# Centralized Electronic Health Record (CEHR) - A Novel Concept for Better Planning and Management of Health Care Delivery in India

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***Abstract***

*Health is an inveterate index of economic growth of any nation. World Health Organization (WHO) is spearheading global health programmes in a sustained manner. According to WHO Information, financing, medical products, medical professionals, health workers, service delivery and leadership/governance are essential for developing health care programmes. Indian health scenario suggests that non-communicable diseases burden is going to increase in the coming years due to changed life style. According to Planning Commission, accessibility, availability and affordability are the three greatest challenges being faced by India's healthcare system. In India the public spending on health is around 1.2 per cent of its GDP which is among the lowest in the world. According to WHO India's ranking is 52nd out of 57 countries facing crisis in human resources in health. Therefore, health care and its delivery is a big challenge in India. Public-Private Partnership (PPP) in health care and its delivery is being encouraged in some states to support governmental efforts. Studies have shown that around 70% of CSR funding is being done in health related activities. Increased accessibility to internet has changed face of health care delivery. Government of India's initiative of Digital India has come in a right time to support digital health care services. As a beginning efforts are in to collect information and statistics in digital form. Centre for Data Management and Analytics (CDMA) is helping to pool and manage the data repositories of public health authorities and the union and state governments. Indian digital health startups providing health care solutions on various issues. A new initiative of collecting Electronic Health Records (EHR) is government of India's priority. This helps to formulate and plan programmes to mitigate disease occurrence and spread in an economical way. The Union Health Ministry has designated the Centre for Development of Advanced Computing (C-DAC), Pune, to run the National Release Centre, for distribution and management of SNOMED CT a universal health care terminology with standards for developing EHR. There are several innovative ways where a Private sector can participate with innovative ideas and ICT's in health care. The present paper discusses various issues in developing EHR on cloud technology at national level. The paper highlights advantages and challenges in implementing EHR. A model on how rural health unit can be connected to higher health care centre through digital records using centralized EHR on cloud technology is suggested.*

**Keywords-** *Health Care, EHR, CEHR model, ICT's & PPP in health care.*

## I. INTRODUCTION

The health care in India is a three tier system with sub-centre at the base. More than 68% of rural population lack good medical facilities. There is a large gap in the healthcare system between urban and rural areas due to a lack of resources and infrastructure in the rural region. The rural population depends more on government funded medical facilities due to poor financial capital. According to Planning Commission (2011)[1], accessibility, availability and affordability are the three greatest challenges being faced by India's healthcare system. The role of healthcare in sustainable economy has forced all developing economies including India to raise healthcare expenditure. Even now the affordability and accessibility to Modern Healthcare facility is a mirage to large population of society in India due to socio-economic conditions. NITI Aayog Action Agenda 2017-2020 envisaged data-driven and decentralized health planning to more effectively improve population health[2]. Efforts to develop a health care based on stored and ready to retrieve system is gaining importance because of its advantage in planning long term health care measures at national level. India is coming up with more and more technologies wherein this gap can be minimized. Personal Health Information (PHR) is the tool to document health information on a Cloud based computer technology. Cloud computing is a technology where applications and services are provided to pool resources via Internet with greater flexibility and at low cost. Public Private Partnership

(PPP) is collaboration between the public and private sector for certain common goals is a new philosophy world-over especially in health sector. In India many such PPP scheme are functioning in health in many states successfully. Under the provisions of section 135 of the Companies Act 2013 and requirements laid down in the Companies (CSR Policy) Rules, 2014, 2% of the average profit of the company computed in the manner prescribed in the Act during the three immediately preceding financial years will be allocated for CSR activities by all corporate sectors. The present opportunity of huge funding in the form of social investment by corporate houses under the new law and policy envisaged under UNO charter of '*Millennium Development Goals*' (MDGs) is a big advantage in terms of resources[3]. Researchers have discussed rural health sector and analysed various CSR activities taken up by select Indian companies under different thematic areas'[4,5]. One study on select corporate companies concluded that >70% investments are being made on different aspects health care. Studies state that more than 40 million people are impoverished and run into massive debts to access healthcare and 62% of out of pocket expenditure[6,7]. Burden of non-communicable diseases and resultant mortality is expected to increase in the coming years[8]. Therefore, health care and its delivery is a big challenge in India. The health care has been changing towards simplified management with easy-to-access real-time personal health information[9]. Liberalized policies of government have lead to more investments in the segments of health care companies, digital health care provider services[9]. The health care companies have augmented investments in the manufacture of pharmaceutical ingredients, biotechnology products as well as pharmaceuticals in a big way. Some of the companies have many healthcare verticals including day care speciality facilities. There is a great evolution in providing health care and transparency in operating system of hospital industry. The present communication makes an attempt to provide a Centralized EHR model for better planning and management of health care delivery.

## II. MATERIALS AND METHODS

A Study was made on the health issues and planning process in India. The investigation was based on the secondary data available on websites and in official documents. An analysis of information was done with an aim to summarize evolution of health care, its delivery and available options for better management. An attempt has been made to develop an EHR model for connecting rural health centre to higher level health care facility and to make a national level network of health information. A model to allow individual to access the information and retain the privacy is suggested. The information available on the topic and studies on EHR forms basis for the present model which can suit Indian public health care system.

## III. RESULTS AND DISCUSSION

The Govt of India in 2018 budget has stressed the importance of healthcare and increased healthcare spending by 5% to Rs. 52,800 crore in 2018-19 from revised estimate of Rs. 50,079.6 crore in 2017-18. This is 1.15% of India's gross domestic product (GDP)[11] (Fig.1), which is among the lowest in the world. Hence, there is a need to increase public spending on health with a minimum of 3 per cent of GDP by 2020, and 4 per cent by 2025. Out of pocket expenditure (OOPE) constitutes more than 62% of all health expenses, a major drawback in a country like India where a large segment of the population is poor[12,13]. Approximately 63 million people fall into poverty each year due to lack of financial protection for their healthcare needs[11].Increased aged population with inadequate Geriatric health services is another issue in health care services in India. This has impacted GOI to spend more on health care. Over the years GOI has making health schemes to address many of the core issues which are not adequate looking at the socio-economic conditions and affordable communities (Table 1).

### *A. Indian Disease scenario*

A close look at the disease burden in India suggests a variety of issues to be addressed with a long term strategy. The major concerns are [14,15]:

1. Un-healthy food intake leading to high levels of blood cholesterol and hypertension
2. Smoking, air pollution, occupational chemicals and dust add to the problem of lung like Chronic obstructive pulmonary disease (COP), occupational lung disease etc.,
3. Diarrhoeal diseases are one of the biggest causes of under-5 deaths, killing between 800,000 and one million children
4. Cerebro-vascular disease fourth biggest killer in India.
5. Lowered immunity from other infections leading to Pneumonia, lung abscess and acute bronchitis are the fifth biggest cause of death.
6. India accounts for 2.8 million of the 10.4 million new tuberculosis (TB) cases globally. Improper medicine use leads to complications.

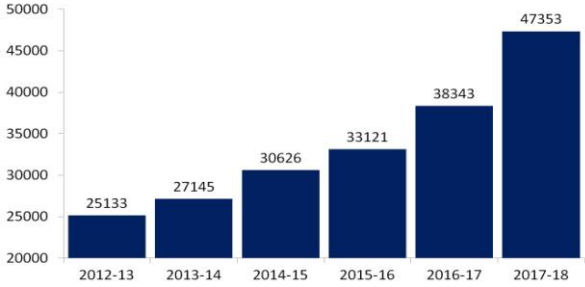


**Fig. 1: Public Health Expenditure by the government of India (in crore)**

**Table 1: Average rural population covered by health facility as on 2016***

| Parameter | Sub Centre | Primary Health Centre (PHC) | Community Health Centre (CHC) |
|---|---|---|---|
| Average rural population covered by health facility | 5377 | 32884 | 151316 |
| Average rural area (Sq.Km) covered | 20.00 | 122.33 | |
| Average radial distance (Km) covered | 2.52 | 6.24 | |
| Average number of villages covered | 4 | 25 | 116 |

* Based on the rural population of 2011 Census.

### *B. ICTs in Indian Health Care*

A rapid growth in digital awareness opened up a new era of smart solutions in health care. An array of startups has come up for addressing needs of clients in health care and its support through various options to get treatments at ease and convenience. The start-ups have revolutionized the perception of heath care in India addressing different needs of the clients and hospital industry. The digital industry at present is offering service like a) medical profession practice management and marketing; b) tools to help patients in tracing healthcare facilities such as pharmacies, hospitals and blood banks across India; c) offering online consultations. Some start-ups providing in-home healthcare program for those suffering from illness, care accessibility through telemedicine. Addressing issues of maternal and infant mortality by collecting physiological data making monitoring maternal and fetal health easier is also, being provided digitally. Some devices for health workers with pictorial and vernacular instructions are also, available. Digital services are being provided for connecting blood donors with those in need, on real time data for locating potential donor matches on a map. Opportunities are available on-line for reposition of health records for users to store. Indian digital health startups providing health care solutions on various issues:

1. Practo (https://www.practo.com) established in 2018 provides health care delivery and management solutions. Funding: $124 million
2. Portea Medical (http://www.porteamedical.com) offering health care delivery Funding: $46.5 million
3. Lybrate (https://lybrate.com) founded in 2013 provides health care delivery. $11.4 million
4. DocEngage (https://docengage.com) established in 2013 offers management solutions
5. LiveHealth (https://livehealth.in) established in 2013 provides health care delivery
6. Praxify (http://proxify.com) provide care delivery & Management solutions
7. Qikwell (https://www.qikwell established in 2011 provides health care delivery and management solutions and acquired by practo
8. Sattva Medtech (http://www.sattvameditech.com) provides care delivery & Medical Devices
9. SocialBlood (http://www.socialblood.org) established in 2012 provides solutions for availability of blood donors and real time mapping of matches.
10. eKincare (https://www.ekincare.com): Founded in 2014 by Kiran Kalakuntla and Sunil Motaparti, Hyderabad-based eKincare helps users encrypt their health records and keep it on the cloud.
11. Medibox Technologies (https://medibox.in) allows patients to search for healthcare facilities such as pharmacies, hospitals and blood banks across India. It is a cloud-based solution with a mobile application that is compatible with any portable device
12. Medikabazaar (http://medicabazar.biz) Founded in 2015 It operates in both B2B (for hospital and medical institution supplies) and B2C (for home health medical devices and aids) segment.
13. Thrymr Software (http://www.thymr.net) is a cloud-based platform for healthcare delivery. It has two products MedNetwork and eRx. MedNetwork interconnects doctors, patients, clinics, pharmacies, diagnostics centres and blood banks.
14. Medical Unique Identity: (http://www.medicalui.com) Founded in 2013, manages personal health information to deliver quality healthcare to the public.
15. Navia Life Care (http://navialifecare.com) is a mobile application-based health management platform that visualises treatments in calendar and list views to effectively manage planning of treatments.
16. BookMEDS (http://bookmeds.com) Founded in 2013 it is an e-commerce portal for medicines and medical products. Founded in 2015 it is an e-commerce portal for medicines and medical products.
17. eKincare (https://www.ekincare.com) Founded in 2014, ekincare helps users to encrypt their health records and keep it on the cloud.

### *C. Electronic Health Record (EHR) system*

Personal health information in the form of PHR and its periodic management becomes essentially important not only to patients but also, for overall management and planning of health care in the country

at national level. PHR can be defined as an electronic resource of personal health information to retrieve and make health decisions at any point of time. PHR is similar to medical records but differs in the sense that it is maintained periodically and also, personally. A PHR gives a health care provider an insight into health status. Meta data has been extensively in use to store information, in which patient can share select information[16,17,18]. PHR's are chiefly two types.

a. ***Standalone Personal Health Records*:** In this type of PHR, patients fill in information from their own records, and the information is stored on patients' computers or the Internet. Patients will have an option to decide whether to share the information with providers, family members, or anyone else involved in their care.
b. ***Tethered Personal Health Records*:** A tethered PHR is linked to a specific health care organization's electronic health record (EHR) system or to a health plan's information system. With a tethered PHR, patients can access their own records.

### *D. Opportunities for PPP in development of C-EHR*

In the global digital health records market Allscripts Healthcare Solutions, Cerner, CPSI, Epic Systems, and McKesson. Other prominent vendors in the market are: Advanced MD, CSC, CureMD, Dell, GE, Greenway Health, MEDITECH, NextGen Healthcare, Practice Fusion, and Siemens Medical Solutions are the major players. The analysts forecast global electronic health records market to grow at a CAGR of 5.53% during the period 2016-2020[19]. The connected healthcare solutions such as personal health record (PHR), EHR, telemedicine, and mobile-based health applications provide access to healthcare services from any distant location. At global level many websites have come up in providing personal health recording. Sites offering a portfolio of services are available (Table 2) and may countries have health IT programmes (Table 3). The Government of India launched Digital India in 2015 to make the people of country digitally empowered with an emphasis on e-governance. India stands around Universal healthcare and e-healthcare programmes for reducing health costs and to give wider access to health insurance. The government's Centre for Data Management and Analytics (CDMA) is helping to pool and manage the data repositories of public health authorities and the union and state governments.

**Table 2: Web based portfolio of health care services**

1. FollowMe (http:///www.followme.com)
2. Google Health (http://www.googlehealth.com)
3. Ge's Life Sensor (http://lifesensor.com)
4. Healthtrio (http://www.healthtrio.com)
5. icePHR (http://www.icephr.com)
6. Koozala (http://www.koozala.com)
7. LifeOnkey (http://www.lifeonkey.com)
8. MiVia( http://www.mivia.org)
9. MicrosoftVault (http://microsofthealthvault,com)
10. My Health info (http://www.my-health.info.health.msn.com)
11. Passport MD (http://www.passportmd.com)
12. Patient Gateway (http://patientgateway.org)
13. Practie Fusion (http://pracicefsion.com)
14. Patient Ally (http://www.patientally.com)
15. Wed MD PHR (http://www.webmdphr.com)

**Table 3: Healthcare IT Programs World-wide**

| Country | National Healthcare IT Program |
|---|---|
| Australia | HealthConnect |
| Austria | ELGA |
| Canada | EHRS Blueprint |
| Denmark | MedCom |
| England | Spine |
| Hong Kong | eHR Infrastructure |
| Netherlands | AORTA |
| Singapore | EMRX |
| Sweden | National Patient Summary (NPO) |
| Taiwan | Health Information Network (HIN) |

The Union Health Ministry has designated the Centre for Development of Advanced Computing (C-DAC), Pune, to run the National Release Centre, for distribution and management of SNOMED CT a popular coding standard in the Health IT industry within India[20,21,22]. SNOMED CT is the universal health care terminology (ET). It is comprehensive and covers procedures, diseases, and clinical data. SNOMED CT helps to structure and computerize the medical record. It allows for a consistent way of indexing, storing, retrieving and aggregating clinical data across sites of care (i.e. hospitals, doctors offices) and specialties. The Indian Healthcare market is expected to grow at a CAGR of 23% to USD 280bn by 2020. The doctor: patient ration in the country is 1:1668. A poor urban-rural share of health facilities with 80% of doctors in urban areas 72% population is facing accessibility to quality health care. Out-of-pocket expenditure in rupees per episode of inpatient and outpatient care in India has increased by 11.4% is also, a concern. There are many EMR providers and hospitals in India which have implemented the EHR at the hospital level[23,24]. These EHR at the hospital level need to be interconnected through cloud as the geographical location of patient will not remain same. The CEHR will enable to track the records even with the mobility of patient (Table 4 & 5).

**Table 4: Major EMR providers in India[24]**

1. CDAC
2. GE Healthcare
3. IBA Health
4. Karishma Software
5. Prognosys
6. Sobha Renaissance IT Pvt. Ltd.

| | |
|---|---|
| 7. | Siemens |
| 8. | Softlink International |
| 9. | Srishti Software |
| 10. | Televital |
| 11. | 21st Century Healthcare solutions |
| 12. | VEPRO |

The Increased Healthcare Budget not only help Public in accessing better Healthcare facility but also increased scope and role of Public Private Partnership in Healthcare domain under Corporate Social Responsibility (CSR), BOT (Build Operate and Transfer) and ICTH (Information Communication and Technology in Healthcare) (Fig.2&3).

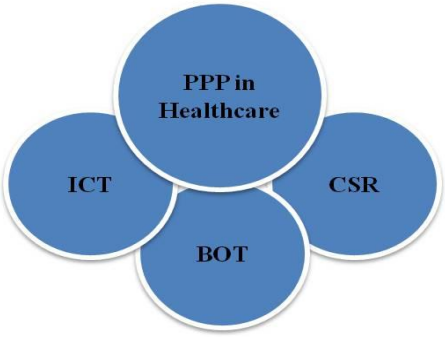


**Fig. 2: Triple possibility option for PPP in Healthcare**

NITI Aayog proposal describes a new plan, under which the public health infrastructure, which used to be built by the government and managed by the doctors and personnel employed by it, is moved to a public-private partnership model. There are several innovative ways where a Private sector can club all the above three possible options which not only will increase the arm of healthcare in India but also increases the efficiency through the use of advanced technology, one such innovative concept is Centralized Electronic Health Record (CEHR). Government of India has approved a scheme to create Electronic Health Records of patients in 2017. This allows creation the EHRs of patients in a centralised manner on Integrated Health Information Platform (IHIP).The Electronic Health Record (EHR) previously called Electronic Medical Record (EMR) or Computerized Patient Record (CPR) is an electronic version of medical history of a patient, which is maintained over a period of time and updated regularly based on the input from particular provider, typical EHR includes data like problems, medications, vital signs, past medical history, immunizations, laboratory data and progress notes given by different Doctor. The Centralized Electronic Health Record connects the Electronic Medical Records of each and every patient by interconnecting Electronic Health Records through Cloud computing[25]. In country like India where majority of masses are unaware of medical terminologies and medical tests undergone it will be futile to expect them to keep their medical history safe or to interpret the historical medical data. The patients' medical history always plays a vital role in curing the problem as doctors find it easy to treat people who keep track of their medical records. The CEHR also, gives essential information to the government for planning health care programmes for efficient delivery. A typical EMR system should have a Clinical decision support databases and security features. The protocol consists following aspects to develop an EHR:

1. Identity: Name, date of birth, blood type, and emergency contact information
2. Patient's Clinical information: Date wise tests and screenings and reports, Major illnesses and surgeries, allergies, chronic diseases, history of serious illnesses in family if any
3. Management: Entry details, date of last physical examination etc.,
4. Electronic Prescription tool: List of medicines and supplements, the dosages, and period of usage
5. Patient's financial records: Bills and financial implications

**Table 5: Major Hospitals equipped with EMR service[23]**

| | |
|---|---|
| 1. | Amrita Institute of Medical Sciences, Coimbatore |
| 2. | Apollo Hospital, Chennai |
| 3. | Artemis Healthsciences, Gurgaon |
| 4. | Christian Medical College, Vellore |
| 5. | Fortis Hospital, Mohali and Delhi |
| 6. | Manipal Hospital, Bangalore |
| 7. | Max Devki Devi Hospital, Delhi |
| 8. | P D Hinduja Hospital, Mumbai |
| 9. | Ruby Hall Clinic, Pune |
| 10. | Sahyadari Hospital, Pune |
| 11. | Sri Sathya Institute of Medical Sciences, Puttaparthi |
| 12. | PGIMER, Chandigarh |

### *E. Advantages of EHRs*

a) It allows the patients to access their Health records at anytime and anywhere.
b) Helps in reducing the repetition of the medical tests.
c) Helps to keep a track of the improvement made through historical study
d) Acts as second opinion hence increases accuracy.

### *F. Challenges in implementing EHR*

Usability, ownership, interoperability, privacy & security, portability and motivation are six barriers for slow adoption of PHRs[26]. Important aspects to be looked at in implementing EHR are:

a) High costs involved
b) Lack of Digital dexterity at the grass root level
c) Legal and Policy Framework of the government

d) Getting Uniformity of Hospital functions across Country
e) Monitoring the Standard Operating Procedure (SOP)
f) Heterogeneity of data
g) Ensuring the Coordination at various levels
h) Converting previously handwritten transcripts into EMR
i) Ensuring Data Privacy

**Format for Medical Record by Medical Council of India**[27]

| | |
|---|---|
| 1. Name of the Patient | : |
| 2. Age | : |
| 3. Sex | : |
| 4. Address | : |
| 5. Occupation | : |
| 6. Date of 1st Visit | : |
| 7. Clinical note of the case (Summary) | : |
| 8. Provisional Diagnosis | : |
| 9. Investigations advised with reports | : |
| 10.Diagnosis after investigation | : |
| 11.Advice | : |
| 12.Follow up | : |
| 13.Observations | : |
| Date | : |
| Signature in full | : |
| Name of the Treating Physician | : |

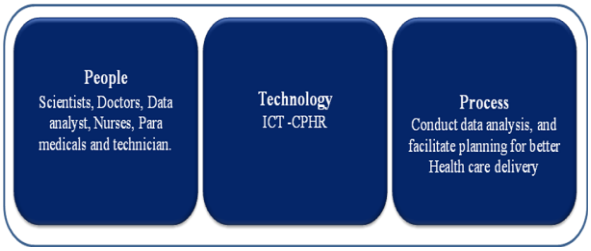


**Fig. 3: Components in CEHR system of health care delivery**

A schematic diagram of how to implement EHR and to interconnect to make a CEHR is presented in Figs (4,5&6 ).

### *G. The Proposed Model*

Tethered Personal Health Record (TPHR) has advantages in terms of its usefulness in planning health care programme at national level. Cloud computing is a technology where applications and services are provided to pool resources via Internet with greater flexibility and at low cost. The Suggested model consists of a networking of health care centres on cloud to enable easy accessing and to deliver health care in a precise manner. When patient visits PHCs in the first instance the data of the patient will be uploaded to the data server which can be accessed by the CHCs and vice versa, the EHRs of the each CHCs are connected to a centralized data server called CEHR which is connected to cloud. The patients can also visit their medical history with unique access code of AADHAR through OTP to maintain the Privacy of the data.

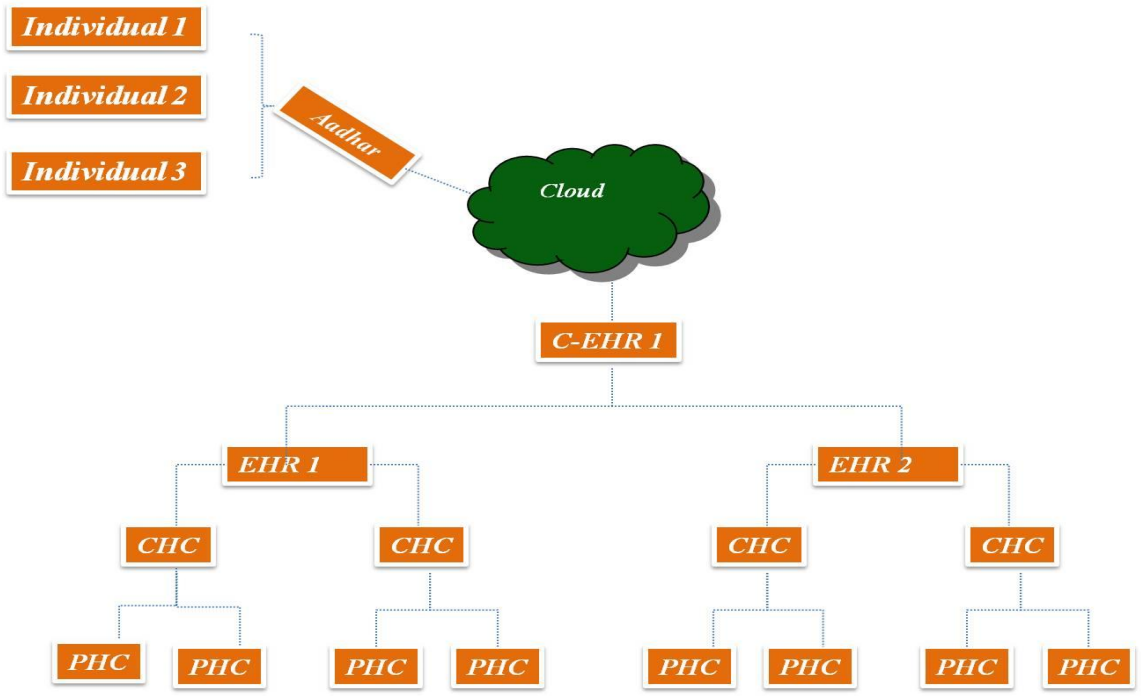


**Fig. 4: Schematic local EHR in a PHC on a cloud network**

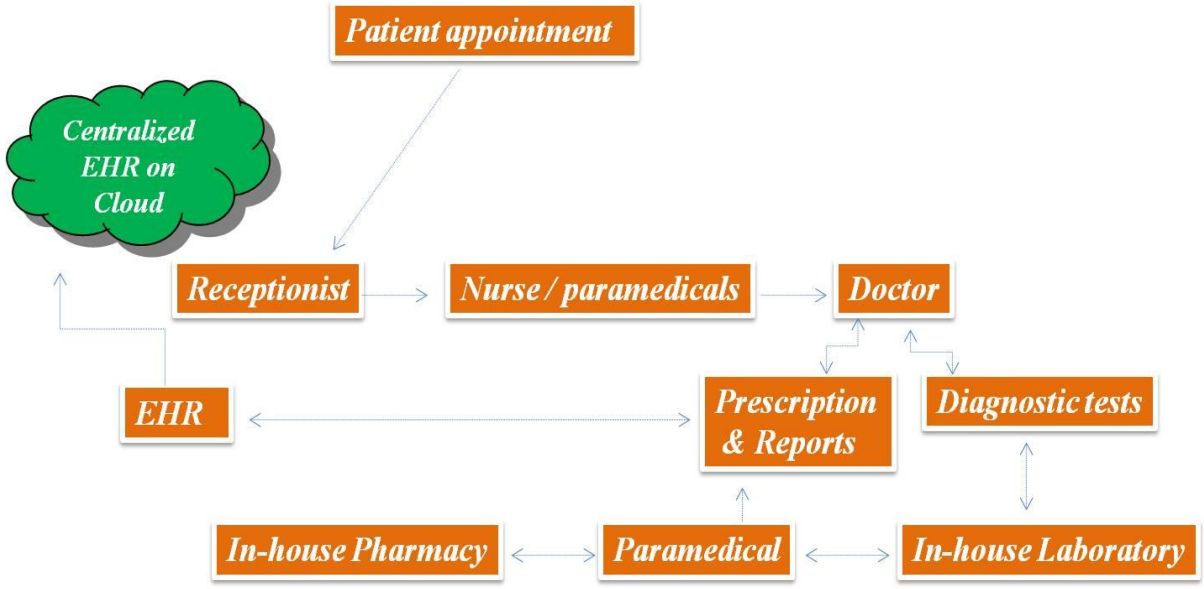


**Fig. 5: Schematic Centralized EHR on cloud through group network**

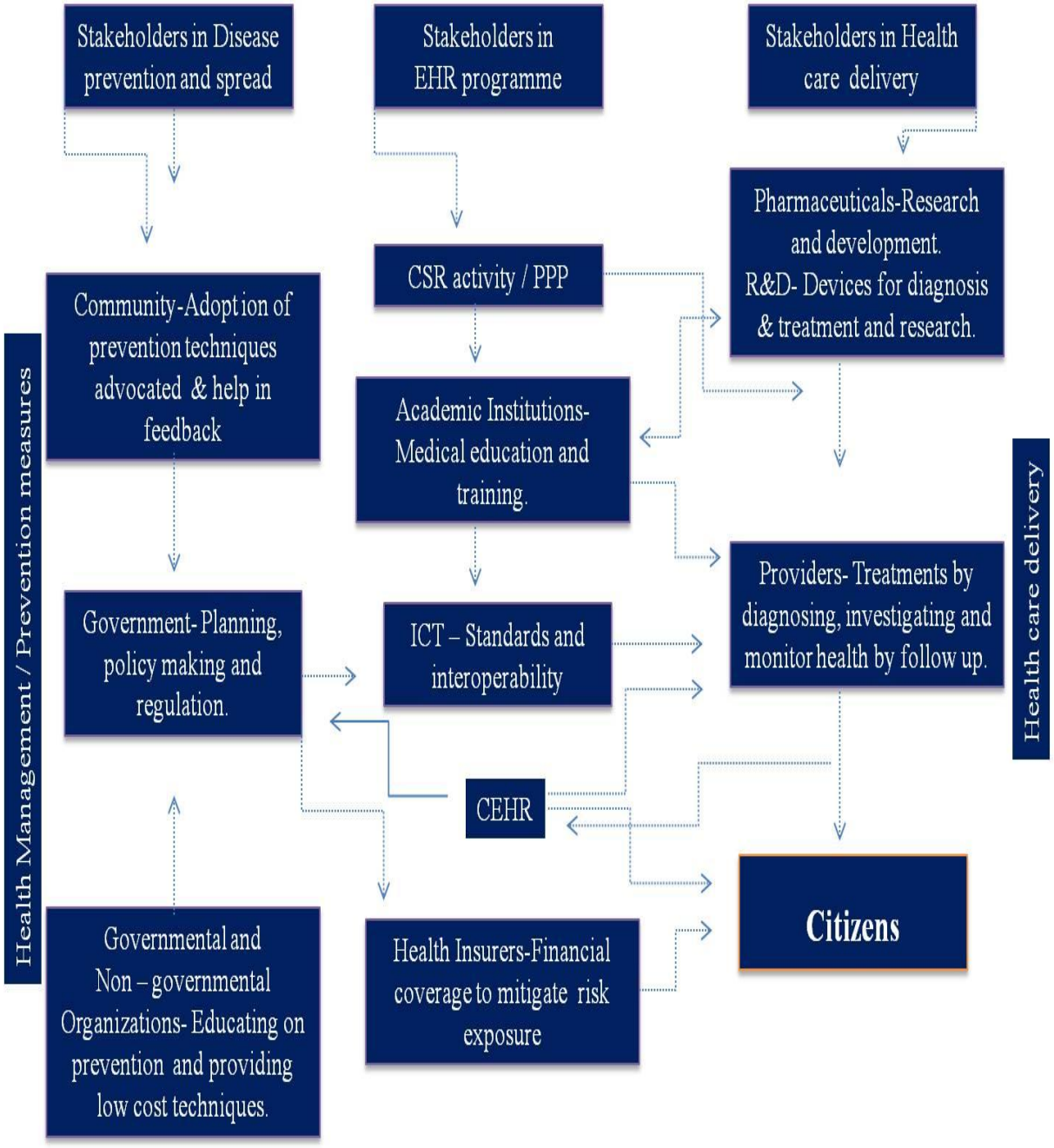


**Fig. 6: Stakeholders in Health care delivery and the concept of CEHR**

## IV. CONCLUSIONS

ICT infrastructure in India is sparse, excepting large medical centres. With National Optical Fiber Network (NOFN), broadband connectivity, cloud-based healthcare delivery can be brought to the village level. Privacy is not guaranteed in the cloud servers, since the patients will not have physical control to their sensitive data. Therefore, the PHR needs to be encrypted to create personalized privacy policy. To ensure privacy and security of health information security mechanism has to be implemented. Country-specific meta-data standards have to be formulated and enforced to make systems interoperable. There is an ample opportunity to IT industry for developing new technologies to make IT friendly health gadgets. Technologies such as Doxper, which is to convert hand written data into digital format which can be used for future purpose, can be integrated with EHR. Government can involve industry under Public-Private Partnership mode taking the advantage of best resource available and CSR funding.

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