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5. Electronic Health Records Challenges with Indian Healthcare Scenario: Data Science Application

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Abstract:

Patients' data produced/recorded during the healthcare process are deposited as a repertoire of a large, resourceful system of electronic health records (EHR). Such a massive amount of data can be used for data science applications, which can be exploited to improve healthcare.

To improve the progress in healthcare, there is a fundamental prerequisite for the right to use EHR data, which is not easily available to researchers and scientists. Relatively a rare concession is the massive EHR database, comprising information commencing further than two million patients that have been prepared available to an inadequate set of data.

In this work, we have explained several possibilities for the data science applications that have been developed concerning electronic health records, signifying the prospective recycling of EHR data to bear healthcare and community wellbeing actions, along with making easy medical research. Nevertheless, to understand completely the requirements are to be accessible to a larger population of researchers, in addition to healthcare sectors. It is prospective to encourage the rise of diligence in the region of the expansion of data science applications which in due course upsurge both the effectiveness and helpfulness of the healthcare sector.

Keywords: *HER, challenges, big-data; data science, healthcare.*

5.1 Introduction:

Cornell University conducted The Global Innovation Economy Survey, INSEAD and WIPO (2017), and it was observed that the main areas of innovation generation in the world are information technology and healthcare [1]. The transition to an innovative economy depends on the integrated scientific, and industrial spheres through technological progress and its implementation which will give economic benefit to the society which is actively seen in many developed countries. One of the main factors in healthcare is the identification and management of innovation technology viz., Data science, Electronic Health Record Management (EHR), Artificial Intelligence, Data mining process, and Electronic Patient records (EPR) [1].

Data science is one of the current useful resources in dealing with large business operations and several other data domains. Data generated by clinicians are very valuable for further analysis and the growth of enhanced treatment procedures, like real-time monitoring, verdict backing, and analysis. Electronic health record (EHR) systems are applied now just about in all healthcare establishments [2-11]. A priceless chance for ancillary data use and growth gives support to doctors, hospital management in their occupation on the progression and healthcare deliverance expansions, and investigators in their work. Health investigation resources are presently obtainable over biobanks and countrywide records such as cancer registers and reason of death registers; for investigators with suitable moral authorization.

To create a road map to adopt EHR in India policy development, regulations, standards, research ICT infrastructure and interoperability of several organizations require to be integrated to have sufficient data to manage the EHR of patients in detail. Health record data contains an awareness of sequences about individuals an enormously significant aspect that requires specific deliberations. To deal with these matters, we recommend developing communication that permits access to recognized EHR data [12-17] for extra investigation and arrangement growth.

Communications will consist of a variety of prerequisite tools and will consist of two channels: one providing entree to ordered collected and completely unidentified data, and one requiring ethical authorization beforehand access to creative data. These communications are grounded on a larger clinical record, the EPR (Electronic Patient Record) quantity.

The EPR quantity, in general, comprises data from the entire hospital both inpatient and outpatient records equal to over two million patients, which are written by numerous specialists at the hospital. A coordinated effort from all the stakeholders is the main key to sustainable healthcare development in India.

5.2 Health Care Industry Scenario in India:

The health scenario in healthcare in India is one of the largest sectors which is rapidly expanding. The government of India has taken initiatives through various policies "The digital India Healthcare" which has led to the increased utilization of health IT products [18]. Further, in the health sector, we need to modify the infrastructure in the public health system so that the challenges can be well responded to in terms of revenue generation, and employment. Despite India making progress in the health care sector through growth-oriented policies adopted by the government, there are challenges based on gender disparities and health care priorities in regional and urban areas.

Also, observed from prior reports that 75% of health infrastructure, medical manpower and other resources required in the health sector are concentrated in urban areas whereas 27% of the populations live currently. Public health has to be given major priority as it is the determinant of health promotion, and disease prevention and helps in controlling the disease. The private sector accounts for 80% of the total healthcare spending in India. But still, in India, 30% of people die without accessing any health reforms.

The leading technologies which are primarily used are EHR and EMR which are mostly used to supervise the patient's health information. In India, the EHR standards were notified by the Ministry of Health and Family Welfare in 2013 [18].

Thus, universal access to basic services must be improved and increased with utmost priority where electronic health record comes in practical usage where large databases of patient information can be maintained. Preventive and promotive health access is to ensure that health expenses can be limited to curative care [19]. The demographic profile in India is shown in Table 5.1.

Table 5.1: The demographic profile in India

Factors in the health sector		**India**	**Reference**
Population	Population (crores)	**1,386,678,800 (2020)**	[20]
	Decadal growth rate (20011-21)	12.5%	[21]
Sex ratio	All ages (females/1000 males)	900 (2013-2015)	[22]
Parameters to indicate Health	Crude birth rate (per 1000 population) Crude death rate (per 1000 population)	16.949 (2020-2025)	[23]
		7 (2018)	[24]

Factors in the health sector		India	Reference
Total fertility rate (TFR)	Rural Urban	2.4 (2019-20) 1.8 (2019-20)	[25]
Life expectancy at Time of Birth	Females Males	70.69 (2018) 68.23 (2018)	[26]
Survival to age at 65 % of the Cohort	Females Males	74.59 (2018) 68.55 (2018)	[27]

5.3 Utilization of Big data and EHR in Health Care:

Consumer satisfaction requires the development of a device that can lead to significant advances in clinical data viz., patients' vitals, computational power, storage and analysis in real-time. This increases the challenges of building a cost-effective, large-scale informational hub in the healthcare sector [28]. This has given rise to a new era of "Big Data" where scientists across a variety of fields can explore new ways to understand the unstructured and unlinked data leveraging in the healthcare sector through personalized and effective treatments. The significance of Big Data is further enhanced by the development and deployment of Machine Learning (ML) approaches. Artificial intelligence (AI) and Machine Learning (ML) unravel the patterns of unscaled datasets that Big Data analytics brings. The application of big data is seen during the varied datasets as sequences of images (in radiology) or in patients' records using Natural Language Processing [29-30] compiling the datasets together to generate prediction models for the response of a patient's treatment regimen. In the USA the supplementation of ML tools is done by the adoption of electronic health records (EHR) after the passage of the Affordable Care Act (2010) and Health Information Technology for Economic and Clinical Health Act (2009) [31].

EHR allows accessibility of patient data to physicians and researchers allowing for remote electronic access and easy data storage facility. In a study on Oncology care, big data has made a significant impact on patient care. With an integrated approach of EHRs and diagnostic several tests viz., genomic testing, MRIs and other technologies physicians can understand the genetic causes behind cancers and they can design more effective treatments to improve the screening and prevention measures [32-33]. According to the literature survey, the UK and the USA play a significant role in being the global leaders in healthcare by adopting Big Data. The reports suggested a case study of disease in oncology by the Cancer Genome Atlas (TCGA), Pan-Cancer analysis of Whole genome (PCAWG) and neuropsychiatric diseases (Psych ENCODE) [34-36]. The initiatives of these scientific and healthcare communities have led to major big data generation as the project "All of Us" in the US which integrates EHR by a direct link between patient genome data and their phenotypes by storing the family data in a unique patient's profile for global usage [37]. Further, the "All of Us" project is expanding based on the establishment of 'Biobank' and Genome projects in the U.K. [38].

Literature reports suggest that in Sweden there is a huge investment in rich electronic research registries [39]. In China, with the advent of new digital technologies emphasis on data standardisation and volume management has been initiated by pushing Big Data into healthcare which interlinks administrative data, regional claims data and electronic medical records [40]. In India, Government through 'The Digital India Healthcare' has increased the utilization of health IT products. The Indian Government has shown a specific interest in Electronic Health Records (EHR) and Electronic Medical records (EMR). These techniques are being utilised majorly to supervise the information regarding the patient's health.

The digital EHR format stores personal health records which provide confined, real-time, patient-centred information about the history, diagnosis, lab reports, immunization schedules, and various lab reports to understand the patient's clinical condition. The EHR record can be improvised and can be easily handled by various vendors and staff. Thus, interoperability data can be shared across many organizations and minimise costs to encourage evidence-based research.

In the world, EHR in healthcare is being adopted in China (96%), Brazil 92%, France (85%), and Russia (93%) and in India, the market for EHR is booming in this respect. Fast Healthcare Interoperability Resources (FHIR) is a standard describing data format with an application programming interface (API) to exchange electronic health records (EHR).

The EMR/EHR providers in Indian hospitals are given in table 5.2. As reported by Dean/ Group Head of IT, Columbia Asia Group of Hospitals there needs to employ the seamless transfer of patient data between hospitals and thus significant adoption of common EHR data standards with FHIR [41].

Table 5.2: Indian EMR/EHR providers in hospitals

EHR/EMR Provider	Hospitals using EHR/EMR
Vepro	Apollo Hospital, Chennai
Siemens	Artemis Health Sciences, Gurgaon
IBA Health	AIMS, Coimbatore
Sobha Renaissance IT Pvt. Ltd.	Fortis Hospital, Mohali & Delhi
Karishma Software	Christian Medical College, Vellore
21st Century healthcare solutions	Manipal Hospital, Bangalore
Soft link International	Max Devki Devi Hospital, Delhi
Prognosys	P D Hinduja Hospital, Mumbai
Srishti Software	Ruby Hall Clinic, Pune
CDAC	PGIMER, Chandigarh
GE Healthcare	Sri Sathya Institute of Higher Medical Sciences, Bangalore
HODO Medical Informatics Solution Pvt Ltd.	Medical College and Non -Government organizations in Trivandrum, Kerala
Vista Care	AIIMS Trauma Centre, New Delhi
Care 21	Columbia Asia Hospitals, Bangalore

5.4 Data Science Applications for Healthcare:

Electronic Health Record Data (EHR) stores a significant amount of voluminous data in the database viz., patient data of laboratory test values, medical data, various treatment data, doctor's prescription, diagnostic reports, pharmacy and clinical related data, health-related insurance data and several medical journals report which will be prioritized to for investigation and analysis. All this information when gathered together forms big data in healthcare [42].

There are a variety of tools that are used to extract healthcare-related information viz., Hadoop, MapReduce, PIG and PIG Latin, Hive, Jaql, Zookeeper, HBase, Cassandra, Oozie [42]. It is estimated that the Indian Healthcare industry with an IT market valued at USD 1 billion in 2014 is expected to grow 1.5 times by 2020. The sectors of telemedicine and medical tourism are having huge potential. The Digital India Programme (DIP) is undergoing a makeshift by integrating patients' electronic health records (EHR) in a 'digital locker' assisted by Aadhar maintained over a lifetime which can be shared with doctors in both public and private establishments. Data analytics can be used as a source for actionable insights in the Electronic Health care management system by taking care of patients' records, diagnostic tests, and converting this structured and unstructured data into useful information. With the EHRs being maintained by healthcare providers there can be the adoption of data analytics through descriptive, predictive or prescriptive analysis which has already been studied by several hospitals such as Wockhardt Hospitals Ltd., Mumbai, L V Prasad Eye Institute, Hyderabad, Apollo Hospital, Chennai [43].

5.5 Electronic Health Record (EHR):

Mostly the EHRs (see fig.5.1) are web/client-server based as it uses relational databases, and data access. A few EHRs were developed between 1971-1992 based on hierarchical or relational databases used systems such as COSTAR, PROMIS, TMR and HELP which being developed as clinical systems is used to improve medical research [44-46].

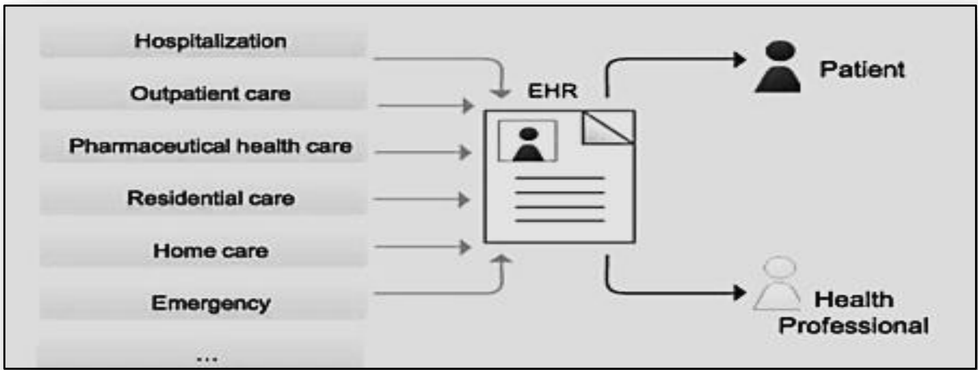

Figure 5.1: EHR, an integrated model of care

In Canada, EHRs are interoperable nationwide through the Canada Health Info way initiative. Further, there are kinds of literature from countries such as Australia, Estonia, and Hong Kong where EHRs are implemented based on the consumer’s needs and for patient’s healthcare [47-49] An EHR is a select e-record of a person’s health over the life course that cover patient demographics, notes on advancement and advances, clinical hitches, treatment, medicines, previous health accounts, clinical data etc. and can be retrieved immediately and steadily by certified personnel.

Makes accessible instantaneously and securely to the certified users the information required on the patient in real-time, treatment-centered records contains both the therapeutic and medical management history of patients.

The users are using order sets, mobile devices, voice recognition, barcodes and documentation system to transfer the information into EHR. The medication facility is being integrated with clinical documentation, e-prescribing formats and several pharmacies [50-51]. EHR is widely used in nursing homes, home health, and various organizations caring for homeless populations. There can be interfacing of personal health records within EHR which can be used largely for large facilities and vendors.

The DNA can be used for clinical decision support key features for practitioners and the large information can be used as a source of phenotypic information for analytical purposes. The data sources make the data sources for phenotypic and genomic information research which can be stored in records of EHR [52-53]. EHRs, in one way help to build an improved healthy future of a nation; is more inclusive information of the patient's complete wellbeing broader than the electronic medical record of a patient.

Benefits:

- Electronic patient record files are easier to transfer [54], and there is no confusion over illegible handwriting, possibly leading to cost savings for both the patient and the medical provider.
- Electronic clinic management can reduce cancellations missed appointments and waiting times
- The use of electronic prescriptions would help patients get their medications more quickly.
- Surveillance of healthcare-associated infections (HAI)
- Clinicians identify and stratify chronically ill patients.
- EHR can improve quality care by using data and analytics to prevent hospitalizations among high-risk patients.
- Facilitate the coordination of health care delivery in non-affiliated healthcare facilities.
- Statistical reporting in matters such as quality improvement, resource management, and public health communicable disease surveillance.
- It can reduce the risk of data replication, the risk of lost paperwork.
- Digital information viz., possible trends and long-term changes in a patient being searchable.
- Population-based studies may also be facilitated

Limitations [55- 57]**:**

- Electronic medical records should only be stored on secure networks.
- Unauthorized access to records for illegitimate purposes is of major concern
- During a natural disaster, the crisis of electricity, proper network access to e-records will be difficult.
- Accessibility issue. Perhaps one of the most important concerns when dealing with this data is creating a system that works for patients and clinicians alike. As researchers in perspectives in clinical research highlight, “Interface issues are the greatest system risk because these failures can be invisible initially.” When clinicians do not know how to handle EHR properly, problems can go overlooked, and that can cost serious health issues.
  Thus, healthcare institutions must employ health records management professionals to ensure doctors and patients understand these new technologies and their usage.
- It is also important to realize that patient access to health data is an important component of patient engagement because it empowers patients with knowledge about their conditions and incorporates the patient as a partner in care. However, patients may struggle to access health data because of underutilized patient portals, ambiguous security protocols, and a lack of health IT interoperability.
- Lack of uniform standards for both national and international operations for electronic patient records. For the system to work seamlessly, the software must be uniform, or there must be a way to convert among different standards easily.
- Cost Factor- The implementation of EHRs places a significant burden on both the practice and providers. EHRs are financially burdensome for practices; this is especially true for independent practices that do not typically have the same resources as larger health systems. Practices not only have to purchase the EHR software, but they often have to employ experienced IT staff for support and training. Training, and the learning curve associated with adopting EHRs, demand substantial time from physicians and staff – time that is taken away from patient care. When staff have a difficult time adapting to or understanding the system, errors are more likely to occur. A tool that was originally developed to increase communication and quality of care may create a riskier healthcare environment.
- Increased use of mobile technology may impact, security measures and patient privacy regulations.
- Long-term preservation and storage of records. There is a lack of consistent, well-regulated, and efficient standardized preservation infrastructure to support a wide variety of electronic health records and data formats.

5.6 EHR in Developed Countries:

In Europe, 19 out of 33 countries are at the stage of the planning and implementation process of a patient summary and EHR – like system. A few countries viz., Sweden, Denmark, Norway, Finland, the UK, Austria, Germany, Netherlands and Switzerland are leading in EHR [58]. Countries like Canada and Australia are in the most advanced stage of nationwide EHR policy [59]. Denmark leads as far as eHealth integration and daily services of healthcare are concerned [60].

In England, the approach introduces Summary Care Records with limited storage of data for the patients except for the patients who are not interested to have one [61]. EHR was initiated in Austria in 2005 with the health reformation law (Austrian Health Care Reform Act,2005).

A single information exchange platform for health providers and authorities was developed by the government as National Health Network in Norway. The health quality of Switzerland is high quality and costly. In New Zealand 2010 launched the National Health IT plan. In mid-1990 Israel is the first country that introduces a Health IT information exchange system with primary care doctors using EHR [62]. Among Asian countries in Korea, a health information exchange project was initiated in 2014 which supported healthcare information by integrating both wired and wireless networking by healthcare ICT infrastructure. EHR is of high priority in developed countries due to public funding while EHR is still in a nascent stage in low to medium-income countries.

The implementation of EHR in countries like Nigeria, Uganda, Kenya, Malawi, Sierra Leone Peru, Haiti and Pakistan was funded by international donors predominantly supported by vertical disease programs.

5.7 EHR in India:

In India rate of Life expectancy in 2018 was overall 69.4. Female is 70.7 and male is 68.2. In mid-2020 Health index is 66.21. In 2017 number of beds was 0.53 per 1000. National Digital Health Blueprint (NDHB) has been proposed in 2019 which manages and recognizes health data and disease management. Ministry of electronics and information technology (MEITY) is the adoption of EHR [63]. Big Data and AI play an imperative role in improving healthcare outcomes.

In India, Ayushman Bharat (AB), a flagship scheme from GoI [64], was inaugurated as a National Health Policy in 2017, to accomplish the vision of Universal Health Coverage (UHC), premeditated to meet Sustainable Development Goals (SDGs). Ayushman Bharat is an attempt to move from the present approach of health service delivery to an all-inclusive need-based health facility. Electronic Health Records would augment community health by collecting data, collating and drawing interpretations on patients' progress and management of medical practices in India through the acceptance of EHR in the AB programme. Some of the perceived challenges by healthcare units towards electronic health records posed in India are -

- Clinicians' deficiency in computer literacy
- Non-availability of multilingual EHRs
- Primitive awareness around privacy and security protocols about health information
- Collaboration between healthcare professionals and software developers
- Sensitizing healthcare workers
- Transparency of clinical documentation
- Other problems like the creation of infrastructure, policy and regulations, standards and interoperability to R&D
- Basic ICT infrastructure

- Conformance of test facilities
- Open EMR
- Guidelines for IT health solutions
- Proper health record
- Obstacle free sharing
- National health policy
- Standards and interoperability
- Privacy protection
- R&D and education

In India more or less the corporate hospitals, like Max Health, Sankara Nethralaya, Apollo, Fortis, etc., have executed assimilated ICT systems, covering most of the characteristics, i.e., registration, billing, results from laboratory and confidential clinical data. In the EMR adoption model for hospitals.

The Apollo Group achieved Stage 6 in a few branches located at Chennai, Nandanam, Aynambakkam, and Jubilee Hills. Such a health-based national policy could do only good for the public, a framework for government-led initiatives for developing data science/ big data/ AI models towards improving the citizen's health is an important initiative for EHR adoption [65].

5.8 EHR Resources for System Development:

The potential value of EHRs lies in the transformation of the health care community. The creation of a database through an Electronic Health Record system is a significant process due to spatial, complexity, interrelation, temporal, heterogeneous and fast-evolving data. Nevertheless, data models are created through several processes. As, EHR is an integration process that involves the network of systems, databases, interfaces, physicians, order entry, and electronic and clinical workstations. EHR system consists of highly structured data viz., medical, security, legal and financial data [66]. EHR is an electronic record of the patient which keeps track of an individual’s lifetime health. EHR uses cloud computing for easy access as it reduces the cost of installation, hardware and software. SaaS (software as a service) is implemented on cloud computing with software-oriented architecture (SOA) which accesses records through web service. SOA can be accessible through a web portal and background services from the clouds where stored data of EHR is present [67].

5.8.1 Data Model:

Design methodologies are created for database viz., hierarchical model to object/relational model and object-oriented model [66-67]

- The object model is suitable to design complex databases such as EHR but it is not as popular due to query language complexity.
- Relational Database – It is the most applicable model but is not readily used due to the cost factor.

5.8.2 Electronic Medical Record Adoption Model (EMRAM):

The creation of Electronic Medical Record Adoption Model (EMRAM) was established in 2005 (see for stages in Table 5.3) by Healthcare Information and Management Systems Society (HIMSS). EMRAM can be measured through the eight stages (0-7) model by the functions of the level of adoption and utilization of electronic medical records (EMR) [65]. Lifetime medical records of a patient may be recorded in EHR according to clinician workflow and in case of emergency, they may be transferred to save a life.

Table 5.3: Electronic Medical Record Adoption (EMRAM) and its various stages [65]

Stage	Record Adoption
Stage 0	Laboratory, Pharmacy, and Radiology all three ancillaries are not installed
Stage 1	Management of ancillaries viz., Laboratory, Pharmacy, and Radiology/ Cardiology Information Systems; PACS; Digital Non-DICOM Image Management
Stage 2	Basic Security, Internal Interoperability, Call Detail Record (CDR)
Stage 3	Nursing and Allied Health Documentation, Role-Based Security, Electronic Medical Administration Record (EMAR)
Stage 4	Nursing and Allied Health Documentation, Basic Business Continuity, Computerized provider order entry (CPOE), Clinical Decision Support (CDS)
Stage 5	Structured Templates using Physician Documentation; Intrusion/ Device Protection
Stage 6	Blood Products, Human Milk, Risk Reporting, Full CDS, Technology Enabled Medication
Stage 7	External HIE; Data Analytics, Governance, Disaster Recovery, Privacy and Security; Complete EMR; External Electronic health information exchange (HIE)

In an observed case study in China Open EHR was followed [68]. The Open EHR approach is reported from many countries viz., Brazil, Australia, Germany, Russia, Japan, Norway, the UK, Sweden, Denmark, Indonesia, and China. The open EHR approach facilitates interoperability of EHR systems based on the total EHR dataset which can be fully represented by using sharable archetypes [69]. It divided models into two levels: The Archetype Model (AM) and the reference model (RM).

RM focuses on logical structures and it is a stable and formal information model, defining basic structures and attributes needed to express EHR data structures, data instances types and components of EHR [69-70]. AM Consists of archetypes and templates which are formal and semantic artefacts that collect, store, retrieve represents communicate and analyse data clinically which can be modelled by health informaticians and clinical professionals. An open EHR approach is archetypes-driven which is generated by templates [70].

The case study published reported and verified the feasibility of modelling EHR with an open EHR approach and estimated the challenges viz., localization, tool support and the publishing process which can narrow the applicability of the open EHR process [71].

5.8.3 Case Study in HER:

Also, observed through the published work of Singh et al., 2015 that predictive models are being built using temporal data in electronic health records (EHRs) which is required to play a major role in managing chronic diseases [71].

Integrating temporal data in a patient's medical history can lead to a better prediction of loss of kidney function as published in the paper. Here they followed three different approaches and used them to build predictive models for using temporal data for risk stratification. Chronic Kidney Disease (CKD) is divided into five stages.

In stage 3, the risk assessment can be predicted by guiding clinical decision-making through different models to predict the progression of loss of kidney function [72]. Tangri et al.,2011 used EHR data to develop a predictive model to check the progression of End-Stage Renal Disease (ESRD) [72]. The Gaussian process was used to model longitudinal time series of postsurgical processes of cardiac patients [73].

Electronic health records (EHR) support prognostic modelling in clinical practice and epidemiology for patient management and research. Cox modelling and data-driven approaches were utilised to study a cohort of above 80,000 patients assessed through electronic health records. Machine-learning models are used as a case study in predicting the mortality rate of patients with coronary heart disease [74].

Centres for Disease Control and Prevention (CDC) data indicate that the majority of U.S. hospitals and U.S. health care professionals have implemented an EHR with advanced functionality.

Study shows innovations in EHR provided new possibilities for the primary care of patients with type 2 diabetes using IT. Diabetes registries and clinical decision support systems were facilitated by EHR-enabled tools [75].

A previous COMPLETE II study by Holbrook et al., 2009 reported significant improvements in clinical diabetes patients were observed when decision support was shared through the web-based interface by the clinicians [76].

5.8.4 Automatic Surveillance:

The core function in practicing public health is surveillance. It is an integral part to track public health diseases and act as indicators to trigger any action and control diseases. EHR role can be expanded to boost surveillance efforts which can bridge the gap between health informatics and clinical medicine [77].

Healthcare-associated infection (HAI) is an infection obtained by a patient during healthcare treatment; a requirement to report annually goes in two ways: Compulsory reporting and Point Prevalence Measurements.

The estimates obtained through Point Prevalence Measurements are not very precise due to the limited sample size. Researchers have developed several prototype tools for detecting HAIs in EHRs [78].

As the traditional methodologies for healthcare-associated infection surveillance are intensively time-consuming several databases and electronic surveillance systems are feasible.

The complete integrated hospital information systems can be used for routine surveillance through EHR [79]. It was reported from a study that 6%of patients hospitalized in Europe are affected by HAI which can be translated to 2.6 million infections annually. A similar prevalence of 4% has been reported in the US [80]. In Figures 5.2 and 5.3, the HAI surveillance system is illustrated.

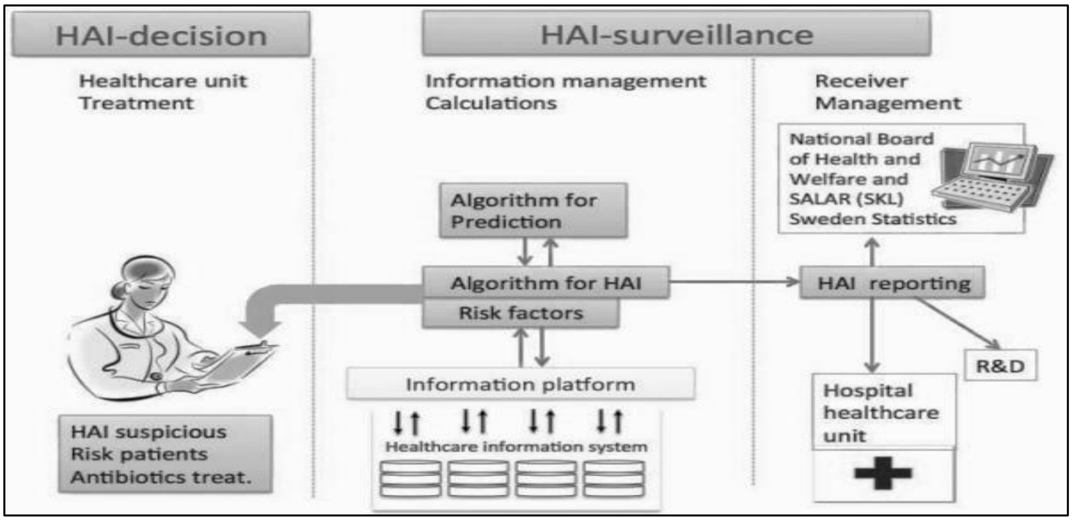

Figure 5.2: An interim system for Healthcare-Associated Infections (HAI)

Data published on the efficacy of the Nosocomial Infection Control study is significant to improve the quality managed by HAI prevention programs [80] through surveillance and feedback on infection rates [81].

Studies reported similar approaches in HAI surveillance in various countries through organized networks viz., PREventie van ZIEkenhuisinfecties door Surveillance initiative in the Netherlands and the German Krankenhaus Infektions Surveillance System [82-86]. The selected patients can thereafter be assessed by a clinician.

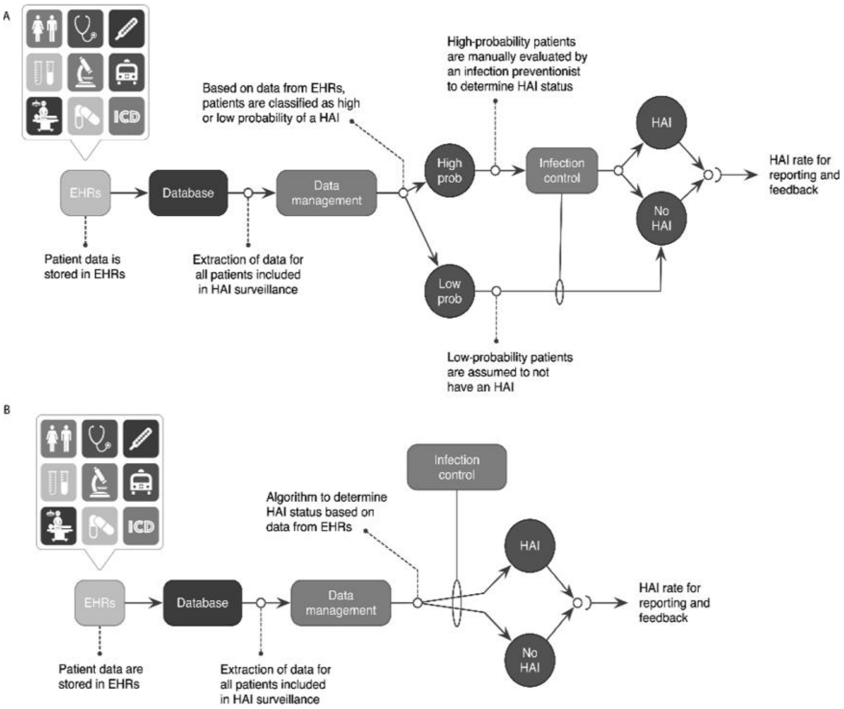

Figure 5.3: Flowchart of Surveillance A) Semi-automated and B) Automated Surveillance

A pipeline exemplar of the proposed technical clarification in accessing the database is given in figure 5.4.

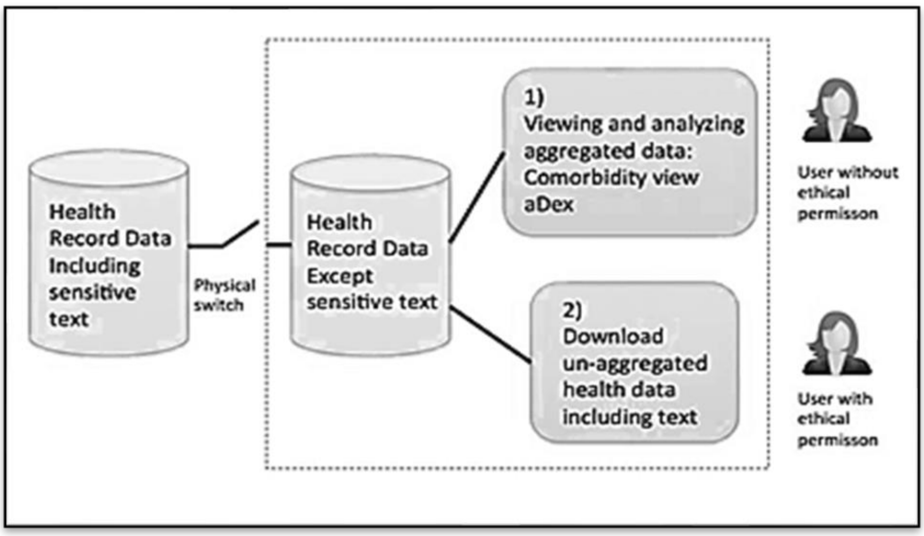

Figure 5.4: Proposed technical clarification to access the database (a pipeline exemplar)

5.9 Challenges:

Observations indicate, that there is less evidence of successful research for the implementation of strategies to ensure the integration of national EHRs in low-middle-income countries unlike developed countries [87]. The significant challenge in formulating EHR requires the integration of digital infrastructure and healthcare. The healthcare system requires multidimensional factors viz., health workforce, health information, financing, medical technologies, service delivery, leadership and governance. A significant investment of money, time and proper leadership are substantial to maintain the implementation of challenges and relevance of EHRs. The EHR need to be adopted but there lie key adaptive challenges as reported in the exemplary case study for India's Sankara Nethralaya hospital which specified scepticism and lack of technology skills, user-centric EMR design approach, continuous user engagement ensuring strategies, testing of theoretical and conceptual models for EHR implementation. An external EMR vendor was engaged to support the in-house effort to ensure maximum usability of the EMR system in the hospital. Thus, the adoption of EMR in the Sankara Nethralaya hospital proposes valuable insight and experiences. The work was carried out before the establishment of EHR guidelines by the Government of India in 2013 [87]. One of the specific challenges is also the purchase and implementation of EHR are of significant investment. EHR implementation also depends on the effectiveness of adoption by physicians into everyday practices [88]. Researchers used EHR systems to predominantly gather varieties of data for vertical disease programs viz., for heart diseases, HIV, tuberculosis (TB), TB/HIV, and antenatal care, smoking [89-90].

Health practitioners face the challenge to implement EHR systems in high and low-middle-income countries. There lies a progressive gap among these countries thus widening the risk of the populations in different healthcare and public health strategies [88-90]. Although EHR is used to track and consolidate vaccination programs by ensuring improved design and sustainability of effective immunization strategies [91].

There are studies published which reviewed the studies on contextual factors both internal and external factors. The required external contextual factors are wider infrastructure, human resources and information and communication technology (ICT) constraints [92-96]. Studies reported that there are healthcare system issues observed in Japan during the implementation of EHR for intractable diseases. The studies reported due to a decentralized administrative system with language barriers in Japanese script required country-specific tools and expertise to overcome data entry challenges [97]. Similar studies in Taiwan explored ways to overcome various challenges of data exchange between hospitals [98]. Other challenges include the lack of funds in the healthcare sector, lack of public health government initiatives and a fragmented system of healthcare are significant factors [99]. In countries like India, Myanmar, and China access to mobile networks and web-based technologies vary which is a constraint particular to LMIC contexts [99-101]. Internal contextual factors are often related to the organization's local access to ICT; the human resource required for the transition from paper to electronic; levels of provincial, state, and national infrastructure web-based platforms; locally existing and lack of EMR [102-104]. Studies reported variability in constraints viz., infrastructure, reliable electricity, mobile technologies, ICT technologies, resources of humans in addition to a layer of complexity in terms of system requirements and level of EHR sophistication are the challenges that need to be supported. Further ethical concerns like patient confidentiality, informed consent data security, cultural diversities, health disparities, linguistic challenges, literacy and patient management lead to the ongoing debate on introducing EHR in low to medium-income countries.

A study in Iran reported lack of efficient planning, organizational barriers, and lack of skilled manpower are the limitations to implementing EHR [105]. Among several challenges in the current healthcare landscape “physician burnout” is a prevalent issue. According to reports, about 50-60% of physicians are facing this challenge due to the association with reduced patient safety, lower patient satisfaction, and higher instances of malpractice claims. It is observed that excessive usage of EHRs contributes to physician burnout due to the burdensome user interface, and time-consuming usage for clerical-type data entry. This contributes to lower job satisfaction, increased stress, and decreased quality of patient care [106]. Nevertheless, the migration of people with health issues, thus, establishing a uniform set-up of EHR in several countries is difficult to encompass. Previous studies through the project by The European Institute for Health Records, Euro Rec Institute, as part of the ProRec initiative, created "Transatlantic Observatory for Meeting Global Health Policy Challenges through ICT-Enabled Solutions" which allowed the promotion of "Common Methods for Responding to Global eHealth Challenges in the EU and the US". It highlighted several challenges to establishing competency in e-health informatics due to reasons such as variation in understanding, qualification, and competent staff across Europe and the US [107].

Based on usability and interoperability along with slow growth due to market saturation, the worldwide EHRs market faces condemnation. Regardless of these encounters, the EHR market topped $31.5 billion in 2018 grew 6% from $29.7 billion and is further anticipated to grow by 9% to reach $34.5 billion by 2020 [108]. As per the World Bank income group, the percentage of countries with an EHR system is shown in figure 5.5.

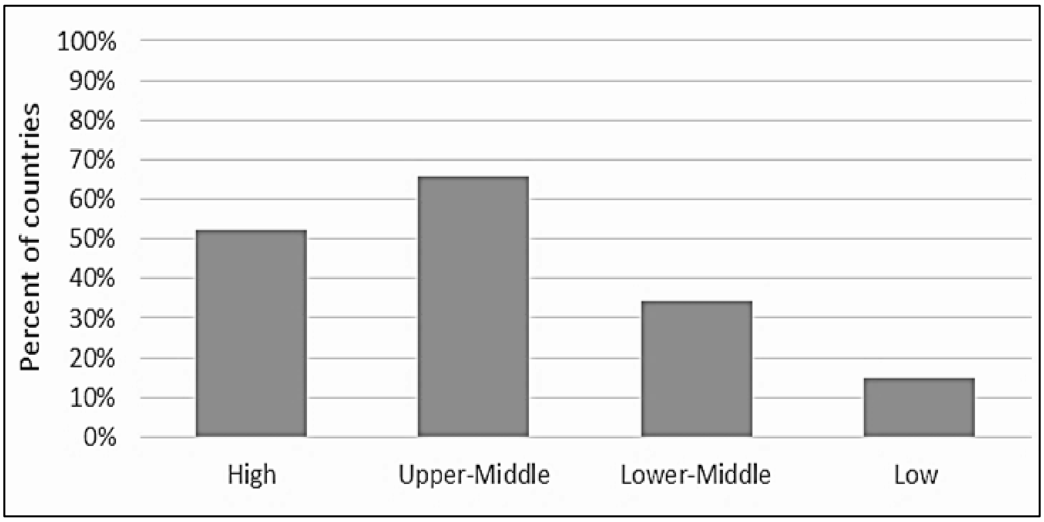

Figure 5.5: Percentage of countries with EHR system (World Bank Income group) [109]

5.10 Conclusions:

In this work, the authors have outlined the adoption of electronic well-being records and further utilized them as a database. The EPR quantity represents the potential of abusing and salvaging such data to create data science applications that are envisioned to support and improve medical services.

To recognize the full conceivable of information science applications in the social insurance area, wellbeing record information should be made accessible to scientists and industry players, framework engineers.

Also outlined a vision to create communication, around the EPR quantity, efficiently providing access to EHR data in the aggregated and non-aggregated form; though, making sensitive data obtainable to numerous possible users necessitates paying care to ethical issues and obeying within sequence security protocols and regulations: Database makes data available readily and securely subsidiary users with concrete, legal and ethical plans to achieve excellent research.

Traditionally in India, it was a knowledge-based approach. India is on the verge of becoming the world capital of health data possibly a treasured occasion for constructing a future-ready person-centered health system.

Herein voyage, a nationwide homogeneous EHR might be the first step. Authors believe these databases, provide a platform for system growth; will promote an increasing industry for the realization of data science applications in healthcare.

5.11 Summary:

Despite the various issues, it is possible to improve the current situation involving the use of EHR for research, as mentioned -

- Improve awareness and motivation amongst the professionals and patients alike
- Legislation to ease the legal obstacles to using electronic health records for research
- Initiate actions by setting up task forces at the national level specifically to address and improve barriers to the use of anonymous health records for research, including wider and free access, under strict guidance.
- Technological innovations, improvements and support to facilitate training, participation, efficiency and security
- Cross-border cooperation involving EHR certifications, with strong political and professional engagement
- Availability of resources, both at government and private levels, to disseminate the benefits of research to all

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