacist maintains the medical records. In some HCs there are no fulltime employees for maintaining the records. Most of the HCs spend a lot of efforts (time/money) on maintaining paper based patient records.

As many as 15 out of 83 HCs have reported occasions where patients wanted to have access to their health / treatment files. However, most hospitals have reported that they were unable to provide health / treatment files to patients on request by the patients themselves or their representatives. New Patient Records were easily accessible for medical and administrative purposes within the hospital. Some HCs provide easy access to patient medical records for doctors. Old records of patients were difficult to access to get the required information as records are written on paper and stored in files, which in turn were retained in a storeroom. All the HCs surveyed used paper to maintain patient medical records. However, during informal chat with the respondents, they felt that the usage of medical records is very minimal since the MR does not provide adequate information that could be used for effective treatment. This definitely hampers the effectiveness of healthcare delivery system.

## 4. Quality of Care

Most HCs agreed that there are no facilities available to accurately record a patient's history. In fact, some HCs reported instances of patients having been administered wrong medication due to lack of patient history. Most patients had also had to wait for longer periods of time to receive either the treatment or diagnosis as they had to wait for their records, or diagnostic centers to extract data from archives.

As many as 49 out of 83 HCs responded that they fell far behind on the use of proper technology in treating patients. They also felt that they could have treated patients better if they had access to quicker and more accurate information.

## 5. Patient Referrals

Some HCs (27 out of 83) reported having patients return to the same center for a completely different treatment. Each HC refers 5 to 10 patients to other HCs every month. Under different conditions of climate/endemics, this number may rise to 20 every month. Patients are referred from one HC to another predominantly (77%) by using paper documents and the rest are referred over telephone. In the case of referral based on paper documents, the quality of information flow depended on the past history of the patient and the respondents further conveyed that an accurate record of patient history was not available in most of the cases. In the case of telephone referral, the quality of referral is based on the doctor's knowledge about patient medical history and also depends on the extent of time spent on phone to provide the history. As doctors keep treating on an average of 70 patients per day, it will be difficult to convey accurate diagnostic information during the referral. In both cases, the quality of referral suffers leading to repetition of the same treatment or ineffective treatment at the secondary Healthcare center. This reduces the quality of Healthcare and increases the cost of treatment.

## 6. Improvement of Operating Efficiency by Using EHRs

The study suggested that for improving quality of care, there is a need for keeping **patient records** that are available easily and providing accurate information during **patient referral** to another healthcare facility. These two objectives can be achieved by employing Electronic Health Record (EHR) systems. The usage of EHR systems even in developed countries is limited. There is a high failure rate for EHR implementation because of the complexity of nature and usage of EHRs. Hence, there is a need for using a simple and pragmatic EHR. This kind of simplification will aid in motivating people – doctors, technicians and patients - to use this EHR system.

## 7. Electronic Health Records

An electronic health record is a collection of data and information gathered or generated to record clinical care rendered to an individual. It is a comprehensive, structured set of clinical, demographic, environment, social and financial data and information in electronic form, documenting the health care given to an individual. Considerable effort is spent in standardization of EHR in different regions. Different standards – CDA, CCR, HL7 and DICOM – exist but most of the countries suffer from lack of using these standards [10]. These standards have common purposes though they differ greatly in their complexity.

The primary purpose of an electronic health record is for continued care of the patient. The EHR should be comprehensive with all significant clinical and administrative information pertaining to a given patient, enabling the attending clinician to provide effective continuing care and to determine the patient's condition at any given time. EHRs should enable all activities that physicians perform with paper records. The EHR should also enable healthcare providers other than the attending clinician to review the patient and render his/her expert opinion or continue the patient's care at any time.

Secondary purposes are research/historical, epidemiology/public health, statistics, education, peer review, utilization studies, quality assurance, legal document (used as evidence) and healthcare policy development.

The content of an EHR consists of administrative and clinical data. This content should be comprehensive and expressive, addressing all aspects of the healthcare process for all related disciplines and authorities. There should be no restrictions on the type of data that can be entered into the EHR.

The administrative content includes

1. Identification/demographic data - patient unique identifier or medical record number, address, next of kin/guardian, sex, ethnic origin, complete name, date of birth, place of birth, marital status, religion, mother's maiden name, etc.

2. Financial data - Employer, health insurance, type of coverage, third party
3. Social data - Race, family status

The clinical content includes medical history, physical examination, clinical orders, progress notes, pathology reports, radiology reports, ECG, EEG, EMG, consultations, operative data, anesthesia, medication data, monitoring data and observations.

Ideally, the EHR includes all available patient data, irrespective of its source and provides medical professionals with meaningful views on these data. The EHR must contain psychological, social and family information.

The EHR system

1. Must be capable of containing information on: healthcare processes, activities, medical problem, healthcare requests, healthcare characteristics, resources, users and authorization.
2. Should allow for the recording of all data on the patient history, physical examination, diagnostic test, and therapeutic interventions to support patient care.
3. Should allow for pre-birth and post-death entries.
4. Should allow for the recording of interpretations, observations, decisions request for further investigations, treatment or discharge.
5. Must be able to reflect that a patient may have concurrent problems.
6. Should support the use of technologies, decision support and management plans.
7. Must enable recording of events apart from the provision of clinical care. An event can be regarded as having been discovered at a given moment. Specific information about each event in the EHR must include: the type of event (first visit, follow-up visit, specific test), the time of the event and the department and specialty involved in the event.
8. Should support the following characteristics for lab tests: type of test, the moment the sample was taken, the moment the sample was examined, the test result and the reference values and optional comments on the test
9. Must have capability to include free text entries in the EHR.
10. Should support the recording of the normal reference range as defined at the current time.

11. Should place no restriction on the clinical vocabulary used within it. The EHR must cater for information recorded in different languages, be they individual entries or complete sections of the record.
12. Should allow concurrent assessing of effectiveness and outcomes. Comparative performance data and information are defined, collected, analyzed, transmitted, reported and used.

## 8. Employable EHR

As the research is oriented towards Rural India, there is a need for using a simple and pragmatic EHR which excludes non-essential data. This kind of simplification will aid in motivating people – doctors, technicians and patients - to use this EHR. The EHR so designed is called an Employable EHR (EEHR). The following sections provide details on the Employable EHR with its content and the reasoning for not including some of the recommended content as per standard EHR described in the earlier section.

The administrative content includes: (1) Identification – Patient’s complete name, Medical record number, Address, mother’s maiden name and (2) Lifestyle indicators – Education level, profession, allergies, chronic illnesses, marital status, food preferences, smoking and alcohol consumption.

The clinical content includes: (1) Symptoms, Physical examination results (2) Drugs prescribed, inpatient history and (3) lab reports: pathology / radiology / ECG / EEG / EMG.

The following data is excluded which is normally expected in a typical EHR. The reason for exclusion is also provided:

1. Next of kin/guardian - Identity of the patient is captured in sufficient detail. There is no need to capture information pertaining to guardian in detail – which is volatile information. Only emergency contact info is collected.
2. Financial data - This is a very volatile data. And we believe billability and insurance related details are of interest to care facility administrators and the physicians should not be biased by this data.

3. Race – The system addresses predominantly Indian rural population.
4. Multiple language support - Captures all information in English only. As a subsequent improvisation, voice records will be enabled in addition to data entered into the system. Voice records can be in any language but can be accessed only on computer terminals and not in paper form.
5. Cost indicators - Not currently focusing on financial aspects of care.
6. Workloads of care providers - focus is entirely on health records and not on monitoring the care provider.
7. Productivity and performance of care providers - focus is entirely on health records and not on monitoring the care provider.
8. Comparison with standards of care – we do not have a baseline to compare with. Comparison with ‘standard’ can be thought of as a future plan.
9. Birth & Death related data - This information is indirectly captured – a birth triggers the registration of a new member into the system; whereas, a death can be reported as a log of information by a Kiosk operator on behalf of the user.

## 9. WebEHR system

The system designed to implement the usage of Employable EHR is called WebEHR. WebEHR system

1. Allows for the storing all of the Administrative & Clinical Content, Patient visit information, Prescription report and Inpatient & Discharge Information and reproduce them for formatted display or on paper form for study.
2. Supports generation of statistical information for mining the general health conditions of public.
3. Allows concurrent access from multiple locations.

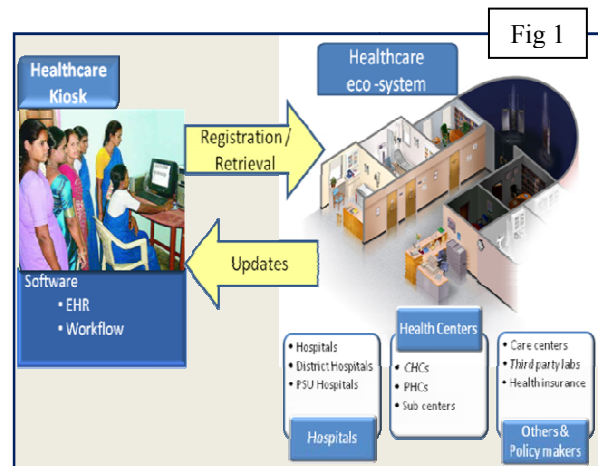
WebEHR is capable of recording chronologically the information on:

1. Symptoms, complaints, healthcare requests as expressed by the patient.
2. Type of events such as first visit for treatment, follow-up visit.
3. Vital and common Health parameters such as: Weight, Blood Pressure, Temperature.

4. Diagnosis, instructions and suggestions by treating Physician.
5. Information that became available including the source of such information or basis for such inference.
6. Medicines prescribed by the Physician.
7. Lab tests ordered by the Physician.
8. Lab test results obtained from various medical devices of a diagnostic center including reference values.
9. Therapeutic interventions.
10. In-patient treatment log of the patient.
11. Patient’s own log of health diary.

## 10. Health Kiosk

This kiosk (figure 1) will have a desktop computer along with a printer and runs the WebEHR software.



The patient will be able to

1. Register the name if it is first visit.
2. Take a printout of the record.
3. Enable the doctor will examine the patient, diagnose and prescribe treatment. Or the doctor can suggest for additional tests. This is done on the EHR printout of the patient.
4. If additional tests are suggested the patient takes this prescription to the lab and brings the test reports back to the doctor. Doctor prescribes the treatment.
5. On the receipt of the requisite diagnosis and prescribed treatment, the patient will bring back the record to the kiosk for updation of EHR.

In the above manner, this way the kiosk will be able to maintain the EHRs of all the patients in the rural areas. The advantage of this system is that the patients, doctors and other medical professionals need not know about computers and software and there is no hindrance for the EHR usage. The system provides connectivity between the Healthcare Centers through a web-based interface. Automatic updating of the data and data storage will be facilitated by instantaneous entry of data from any given point. Subsequently, this system will provide the ability to use patient health records and statistical data for training and educating medical, paramedical and administrative personnel. This data and the knowledge created will help in analysis of the health conditions for the particular demography that aids in planning for better healthcare delivery.

## 11. Conclusion

The benefits of implementing such a system are

1. Healthcare awareness of patient increases.
2. Demographic information will be available for planning better healthcare delivery.
3. Addresses the issue of patient mobility as patient information is available for all healthcare centers as it is web enabled. The risk of losing data and data confidentiality is reduced because of non-centralized database.

By deploying such a kiosk in different healthcare centers in rural India, we can increase the usage of EHRs thereby increasing the efficiency of Healthcare Delivery and reducing the cost of healthcare. Currently the kiosk is operational in one of the healthcare centers in Karnataka. The initial response from rural patients and doctors is encouraging.

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