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Proposed Usage of ICT and Big Data in Healthcare of Madhya Pradesh

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Abstract: ***This paper gives an insight of how information and communications technology (ICT) in combination with big data analytics can help to improve healthcare services in Madhya Pradesh, which is a state in India having approximately 75 million populations. With ongoing projects like 'Digital India' which will allow computerization of hospitals and digitization of healthcare data. Digital India coupled with ICT, can play an indispensable role in providing effective healthcare services through e-health application like electronic health record, e-prescription, computerized physician order entry, telemedicine, m-health along with the network like State wide area network (SWAN) and National health information network which will allow sharing of healthcare records across the network. Data stored through e-health application is of huge size having different formats which makes it difficult to perform analytics on it. But with big data analytics we can perform analytics on large voluminous healthcare data and useful result obtained from data analytics, patients can be given better and specific treatments. It will also help doctors to exchange their knowledge and treatment practices. This paper also illustrates a case study on M.Y. hospital located in Indore, Madhya Pradesh.***

Keywords: ICT, E-health, Digital India, SWAN, CUG, Big Data Analytics.

I. INTRODUCTION

Information and communication technology have capability to provide innovative and efficient healthcare facility to people where traditional healthcare systems have failed to reach people at large. ICT includes all the communication devices like Computer, its network, radio, satellite, software, telecommunication and storage devices etc. ICT is widely used in healthcare & medical services in many developed countries and has proved to be a blessing for people. Similarly, ICT's can play a tremendous role to improve healthcare and medical structure in the state like Madhya Pradesh (M.P.) of India. Madhya Pradesh is located centrally in India and it covers an area say 3, 08,245 sq. Kilo meters, which makes it India's second biggest state and has population of about 75 million. Madhya Pradesh has the highest child malnutrition, infant mortality and maternal mortality rate as compared to other states in India. It also has poor,
doctor patient ratio around 1:3700 as compared to WHO's benchmark of 1:1000. To relate healthcare services with ICT in Madhya Pradesh we have referred a case study of M.Y. hospital which is Madhya Pradesh's & central India's largest government hospital.

Problem faced by M.Y hospital at Indore in Madhya Pradesh.
In current healthcare system of M.Y. hospital both patients and healthcare authorities face many problems such as

1) Whenever a patient visits to hospital, he has to stand in long queue for registration in OPD.
2) If patient is visiting hospital after long time neither patient nor hospital has previous medical history due to which all the treatment process has to start from scratch.
3) Due to less digitalization it becomes difficult for healthcare authorities to manage large number of patients.
4) Traditional healthcare structure takes lot of time which affects people and discourages them to take treatment, as they work on daily wages.
5) Doctors face challenges in treating patients without previous medical history as in Madhya Pradesh doctor patient ratio 1:1350.
6) During emergency both patient and healthcare authorities have to do a lot of paperwork as they are not aware of patient's health and personal record which consumes lot of time and sometime results in loss of patient's life.
7) Medical practitioner do not have latest medical data as medical data is not stored electronically.
8) Lack of super specialty doctors, proper treatment or consultation, due to lack of connectivity among local doctors.

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It is catering the needs of 70 % population of Indore division.

The healthcare organizations now days generate large amount of data from record keeping of patient related data [1] to genome analysis. Its data type can be both structured (relational database) and unstructured (text, multimedia) so it is mandatory to digitize this data. For computerization of hospitals and digitization of healthcare data, government of India has started "Digital India" project. This project will also allow the deployment of electronic health record (EHR), with the integration of digital locker in it. Digital locker is for personal cloud storage, provided to each Indian citizen by government to store their documents and records online with access to it, irrespective of their physical location. And of course, if data is in available in electronic format, data analytics can be performed on it very easily as compared to data in non-electronic format. Data analytics on healthcare & medical data using big data analytics are widely used. It encompasses Hadoop and MapReduce techniques. Above all "Big data analytics" can help to effectively figure out the hidden facts and figure from large volume of collected data to answer new challenges faced by mitigating cost of healthcare [4].

With the digitization and implementation of ICT along with big data analytics, healthcare and medical service, shortage of doctors and faults in curing of diseases can be improved drastically in Madhya Pradesh.

II. LITERATURE REVIEW

It is realized that to improve the healthcare services in the state like Madhya Pradesh where most of the people reside in either tribal or in the rural area. Here child suffering from malnutrition are highest in the country. Also faces a large shortage of doctors and medical staff. The best way to improve healthcare service, is the

implementation of ICT which has the potential to change the scenario of current healthcare situation of Madhya Pradesh.

Szymon Jarosławski and Gayatri Saberwal in 2014 stated in their paper that e-health is the only option which can provide treatment to the poor people who are yet

unreached by the modern medicine. They also discussed about how the e-health, can bridge the gap of finance between healthcare services and government while a proper training is required to run e-health activity with full pace.

Nasriah Zakaria et al of University of Wollongong in 2010 said, ICT implementation comes with many challenges and issues like lack of communication between different tiers of organization, lack of user training, need of IT experts to make it successful.

Muni Kumar et al in 2014 said that to achieve better outcomes at lower cost, it is important for health care to implement Hadoop HDFS and MapReduce to uncover the information lying in big health data sets [5].

Sokratis Vavilis et al in 2012 showed the impact of ICT on home healthcare, showing how a specific patient healthcare facility can be provided by health data shared by patient to doctor through the telecommunication and how this treatment can be reliable with privacy of patient' data.

European Commission, Directorate-General for Health and Consumers in 2014 discussed about use of big data in public health and research that how the patient level data can be made available to researchers and data scientist to improve the quality and comprehensiveness of care for patients with chronic illness [6].

III. CURRENT HEALTHCARE IN MADHYA PRADESH

Madhya Pradesh follows a three plus two-tier healthcare structure which is also followed across India. The tiers include primary, secondary and tertiary health care.

At the lower level, we have sub centers and primary health center (PHC) which is the basic unit having minimum facilities serving the rural India, each PHC supervises 6 sub centers, sub-centers are most basic units of healthcare in villages and first point for treatment between villagers and public health care. Secondary Healthcare is the second tier of health system where patients from primary health care are referred for specialized treatment [5]. The health Centre's for secondary health care are District hospitals and Community Health Centre. Tertiary Health care is the third level of health system, where in specialized consultation is provided on referral from primary and secondary health care. Specialized Intensive Care Units, advanced diagnostic support services and specialized doctors are the key highlighting features of it.

The state has 8000 hospitals where in only 4100 thousand doctors [7] cater services, due to this scenario; people of this state don't get quality treatment. We have referred M.Y hospital's case study in context to review healthcare service in M.P. and we have found out that in-spite being state's largest hospital it lacks many specialties like limited number of doctors to treat large no. of patients coming from primary and community health centers of states.



Fig. 1. 3+2 levels of healthcare in India.

Sometime many patients lose their life because of communication and information gap, between different tiers of healthcare system. The Infant Mortality Rate is 59 and Maternal Mortality Ratio is 230 in state, which is high as compared to other states of India which is 40 and 178 respectively [7]. The key reason for this situation is government is neither able to provide medical & health services to people nor educating them toward their health awareness.

To full fill the gap of doctors, health and medical staff, state with the help of national rural health mission (NHRM) have deployed Auxiliary Nurse Midwife (ANM) and Accredited Social Health Activist (ASHA) at the root level. ANMs are female health worker at village level in India which act as first contact person between villagers and the health organizations in Madhya Pradesh.

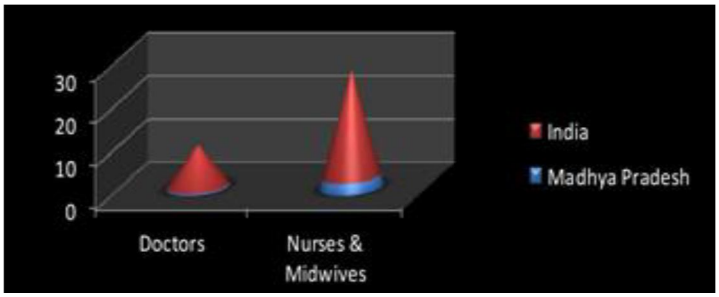


Fig. 2. Comparison between number of healthcare workers (in million)

ASHA, is women community health worker and their job is to motivate women in rural area to deliver their babies in hospitals, bringing children to immunization clinics, encouraging family planning, treating basic illness and injury with first aids. Depending on the area covered by the sub-Centre, each ANM is supported by four or five ASHA workers. ANMs are required to take weekly meeting with ASHAs to review work done [11]. Due to lack of ICT applications state government has recently
introduced facility for doctors, and other health supporting staff by connecting them day and night through cellular phone using closed user group network (CUG).

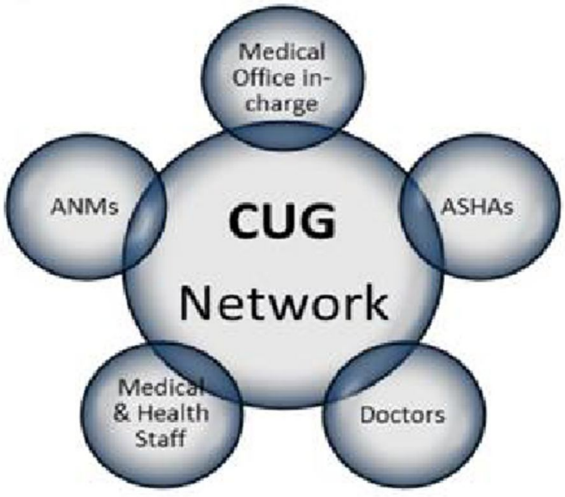


Fig. 3. Closed user group network for doctors, health and medical staff of M.P.

CUG is a group of GSM cell phone subscribers, including all the doctors, medical officer in-charge, ANM, ASHA, medical and health staff. They can make and receive calls from group but lacks SMS facility. With CUG set ANMs and ASHAs in sub center will have facility through which they can coordinate between the community and primary health care Centre. If a health application is installed in CUG set it will allow senior health officials to check out the location of the medical and para-medical staff in terms of operational area and they can also receive feedback in an effective manner thus improving healthcare facilities.

IV. BIG DATA ANALYTICS USAGE IN HEALTHCATE OF MADHYA PRADESH

As discussed above to improve the healthcare structure of Madhya Pradesh, it needs to be computerized. As the health organization at all the tier of healthcare, are generating large amount of data, and making it difficult to maintain it manually, big data is required.
Referring to our case study M.Y hospital which act as tertiary hospital in Madhya Pradesh suffer from the same problems of traditionally storage of health data, due to which patients, largely daily wagers, as well as doctors suffer from this problem, which affect the quality of treatment and also increases the cost of treatment. People of Madhya Pradesh who suffer from child malnutrition, anemia, infant mortality, maternal mortality, chronic diseases like diabetes, cancer, HIV, TB, heart diseases, due to lack of arranged health records, lose their life.
So, by implementing ICT in health structure at Madhya Pradesh several problems can be solved. Following are the ICT and e-health applications that can be deployed in healthcare here:

A. Electronic Health Record

Electronic health record (EHR) allows systematic collection of patient's health data. Data can be stored in local database or it can be stored using cloud storage. Digital India which will play a key role in implementation of EHR in state will link the patient's health data with digital locker. Digi-Locker or digital locker will provide Indian citizen 1 GB cloud storage to store their documents like voter-id, passport copy, aadhar card, mark sheets etc. which would be accessible from any place, thus one can also access his health data from anywhere anytime which can be very useful in case of emergency. EHR not only stores patient's data but it also stores patient's laboratory test result, past medical history, demographics, medication & allergies, immunization status, radiology images, vital signs, personal statistics like age, weight and billing information [8] etc.



Fig. 4. Electronic Health Records Working for Healthcare in Madhya Pradesh

One of the biggest advantages of EHR is that physician will have patients complete past medical history allowing them to give more specific treatment to patients with reduced cost and time.
Doctors can be consulted at remote super specialized hospitals for advice regarding the line of treatment possible. Another thing which EHR allows is sharing or exchange of healthcare data among the different units in hospital which again saves lots of time of patients. As the data generated by healthcare system of M.P. would be large in size and would be both structured and unstructured and will be regarded as "big data". Big data analytics or health analytic can be now done easily on this data using different techniques like classification, clustering, image processing, association, sequence analysis, segmentation, regression and with the tools like hadoop, google refine etc. The outcome of big data analytics can uncover hidden facts and figures by improving healthcare services. With the help of EHR we can develop SMART HEALTH applications, these applications can use EHR data linked with the Digi-Locker through the aadhar card help, for the specific or personal treatment as well as the public healthcare.

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B. E-Prescription

E-prescription or e-prescribe is a computer-based system which generates, store and transmit a medical prescription by doctors or medical staff electronically against paper prescription. E-prescription allow doctors, health and medical staff to electronically transmit a new prescription to a pharmacy or researcher with accurate, understandable and error free data. It also reduces the risk associated with paper prescription script losing and it also provide transparency of medical data. It also pushes toward electronic medical record (EMR) which help researcher in drug analysis and to develop new drugs and vaccines also will help individual fight legally against wrong & unnecessary treatments. Referring to case study of M.Y. hospital where thousands of people come regularly here prescription is completely done traditionally with paper work. With implementation of e-prescription it can save a lot of time of patients as well as of physicians.

C. Computerized Physician Order Entry

Computerized Physician Order Entry (CPOE) is system which allows electronic entry of physician's prescription for the treatment of patients. Advantages of CPOE is that it mitigates the errors related to poor handwriting of doctors or transcription of medication orders [9]. It's like a work or treatment chart of patient and involves different units of hospital like pharmacy, laboratory, billing departments etc., to full fill the orders thus CPOE maximizes usage of resources, saves time, timely & proper treatment of patients. CPOE can be linked with EHR and e-prescription to enhance healthcare capabilities.

D. State Wide Area Network (SWAN)

State wide area network (SWAN) is a government of India initiative, to connect all the government departments through a common network, provided with high and secured connectivity, by now 29 states have deployed and started services of it. SWAN connects state headquarter to district head quarter with 4 Mbps bandwidth, similarly it connects district headquarters with block or tehsil headquarters with 2 Mbps bandwidth per link. Through SWAN, one can share the data from one tier to another tier of organization. Bandwidth of SWAN between state HQ and district HQ can be extended to 32 Mbps where bandwidth between district HQ and block HQ can be extended up to 8 Mbps per link. SWAN is modeled as the converging backbone network for data, voice and video communications throughout a state [10]. Swan network is also implemented in Madhya Pradesh and government departments like police. Ministry of law, departments of registration are using it. But SWAN is yet not implemented in healthcare system of Madhya Pradesh, if SWAN is deployed in healthcare system all the tier of healthcare ranging from a sub-center to tertiary care & medical college can be connected together and can share or exchange healthcare data & information among each other.

SWAN which can act as key application of ICT in Madhya Pradesh have capability to change healthcare services completely as doctor patient ratio is very low here, with the use of telemedicine through the SWAN, doctors from tertiary healthcare can efficiently treat patients at sub-centers or at remote location and this can be very crucial at the time of emergency and can save life of many patients, also fulfilling the gap of doctor- patient ratio.

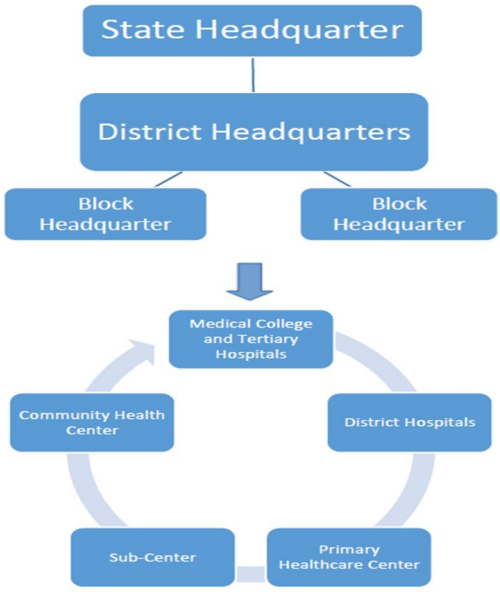


Fig 5. Proposed implementation of SWAN in healthcare of Madhya Pradesh

E. Telemedicine

Telemedicine is the digital way of treatment and medical consultation of patients from tertiary center to primary health center. It uses telecommunication and information technology for transformation of medical information and clinical treatment between distant locations. Madhya Pradesh where infant mortality, maternal mortality and malnutrition ratio is high, telemedicine can be used for treatment with the help of ANMs and ASHAs as they are always present at grass root and in case of emergency with telemedicine specialist doctors can treat them irrespective of their location and also telemedicine can be used for educating people at rural & remote location toward the health awareness and basic self-treatment in case of emergency.

F. Mobile-Health

Mobile health or m-health is used for practice of medical & health care, to improve public healthcare using mobile phones. It can be referred as smart health. M-health includes developing and deploying of applications related to healthcare which guide people about their treatment, diet chart, precautions, symptoms of diseases, preliminary action in emergency using smart phones, internet etc. M-health can be effectively used in Madhya Pradesh as availability of internet and mobile connection are in good numbers.

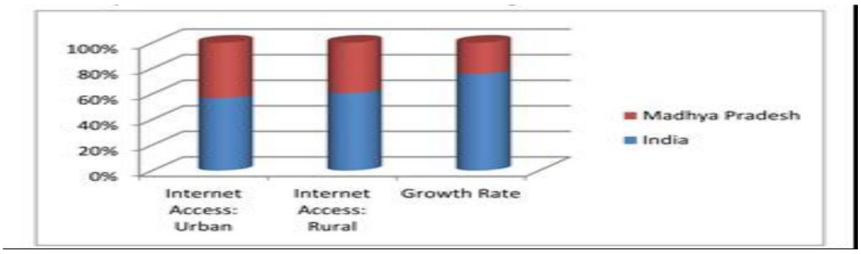


Fig. 6. Internet user in Madhya Pradesh

There are around 2.5 million smart phone user in Madhya Pradesh and if a health application with video and audio services is deployed it will be a major boost up for the people living in rural area as they can connect with the doctors and physician through it and doctors can also give them on-spot treatment saving time and money of both. M-health application can provide awareness among female patients toward their health as they are shy visiting male physician, but with m-health application, they can share personal information and then go to hospital for treatment. M-health applications with CUG data sets among ANMs and ASHAs can be effective as they can exchange data easily.

V. PROPOSED IMPLEMENTATIONS OF ICT FOR HEALTHCARE IN MADHYA PRADESH.

Big data analytics is a technique which examines large amount of data of different data type to uncover the hidden facts and figures. Madhya Pradesh's health industry is generating day to day large amount of data from patients about their health. Genome analysis and with the implementation of ICT the data is going to increase drastically. Thus, this data can be termed as big data. The sources of data on implementation of ICT in M.P. are listed below in the diagram.

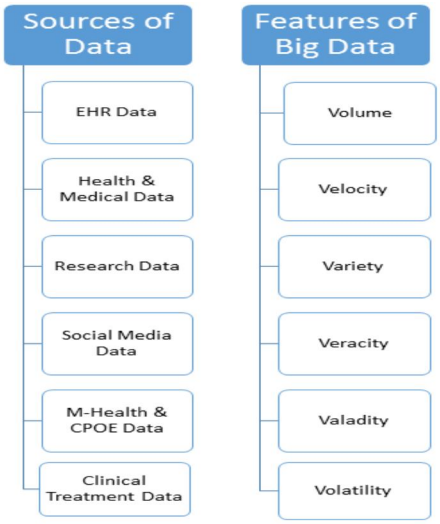


Fig. 7. Sources of healthcare data and Features of big data

Features of big data

1) *Volume:* It refers to large amount of data from different sources of healthcare data as shown in diagram above.
2) *Velocity:* Different tiers of healthcare simultaneously generates large amount of data. Telemedicine in which data comes in megabyte per second speed it is important to manage this data efficiently.
3) *Variety:* It refers to many sources of data both structured and unstructured. They are used to store data from sources like spread-sheets, databases, emails, photos, videos, monitoring devices, telemedicine, sensors, EHR etc. This unstructured data creates problems for storage, mining and analyzing data [4].
4) *Veracity:* It refers to the noisy and abnormality in healthcare data [4].
5) *Validity:* It refers to time dependent data in healthcare like in telemedicine patient's information of each second is important during treatment. If data reaches late patient's life is at stake [4].
6) *Volatility:* It refers to how long data is valid and should be stored and if obsolete should be deleted [4].

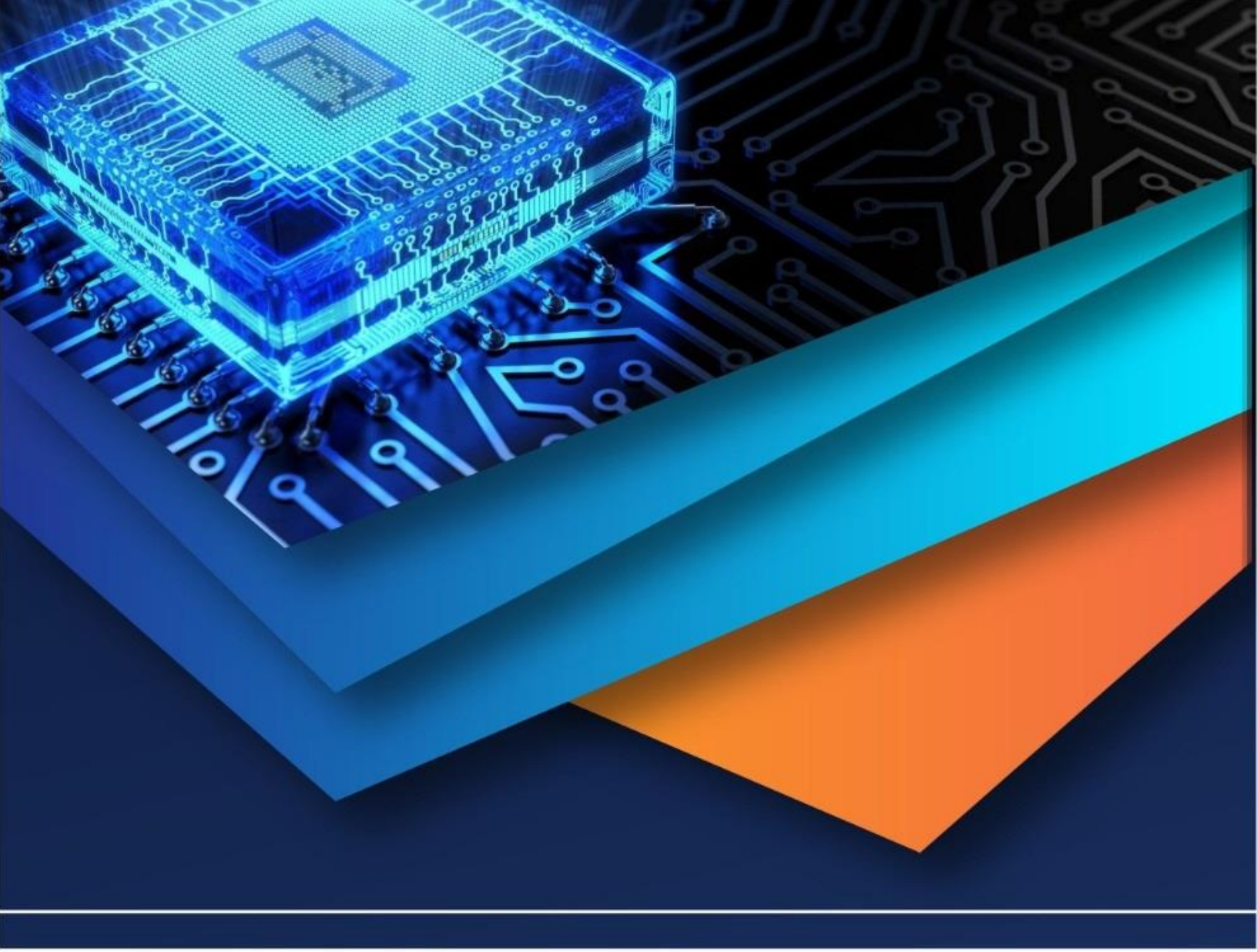
Big data analytics can be performed on this data with the tools like Hadoop. Hadoop and HDFS (Hadoop file system) are used for data storage and processing, Hadoop being scalable, open source and fault tolerant may be used. It runs on commodity hardware using HDFS having features like fault tolerance, high bandwidth and clustered storage architecture. For distributed data processing of structured and unstructured data it runs MapReduce [2]. MapReduce is a programming paradigm that allows for massive scalability across hundreds or thousands of servers in a Hadoop cluster [3]. Other analytics tools like OpenRefine which removes noisy data and abnormality makes the data ready for analytics by cleaning. Machine learning, visualization also help in analytics of big data. Big data analytics on EHR, m-health, telemedicine, e-prescription data will also allow policy makers and higher authority of M.P. to launch additional health and medical program to improve healthcare services of that area, also it will provide real time analysis to researcher who can develop drug or vaccine for new diseases, virus or infections.

VI. CONCLUSION AND FUTURE WORK.

In Madhya Pradesh, its large population resides in rural area. With reference to M.Y. hospital case study, we realized that digitization of all tier of healthcare structure is the need of hour. With digitization we would store health data through EHR, e-prescription and create a bank of health and medical records. And with the help of SWAN & CUG we would exchange or share this data throughout the state leading to transformation of the current health structure and providing better health & medical facilities to people at large. Super specialty treatment can be imparted to people at remote locations, by use of telemedicine and mobile telemedicine treatment which can be done through the implementation of ICT from sub centers to tertiary healthcare. Proactive and individual health treatments can be facilitated to people with the implementation of smart healthcare services like m-health & e-health. M-health can be linked with EHR data and patients with the help of healthcare applications on their smart phones can find doctors, laboratory, blood bank, medicals nearby, and can also share their medical & health details to get proactive treatments. On the other hand, with the help of big data analytics we can find out hidden information from the voluminous healthcare care data which will help in patient specific treatment, to uncover the reason behind chronic diseases and will also help researchers in genome analysis as well as discovery of new drugs & vaccines. In states like M.P. where doctor- patient ratio is very less, we feel that ICT and big data has capability to provide quality healthcare services throughout the state. İn this paper whatever we have proposed we will work further towards its implementation and realization in the interest of people living in Madhya Pradesh and India.

REFERENCES

[1] Wullianallur Raghupathi and Viju Raghupathi. Big data analytics in healthcare: promise and potential, http://www.hissjournal.com/content/2/1/3; 2014.
[2] Puneet Singh Duggal: Big Data Analysis: Challenges and Solutions, International Conference on Cloud, Big Data and Trust; 2013.
[3] Mapreduce. https://ibm.com/software/data/infosphere/Hadoop.
[4] Mimoh Ojha, Kirti Mathur. Proposed Application of Bigdata Anaytics in Healthcare at Maharaja Yeshwantrao Hospital. In: IEEE 3rd MEC International Conference on Big Data and Smart City (ICBDSC), IEEE Oman Section, Muscat; 2016.
[5] Muni Kumar and Manjula R. Big Data Analytics in Rural Health Care - A Step Towards Svasth Bharath, International Journal of Computer Science and Information Technologies, Vol. 5 (6) , 2014, 7172-7178, ISDN 0975-6946; 2014.
[6] European Commission, Directorate-General for Health and Consumers, Unit D3 e-Health and Health Technology Assessment; 2014, http://www.ec.europa.eu/health.
[7] Rural Health Statistics Report; 2014-15. http://nhrm-mis.nic.in/Pages/RHS2015.asp.
[8] John A. Gale, David Hartley, Zach Croll, Meaningful Use of Electronic Health Records by Rural Health Clinics, Muskie School of Public Service University of Southern Maine, 2014.
[9] Computerized Physician Order Entry, Promise, Perils and experience, Raman Khanna and Tony Yen, http://journals.sagepub.com/doi/10.1177/194187441349570.
[10] SWAN. https://deity.gov.in/content/state-wide-area-network.
[11] ASHA. http://nrhm.gov.in/communitisation/asha.



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