Big Data in Health Care: A Mobile Based Solution

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***Abstract*—In the present Indian scenario, healthcare information is independently maintained by hospitals , institutions and not readily accessible in a centralized, informed manner. This greatly limits the health providers' efforts to improve quality and efficiency. Through this paper, we address this issue on bringing various information from many sources into one place in realtime which can be truly life saving. Also, low ratio of doctor to patient and the low per capita income in India hikes the medical expenses thereby increasing the patient's inaccessibility to receive proper health care in their reach especially for people in the rural areas. A means by which the bridge between the patients and doctors can be gapped and how patients can be treated at a lower expense is the prime concern. This paper focuses on the development of a mobile/web application, through which patients sends their symptomatic query to the doctors through a server. The mobile application will be equipped with first aid instructions, according to the nature and severity of the symptoms, either the patients are directed to respective departments or given emergency help for further treatment.Within the time huge amount of data is collected from users and doctors, this big data will be used to train machines to automate the tasks to some extent. The information gained from analyzing massive amounts of aggregated health data can provide useful insight to improve quality and efficiency for providers and insurers alike.This makes the patients reach out for healthcare solutions easily and cheaply and makes healthcare a easy reach for the unprivileged also. Thus, this unified model can serve as a data collection, delivery as well as an analytic tool in the healthcare domain.**

***Index Terms*—Health Big Data; Mobile Application; Centralized health database; Health analytics; Remote Healthcare;**

I. INTRODUCTION

In India, millions are deprived from accessing overburdened hospitals and inadequate medical facilities. According to IndiaSpend, India is short of nearly 500,000 doctors and the claimed doctor-patient population ratio is about 1:1,674 is in India. This is below par with the World Health Organization (WHO) norm of 1:1,000 population. Also, there is an 83% shortage of specialist medical professionals in community health centres (CHCs)[1]. The situation is more worse in the rural scenario where there would currently be at best 2.7 lakh doctors to serve close to 870 million people, that is one doctor for about 3,200 people. Rural India still needs 6 lakh more doctors to meet the WHO norm[2].

In addition to the fact that there is a significant shortage of doctors, doctors are also challenged by the lack of access and insight into the medical history of their patients which can impact the quality of care they can provide to a patient. Health institutions maintain independent medical databases and thus electronic health records are poorly interconnected. There is need of analytics which will provide instant and accurate insight into patient's medical history — including past clinical conditions, diagnoses, treatments, utilization, and outcomes. But unfortunately there is a scarcity of medical datasets upon which analytics can be carried out, and this has been addressed by the real-time data collection feature of our application.So there is a major need to shift from volume based to value based healthcare system. Taking these facts into consideration, we have proposed to automate healthcare solutions and reduce unnecessary medical costs.

A Digitised HealthCare Model for India is proposed which has the potential to revolutionize how populations interact with national health services and also strengthen health systems. It will play an important role in preventive, promotive and curative health. The major advantage of such a system is to detect and predict diseases accurately, easily and faster with the help of machine learning. This is because of the fact that a set of particular symptoms will not always lead to a particular disease and can be causing another set of diseases. So we may be able to tap the appropriate set of diseases linked to the symptoms easily after analysis.

This model also meets the key challenges posed to us in health sector that are shortage of human resources in the sector, accessibility of healthcare infrastructure, affordability of healthcare services especially for the rural population. Some major benefits from the model includes:

- Cutting down recurring medical costs
- Well- maintained medical history
- Secured medical records accessible any-time anywhere
- Centralised system with patients having personalised dashboard for self monitoring as well as for surveillance by the doctors.
- Socio-demographic factors and locations of patients taped and analysed

Thus, this research model can be a great tool in data collection as well as produce real-time data analytics insights[3].

II. SCENARIO

People living in rural areas face major crisis due to shortage of proper healthcare institutions as well as medical professionals. The public healthcare centres and community health care centres are poorly run with less professional human resources

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and limited medical facilities. Also, there is a scarcity of specialized centres. Local medical centre may have medications to provide first aid, but may not have the expertise. People in rural areas have to travel long distances to access proper health care which can be the difference between life and death in the case of emergency. Moreover there is lack of ambulance in the remote areas, even in urban areas to pinpoint the exact location of the patient is difficult, hence we need some kind of interface between the patient and the hospital in order to the save the crucial time. Patient should be given proper first aid during the time until some sort of expert help arrives, not everyone is aware of right kind of first aid in every situation.

Also, doctors often have limited insight into all of the patient's disease and comorbidity status. This missing knowledge can significantly have a negative impact on the accuracy of medication and also lead duplication of medical tests and thus incurs more cost. Knowing about patient's medical history will help doctor to more precisely identify the cause of the patient's condition and eventually lower number of inapt practices during treatment.

III. Related Work

There are various applications used today which try to provide remote healthcare to the patients[4][5]. Few of the most popular applications are

A. AmWell

American Well is ranked as the most popular consumer telehealth app in the world by app analytics services company App Annie. It connects the patients remotely with the doctors. The patients can log in with the application or website with their query and can check for the doctor's profile and schedule a meeting (via video, audio or text). A web based queue will be generated and expected waiting time will be provided. After the meeting, the doctor comes up with remedies and all the necessary steps to be considered.

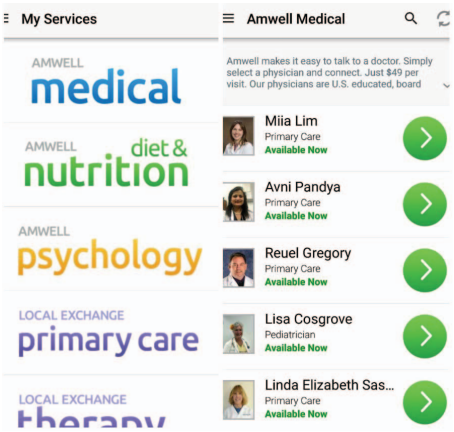

Fig. 1. AmWell Mobile App.

B. Practo

A complete health app to book doctor appointments at clinics and hospitals, order medicines, set medicine reminders, consult doctors online, manage digital health records and read health tips.

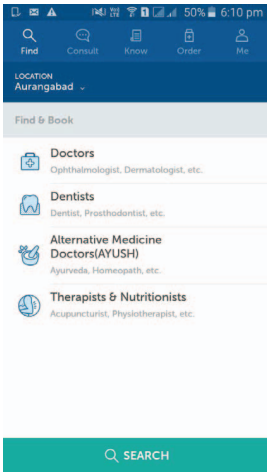

Fig. 2. Practo Mobile App.

C. Portea

Helps patients connect with specialised doctors for consultation and treatment.It also helps delivering medicines online and get medical opinions with hospital-quality nursing care at home.

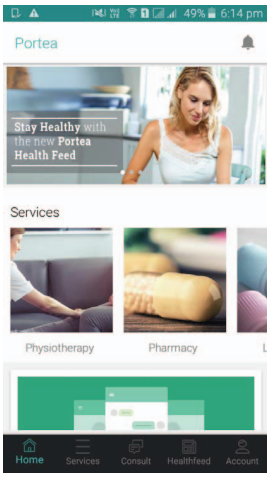

Fig. 3. Portea Mobile App.

D. Isabel (Ann Arbor, Mich.)

Isabel is a clinical decision support tool and gives healthcare professionals access to an online system that helps them arrive at an accurate diagnosis more quickly.The diagnostic tool is to understand multiple symptoms. It has a database of over 6000 diseases and conditions. The results provided also consider age and gender. It helps to research and understand the symptoms so as to have a better discussion with the doctor about the possible diagnoses.

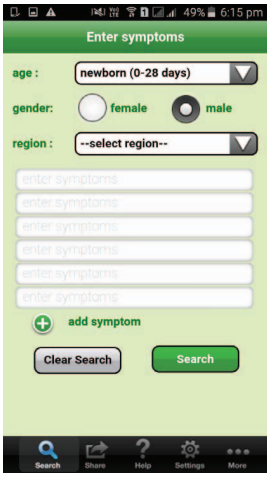

Fig. 4. Isabel Mobile App.

IV. METHODOLOGY

Our motive is to create an automated data-driven model that integrates the process of healthcare data collection, delivery and its data analysis. We believe that this model will enable healthcare organizations and institutions to fully understand and leverage the capabilities of health big data analytics and achieve the ultimate goal by improving the quality of care while lowering costs and enhancing clinician and patient satisfaction.

When an individual's medical history is documented, it helps to assure that health care providers provide the most effective treatment and support for the individual's illnesses and health conditions so that they maintain the best possible health. A person's medical history is made up of many different pieces of information that tell the complete account about that individual's current and past health. The Model aims to provide a centralised platform where patient's database is maintained and thus it will serve as a source to learn about their medical history. It will help ensure maintaining all medical records at a place accessible any time anywhere. It will also help in studying the Socio-demographic factors associated with healthcare.

When the user signs up, unique identification number is generated against which records are maintained. The patient through a mobile device inputs information regarding his/her general details – name, age, gender and major symptomatic query. They can upload voice and pictures also. Using these communication means, vital data concerning the health of the person is sent to the cloud for processing. If the input from the user is in the form of voice, then we will first convert speech into text using google speech to text API[6]. If the data is already in the form of text, then we will send it directly to the server along with the coordinates of the patient obtained by GPS of his/her mobile phone.

A successful and sustainable analytics strategy requires building foundational elements of the model first in order to support the upper levels of the model in later years. Thus initially, there is a need for physicians / medical examiners on the server side to routinely analyse the input of the patient. This analysis contains extracting keywords from the text input received from the patient and storing those keywords into a database along with the original text. The next step of this analysis requires medical examiner to allot this patient to the relevant ward. Moreover this information will also be updated in the above mentioned database. This whole procedure will be automated once we collect enough data from users and achieve desired accuracy.

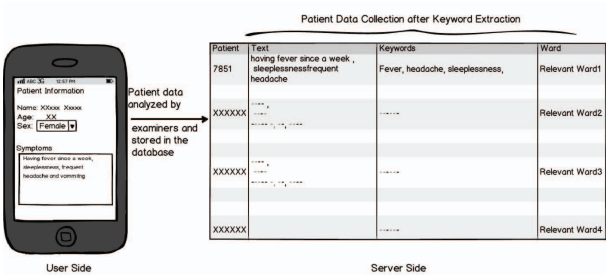

Fig. 6. Data collection feature of our solution.

This learning system, which is trained in the real-time for the whole process will improve overtime with more incoming data points. This method serves as an effective way for collecting data from users. It is this big data which is used for analysis for different purposes. This method can be employed for data collection and further real time analytics. It will help us track/predict the exact disease easily and by what parameters it was mistaken to be another disease preliminarily. The physicians can use the system for decision support by querying the medical literature stored.

Thereafter, communication is established between the nearest hospital and the patient who may be asked for more inputs and answering questions for further medication. After the treatment is over the discharge summary is mined to find the actual disease and is updated again to the database[7][8]. We have divided our server into two layers – first layer will handle non-emergency queries as explained above. The second layer will handle the emergency situations[9].In case of emergency, we will bypass the process of examining keywords and connecting to the ward rather we will directly connect the patient to the nearest hospital using GPS and will dispatch the ambulance right away to the user exact coordinates[10]. Though we will maintain the separate database of emergency situation which can be further analysed and visualised to get the insights.Prescriptions, medicine lists and other medical reports (like X-Rays, Blood tests etc.) are maintained in the database and easily accessible by the patient, at any point of time. The same can be accessed by the doctor appointed for the patient and the patient need not carry physical reports every time.

V. BIG DATA IN PROPOSED SOLUTION

The volume of worldwide healthcare data in 2012 was 500 petabytes. That is estimated to grow in 2020 to 25,000

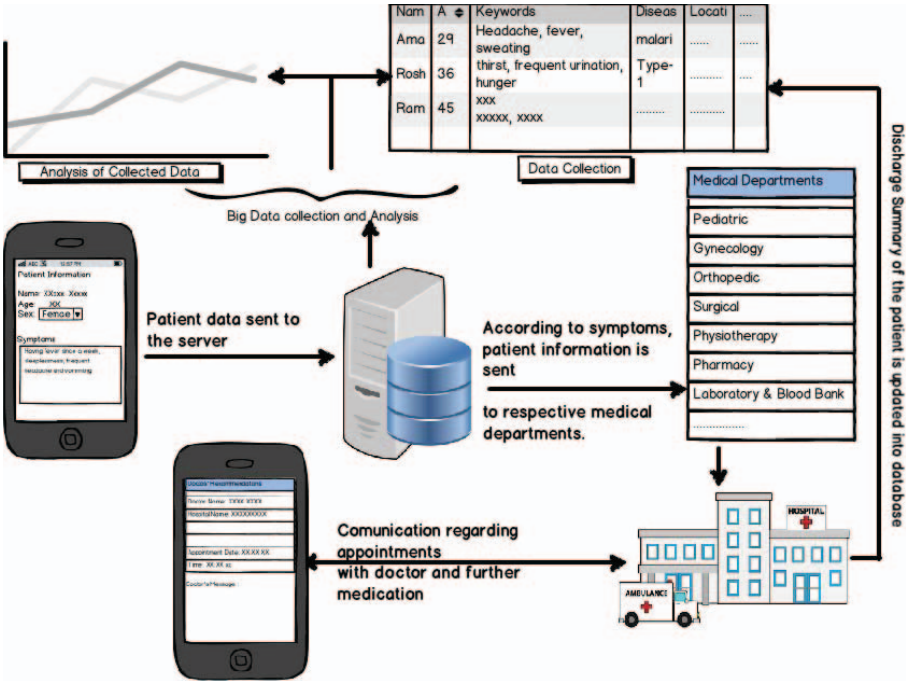

Fig. 5. Flow diagram of the proposed solution.

petabytes - a fiftyfold increase from 2012 to 2020[11]. Thus, Big Data in healthcare domain has great potential to help derive meaningful insights after analysis. Big Data in Healthcare can drive clinical decision support, disease surveillance, epidemic control and population health management[12].

The key function of our application being data collection, data collected can be dealt wih big data technologies. In our proposed system, the patient's input and discharge sheets form the big data. Apache Hadoop provides a technology to process these larger volumes of data and also keep the data on the original data clusters. Per terabyte of storage in Hadoop is, on average, 10 times cheaper than a traditional relational data warehouse system[13]. The Hadoop Distributed File System (HDFS) stores data across multiple data nodes in a simple hierarchical form of directories of files. Conventionally, data is stored in 64MB chunks (files) in the data nodes with a high degree of compression. Hadoop uses MapReduce on the data being processed.

VI. Conclusion

India takes the second place in the world in its population. Increasing population in India over-burdens the health care structure in the country. We see that there is huge incoming data in the health domain. Thus, the proposed model is the solution for efficient data collection, healthcare delivery integrated with analytics. Thus, this system can automate the health care services for patients as well as doctors.

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