

ADOPTION OF NEW TECHNOLOGIES IN HEALTHCARE AND ITS IMPACT ON QUALITY OF CARE

Dissertation Submitted to



The IIHMR University, Jaipur

for the partial fulfilment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

By

Purnima Rathore

Under the Supervision and Guidance of

Dr. Deepti Sharma

2021

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **ADOPTION OF NEW TECHNOLOGIES IN HEALTHCARE AND ITS IMPACT ON QUALITY OF CARE** is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

(Signature)

Name of Student: Purnima Rathore

Date: 21/06/2021



CERTIFICATE

This is to certify that **Purnima Rathore** in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her internship at **ExpressRCM Private Limited** from March 22, 2021 to June 19, 2021.

Place: Jaipur
Date: 21st June, 2021

A handwritten signature in blue ink, appearing to read "Gaurav Mundra".

Gaurav Mundra
CEO

ExpressRCM Private Limited

th

5 Floor, 306, 308, 309, Gomes Defence Colony, Vaishali Circle, Vaishali Nagar, Jaipur – 302 021 Rajasthan

CERTIFICATE

This is to certify that dissertation titled ADOPTION OF NEW TECHNOLOGIES IN HEALTHCARE AND ITS IMPACT ON QUALITY OF CARE is a record of the research work undertaken by (Name of Student) in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management)/MBA (Pharmaceutical Management)/MBA (Rural Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide: **Dr. Deepti Sharma**
IIHMR University, Jaipur

Date: 27/06/2021

School Dean: **Prof. P.R Sodani**
IIHMR University, Jaipur

Date: 27/06/2021

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TABLE OF CONTENT

TOPIC	PAGE NUMBER
DECLARATION BY STUDENT	3
CERTIFICATE FROMM ORGANISATION	4
STUDENT SELF CERTIFICATE	5
ACKNOWLEDGMENT	6
ABBREVIATIONS	8
INTRODUCTION	9
AIMS AND OBJECTIVES	10
METHODOLOGY	10
LITERATURE	11
RESULTS	21
DISCUSSION	22
CONCLUSION	24
REFERNCES	25

ABBREVIATIONS

IOMT: Internet of Medical Things

AI: Artificial Intelligence

CAD: Coronary Artery Disease

EMR: Electronic Medical Record

EHR: Electronic Health Record

RFID: Radio Frequency Identification

ICD: Implantable Cardioverter Defibrillators

DHRs: Digital Health Records

CIMS: Computerized Information Management System

HIMS: Hospital Information Management System

3D Printing: 3 Dimensional Printing

CHAPTER 1: INTRODUCTION

As technology is permeating various sectors a lot of innovation and development can be seen in these sectors too.

The healthcare sector is one of the most prominent sector where technology is actually leading to a lot of innovations as well as improving the clinical outcomes. Remote consultations from various specialities, access to some of the best diagnostic tools and availability of various mobile apps has led to a better outcome for patient's health overall. Over the years, the adoption as well as acceptance of technology resulted in better diagnosis and treatment for the patients.

Technological developments and advancements are getting adopted quickly into the healthcare sector in some parts of the world than others. As technology is rapidly growing its pace in healthcare, Healthcare providers who are working on the frontline are now conveniently and very easily using computers and laptops to record real-time patient data and then sharing it instantly within their updated medical history as well as with their system is an excellent example of acceptance of technology by workforce. Although Developed nations are able to harness these changes more efficiently as compared to developing nations. Medical and paramedical staff who haven't yet adopted the tools and technology, are now realizing their potential as well as importance and are making the required changes to streamline processes, cutting costs, increase overall flow efficiency and to improve quality care.

One of the major problem technology addresses is the shortage of proper facilities, technology can help to cover vast population and provide them facilities. Along with that accuracy is vital in healthcare as well, humans are prone to error but with the help of proper technology human errors can be minimized. Various healthcare facilities like laboratories, diagnosis centre, research centre, hospitals are using technology to provide accurate outcomes. In recent times it has been discovered that it's possible to treat chronic diseases with some enhancement and development in the procedure of treatment. This study covers various diseases and how these diseases can be cured with the help of various advancements while taking care of patient's health and reducing life risk. (1)

Although there are lot of advantages of involving technology in health sector there are some challenges that need to overcome too. This report deals with various challenges of technology and how the world needs to adopt new changes for better.

In this report, we will see, why the adoption of technology is lower in healthcare sector compare to any other sector. Also we will go through other challenges and difficulty in adapting technologies. In this report I focused on various technologies and therapies and their use in various diseases. It intends to reduce the risk of life and help in enhancing the quality of care.

CHAPTER 2: AIM AND OBJECTIVE

A research study designed to understand the adoption of new technologies in medical and healthcare and has the following general and specific objectives:

General objective:

To study the impact and challenges of technological advancements in healthcare industry.

Specific Objective:

- To study the growth in the medical sector due to advancement in technology.
- To study the various benefits in the treatment of various diseases
- To study the challenges in the adoption of technology by health professionals.

CHAPTER 3: METHODOLOGY

This paper is a descriptive research. A transparent approach was used for research synthesis so that the bias can be minimized. Multiple databases were used as sources for this literature review. Google scholar, PubMed and PMC were utilized, to search paper related to the main objective key words have been used. The author systematically searched the English-language literature indexed (2010 to 2021).

Internet has been used as the main method of data/literature collection because of its infinite access to various authentic networking. Articles and papers appeared in the search are further narrowed down based on how recent the research is, to obtain the better results.

Sources used in the research are selected on some criteria, first is source should be authentic and renowned and the second is source must be in line with the purpose of literature review based on the objective of the article.

Only those articles which are peer reviewed are taken in this paper. After selecting the articles/papers/data, I checked if the correct research procedure is followed in the papers or not. A variety of key words has been used to locate different articles such as *Healthcare IT, Technology and care, Quality of care, Technology adoption, IT adoption* etc.

The type of articles that has been added which addressed the workings or implementation of a health technology system: systematic reviews, including meta-analyses; descriptive “qualitative” reports that focused on exploration of barriers; and quantitative reports.

Literatures are not excluded based on which type of data has been used, both qualitative and quantitative data type are included if they are aligned with the proposed research question. Only those literatures and papers that were thematically aligned with the research question and which have met the inclusion criteria were included and summarized. Relevant details regarding the objective of study are extracted from each paper. All the literatures are crosschecked with name of their authors and official source of data that has been used.

CHAPTER 4: LITERATURE

The health of an individual depends on various factors like lifestyle conditions, resources and support available in order to access the provides facilities, societal status, educational background as well as genetic factors too (6)

The health of people or a community not only depends on the society or environment they are living in but also on various other factors such as sanitation and transportation facility, employment, quality of education, availability and accessibility of health centres etc. An unhealthy community leads to a number of chronic diseases such as heart disease, cancer,

diabetes and more. Thus, to have a healthy lifestyle adequate health facilities are of utmost importance.

The key determinants of quality of healthcare apart from medical conditions are the following:

- **Economic stability:** According to healthy people campaign 2020, economic stability is one of the social determinants of health. It comprises of housing stability, employment, food security as well as poverty.
- **Accessibility:** Access to quality healthcare is another determinant. It not only defines an individual health but also the health of the community. In most parts of the world, a very large segment of population is devoid of very basic primary healthcare
- **Education:** This determinant talks about the literacy level of the people in a community and their access to educations centres, schools and colleges. Enrolment for higher education determines the educational status of a society
- **Community Safety:** It includes the crime rate, violent activities and their impact on mental health of people of that particular community
- **Income:** This basically determines the societal status of an individual in a community. Income is the very basic standard of determining poverty as well.

Thus, the quality of life depends upon various factors. With technological advancement life is moving with a rapid pace and therefore it is very important to keep check of regular day to day activities to maintain a healthy lifestyle and to maintain quality of life. (21)

THE NEW TECHNOLOGIES FOR VARIOUS MEDICAL CONDITIONS IN HEALTHCARE

The use of various technologies in healthcare has improved over the time. With this increase use of technology, it's very vital to provide proper training and instructions to medical workforce so that they can use this technology with ease and drive utmost benefit out of it. (19) Various studies from past 10 years talks about how the approach towards healthcare has changed and how easy it is in today's world to connect with a doctor who is miles and

thousands of kilometres away from patient. Technology has changed the overall scenario of healthcare for better. There are many technologies which are getting used in treatment for a number of diseases. Let's take a look at some of the examples:

EYES:

It is one of the most important organ and sense in human body. More than 70% of what we perceive comes from our sense of sight. Therefore, scientists and researchers are continuously studying about different treatments for human eye vision. To improve eyesight following are some treatments with the help of technology to improve eyesight related disorders:

LASIK:

It is a type of eye surgery which treats myopia, hypermetropia and makes a patient life glass/lens free. During this procedure, a flap of cornea is being cut off and flips it open to the stroma. (18) On technological front, to correct the shape of cornea laser pulses are being applied to the middle area of the eye. Lasik effectiveness rate is also commendable as 96% of patients are able to get the favourable results after surgery. According to a study, most of the people who get their Lasik done remains happy and satisfy with the treatments and even happy with their vision after 10 years. It is a little costly when it comes to pay the bills as most of the insurance also don't cover Lasik. It's been in action from more than 25 years now and approximately 40 million procedures are performed till now.

WAVEFRONT ANALYSIS:

There are some eye related disorders, specifically refractive errors which can't be corrected with the help of glasses simply but with the help of wavefront analysis doctors can detect the vision problems and other errors in the patient's eye just by creating map activity when as eye focus on light.

ARGUS:

It is kind of a device which is used to bring artificial vision to the patients. It replaces signals from light-sensing cells of the eyes.

REPROGRAMMING CELLS:

A professor at Kyoto University named Shinya Yamanaka, has discovered this technique of reprogramming cells in which the retina of an eye can be produced with a skin cell. This very same technique can be used to create any other lost body part as well. This is also one of the technique to cure partial blindness.

SKIN:

Light therapy is usually used to treat skin related disorders or issues such as pigmentation, sun burn, excessive hair growth. This treatment of light therapy not only beautifies or rejuvenates skin but also protect it from skin cancer. It uses the photosynthesizing drugs that can be applied to the skin and they react with oxygen that helps in killing cancer cells. (12)

Yellow light therapy effective for various skin issues including redness such as or Rosacea. It

works by penetrating the skin through the various level of skin that is stratum corneum, epidermis, dermis, hypodermis, and then muscle tissue. It works by stimulating the production of red blood cell that helps in the skin healing and skin cell rejuvenation. This treatment is ideal for various skin conditions that involve redness. It has a soothing effect that reduces the appearance of dark spot swelling and inflammations. (20)

The key benefits of this treatment are:

- It is a drug-free alternative for treating skin redness and inflammation. It heals skin irritation and rosacea.
- It has a vital role in skincare as it reduces fine lines and wrinkles. It enhances red blood cells and does increase cellular growth. It helps in removing toxins from the targeted area by boosting lymphatic flow. It reduces the appearance of tiny blood vessels on the nose and face. It heals UV radiation damage.

HEART:

Heart is a very sensitive and never tiring organ of the living beings. In current times, people are facing a number of heart related disorders. Technology has appeared as a boon for the people suffering with these diseases. Due to limitation of resources and lack of technology

there were lots of uncured cases but now cardiologists are also getting accompanied with a lot of technology in order to treat diseases.

Peripheral artery disease patients can have many tools to make them aware of the daily basis activities, diet and exercise they are doing and can share their prescription in real time with their doctor using video call and can stay in touch with the service providers regularly. (10)

Following are some of the advance technology for treatment of cardiovascular diseases that are revolutionizing treatment of heart disease:

STEM CELL THERAPY:

Stem cell therapy is an effective treatment for cardiovascular disease like coronary artery disease CAD, heart attack, heart failure, etc.

This therapy can repair and regenerate damaged heart cells. Bio cardia is a clinical strategy regenerative medicine company that develops that develops innovative solutions that helps to cure heart failure. It has achieved positive results and has over 45% of patient's feedback. According to one trial, the average patient saw improvement in less than 6 months as compared with surgery that involves a very long time. (9)

IMPLANTABLE DIFIBRILLATORS:

If there is any patient which has cardiovascular disease, any heart muscle, heart attack, disturbed heartbeat or heart rhythm can be benefitted with the use of this device. It is an implantable device which is also automated with a small ICD battery that give electric shocks. These electric shocks help in correcting the irregular rhythms of heart.

THE CHALLENGES THAT ACT AS A BARRIER FOR ADOPTION OF TECHNOLOGY IN HEALTHCARE

The advantages which technology provide to this healthcare sector, the challenges come hand in hand. Exposure of medical data to a system foremost gives the first disadvantage of data breach and if not that severe digital risk. Healthcare system is very complex as well as layered and there is data in every layer so it is at risk without any doubt.

- 1) **Cyberattack risk:** When we look at the current scenario it's pretty clear that the IOMT has grown a lot but cyberattack risks has grown simultaneously with it and

that is because of lack of standard security. The rise in the healthcare data that is almost 87.8% in the last two years without proper security measures to protect the data is a great reason for it. (15)

- 2) **The risk of dynamic workforce:** Healthcare has managed to pave its way in remote and rural areas of country and it is getting equipped with advance devices and gadgets as well for better patient outcomes. The disadvantage here is the healthcare workforce in rural areas is faulty and management system in those centres is also catastrophic which again become one of the challenges as staff are not properly trained and their lack of knowledge and hands on practice can get hazardous for patients.
- 3) **Lack of proper training and on boarding:** As discussed in the second point about how important it is to have a trained staff working round the clock. When we talk about staff it's not only doctors but also medical equipment managers, engineers, ventilator specialists, paramedical staff etc. A hospital which is treating a huge chunk of patients' needs to have significant number of employees and proper applications developed for their training. (14) The more efficient and tech friendly the staff is better is the clinical outcome.
- 4) **Rules and regulations around data integrity:** There are standardised and defined set of rules and regulations but the need to make them strict is needed. (24) Healthcare organisation and data entry mistake are ranked as one of the causes of death of patient due to negligence. The entry of wrong data in patient medical form can lead to wrong medications, treatment, lots of expenditure and ultimately the death of a patient.
software which is a little bit difficult for fresher's after a session of training only. (16)
- 5) **Another issue is with time:** Replacement of trained employees to freshers happens, which sometimes make it difficult to train the employee and onboard them and sometimes their work pace gets due to this. Also the traditional process of learning is comparatively easy to gauge than this newly developed eLearning method.

IMPACT OF TECHNOLOGY IN THE HEALTHCARE INDUSTRY

Technology has brought several changes to healthcare, not only doctors and service providers have access to all the data and records but patients can access their medical

data and records at any time from any place. Advanced diagnostic procedures, brand new cutting edge treatments and procedures has led to increase in life years and faster recovery. There is an improvement in health of patients and community due to the use of smart apps which do real time monitoring, virtual consultations with doctors, all of that led to improved patient outcomes.

Table 1.1: The following table explains the impacts and results that have influenced the healthcare industry:

IMPACT OF TECHNOLOGY	EXPLANATION
EMR/EHR and Health Record Digitalisation	Digital medical records is the main need of the hour as traditional way of record keeping results in large files with hefty amount of paperwork. With the rapid evolvement, cloud storage and migration came off as a strategy in which all the medical data can be stored at one place. This data then can be accessed by doctors, service providers, healthcare organisations as well as patients. The storage of data in this way can also makes it compatible with various other organisations. So in need data can be transferred from one entity to another entity with the help of cloud migration. (28) This cloud technology is integrated with EMR and EHR also, this cloud based EHR soft wares can help in running small clinics as this software is highly accessible, provided you have a practioner's license and you are allowed to access the data of a given patient, the only requirement is internet. Remote or inaccessible areas also have access to computerized records as it

	facilitates efficient and reliable delivery of reports. (29)
MOBILE APPLICATIONS	Smartphones can now be counted as one of the basic necessity by looking at the drastic use of it in recent times. Almost everyone in the world has mobile and it is a one click solution to any problem, be it healthcare. Patient can book an appointment on phone, get automated reminders for the appointment scheduling as well as can get a consultation virtually. Even after the consultation patient can get online prescription and can order medicines online by various pharmacy chains such as 1mg. The whole patient journey can be virtual. (29) Gone are the days when patient needs to wait in a long que for their consultations. Now with everything at fingertips the accessible part for a vast segment of population has been addressed. Out of the 3As of healthcare, accessibility and availability are taken care of with this smartphone, the only A of affordability still require a lot of work on execution front.
TELEMEDICINE & TELEHEALTH	One of the major barriers of distance has now been overcome by this new emerging technology known as telemedicine. Doctors and patient can connect to each other irrespective of distance via electronic medium and doctors can provide consultations to patient this whole process is known as teleconsultation. It is taking a boom specially in these unprecedented times of Covid 19,

	where going physically for the treatment facility is more dangerous than suffering. A lot of applications has also been developed recently which are providing free teleconsultations to patients, one of that application is known as ekacare, where volunteer doctors in this time of need are ready to take consultations of the needy. Thereby, covering that another A of 3As that is affordability.
RFID Technology	Radio Frequency identification is a technology comprised of tags and readers, it is an automated device which collects, stores data and then automatically enter it a computer system with the help of radio waves. (30) In healthcare it can be worn by patient as a wrist band which can be monitored with a transceiver. Every moment of the RFID tag passing the transceiver will be recorded thus complex logistic processes of any kind can be monitored easily. These tags provide quality information on whereabouts of a patient, employees, products as well as disposables. RFID tags can also be used to check waiting time of patients, logistics of blood related products and they are also a part of quality control.
Digital Assistants in healthcare	Assistants like Alexa is very famous right now due to its ability to interact, this kind of assistant has also paved its way in healthcare. A number of organisations and start-ups has started integrating this virtual assistant that

	can understand the conversation between a patient and a doctor. In this times of pandemic, a digital assistant helps companies to consolidate data about their employee's health as well as help in detecting the possible cases.
Artificial Intelligence	A replica of human intelligence, not completely but quite effectively. AI has revolutionized healthcare in every possible aspect. One of the most promising feature of AI is to draw useful insights form readily available data of patient. The AI is getting so popular in healthcare because of the availability of huge chunk of medical data and that to complex high dimensional data. (11) AI can cover prescription of a patient to medical history with all ease of flow. It has come a long way in healthcare and a long way to go
Big data	A huge amount of data is there in healthcare and it need to be get integrated and smartly handled in order to improve patient outcomes, big data is a way to do that. By doing systematic analysis of large amount of data various insights can be gathered and patterns can be drawn which will eventually help service providers or doctors to tailor treatment plan for patients. It will also help in predictions of future possibilities.

CHAPTER 5: RESULTS

This segment presents the discoveries and the topics that were extracted from the aims led inside this descriptive study. The future of healthcare is shaping with the advancement in technology like telemedicine, m-health, smart wearables, 3D-printing, big data, cloud adoption, AI, IOMT, robotics and many more. In medicine and healthcare, clinicians and paramedical staff needs to get handy with technology in order to improve patient care and to remain at par with technology. (38)

When we talk about adoption of technology at full fledge, the results are little vague and multifaceted as answer to this question is not straightforward. A study published in Lancet titled, “*High-quality health systems in the Sustainable Development Goals era: time for a revolution*”, 2018 revealed errors in diagnostic accuracy which has led to uncounted deaths. According to that in some of European and Asian countries only 35% of the service providers were able to detect heart related infections which again talks about the challenges and faulty errors of technology.

As per the data of FHI 2019, India is nowhere backward when it comes to adoption of technology by the workforce. According to the data 76% of healthcare workforce is already familiarized with latest developments and using DHRs in their practice.

This descriptive research has talked about the latest developments in healthcare and their impact on system by benefiting the patients by providing favourable outcomes. With the increase in innovative technologies and acceptance of those technologies in society, there are major key challenges such as

- Security
- Data Privacy
- Data regulation
- Training of staff
- Integration and cost effectiveness
- Centralized Data Point

Despite the obvious concerns (and even dangers), the significance of technology in healthcare industry means that the advantages outweigh the disadvantages. Without the innovations available at the moment, there would be a lot more people who will be prone to the many diseases present as well as many people who will never be able to recover from their illnesses.

CHAPTER 6: DISCUSSIONS

This study has explored the impact and challenges which influence adoption of healthcare technology. In health care, the decision to adopt or reject new technology and innovation depends on a lot of factors as certain elements are common to patients, medical healthcare professionals, organizations of healthcare, and the supervisors which holds inferior importance in the users' perception of each factor. This finding claims that the decision of healthcare workers is a subjective process as it is consistent in some studies. For example, some doctors have claimed that the autonomy and diagnosis of patients and also treatment can be affected by technology. The study also found that 46% of the difference, and find useful maps of e-health are related to its ability (41).

The results have explored various challenges regarding the adoption of technology, developing a web-based, real-time monitoring system is a way forward. It releases a variety of functions and the variety of channels on the platform.

Setting up a centralised health information system is one major recommendation came out of this study. (Figure 1.1) With the help of a workflow model, the assistance helps clinicians in recognizing and setting up the most proper patients that offer the help. These are given a confirmed clinical device pack to perform clear assessments directly from home. Patient characteristics are noticed consistently by an Operations Centre, made out of explicit specialists who, because of a typical clinical show, intervene if prepared clinicians occur and fulfil an educating and planning ability to help patient fortifying. The expert gets included where its capacity is required and, in particular, he/she can see, directly from its organization programming, the clinical potential gains of their patients reliably (28).

The patient performs the measurements at home using the measurement kit.
The data are automatically transmitted to the hub.

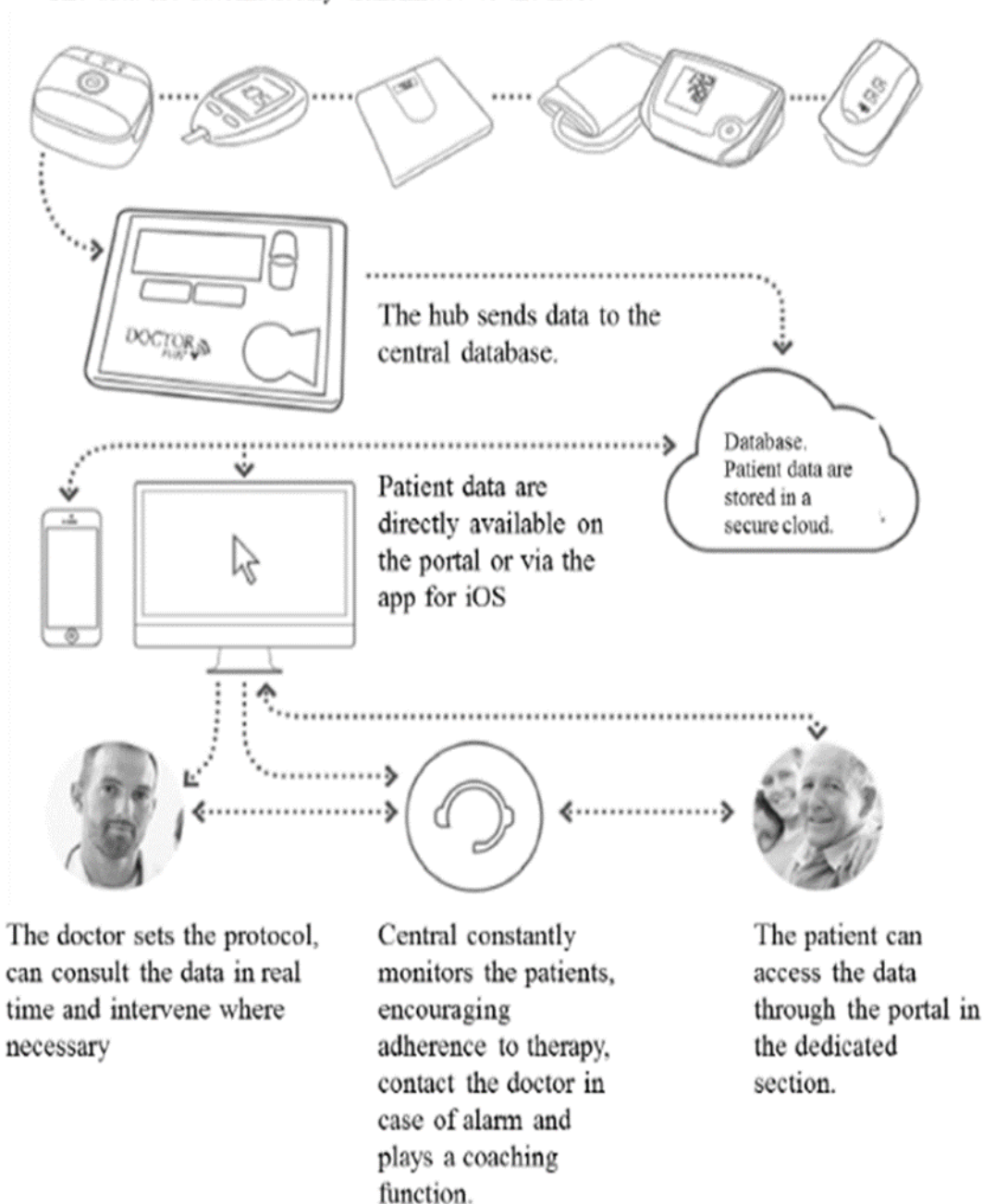


Figure: 1.1

CHAPTER7: CONCLUSION

- The introduction of various forms of digital technology resulted in improved quality of service delivery, readiness, accessibility, affordability and accessibility to healthcare in various countries. For example, the use of virtual consultation has led to reduced hospital admissions which resulted in decrease of unnecessary hospital burden as well as death rates in patients with heart disease and diabetes (46)
- The introduction of digital medical technology can lead to better access to public health care. It includes access to open health information, treatment, problems, and the latest advances in biomedical research.
- Although there is a lot of encouragement towards technological advancement in healthcare industry, a lot of challenges still persists
- A recent study on” *Adoption of computerized information management systems (CIMS) functions: Urban versus rural primary healthcare providers*”, 2021 explains that higher rates of inadequate interoperability standards are related to results viewing, clinical documentation, and computerized order-entry functionalities by rural and urban primary healthcare providers.
- One study by Nebeker et al revealed five major domains of the digital health clinical decision-making domain framework designed for research and clinical applications which includes privacy and security of data of participant, risks as well as noted benefits, accessibility, management of medical record and data and last but not the least ethical and regulatory principles (47)
- In summary, the digital revolution has reshaping health care systems around the world for good. The future of healthcare is better but a concrete system and planning is required to make it happen. As challenges of implementing technology is not large in number but has very serious impact if any loophole is there. The correct implementation with proper research is a way forward

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