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Use of Technology in HealthCare

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Abstract - *Technological development plays a vital role in the advancement of modern healthcare. Healthcare practitioners have become more skilled diagnosticians and provide better treatment. Modern healthcare is not limited only to the hospitals and the doctors but the advanced gadgets have made it possible to reach every household. Healthcare industry is not limited to the treatment of disease but it also focuses on proactive and regular monitoring of the health. Many fascinating inventions in the field of healthcare has been made in the past few years, and many unbelievable innovative technologies are almost on the verge of a breakthrough. The sole aim of the advancement in the use of technology in healthcare is to ensure the betterment of society as a whole.*

Key Words: Technology, healthcare, patients, doctors, surgeons, advancements, devices, gadgets, robots, household healthcare, symptoms, illness, diseases, treatment, monitor, detect, record, diagnosis.

1.INTRODUCTION

Healthcare is to keep up or improve health via diagnosis, treatment, recovery, or cure of disease, sickness, and ot her physical or mental injuries in people. Technology can be referred to as the mechanism and devices developed from the application of scientific knowledge. Medical technology is a vast field where invention plays a vital role in nourishing health. Fields like pharmacy, biotechnology and medical instrumentation and more have all made substantial contributions to refining the health of people all around the world.

2.HISTORY OF TECHNOLOGY IN MEDICINE

The technology used by the doctors in the 18th century was very simple as they made use of homemade lotions, bandages, simple herbs as medicines. They used the methods like taking a history of the patients, observing them, and checking their pulses to learn the diagnose the disease and based on that they set diet plans, and exercise to sustain health and treat the sickness.

The most significant feature of the 19th century was the revolution of diagnosis with the help of technology. The first step towards this change was a simple device that enhanced the transmission of sound, the stethoscope.

Other simple technologies used by the doctors during the 19th century included the clinical thermometer (1867), and the sphygmomanometer (1896). This technological change helped the doctors to become skilled diagnosticians and enabled them to detect the source of the patient's problems through their physical clues.

3.WAYS TECHNOLOGY HAS CHANGED HEALTHCARE

Technology is the significant reason behind progress in healthcare research and treatments. Diagnostic technologies have now entered a new phase of development in the 21st century. The simple instruments used by the physicians have been replaced by advanced sensing machines and technologies.

This allows doctors to use new tools and find new and advanced ways to practice medicine into the future. Healthcare technology is increasing the life expectancy of a person, and helps the doctor in the early and efficient diagnosis of disease.

Following are a few points in which technology has helped healthcare:

3.1 Electronic Databases

The huge pile of files containing patient's medical records have completely vanished from the doctor's office, and those have been replaced by electronic databases. These are now helping to store a large amount of information such as patient's medical history, records of vital signs, lab testing results, and prescription in the database which can be easily retrieved by the doctors and nurses. The medical practitioners are regularly using hand-held computers to record significant real-time patient data and then instantly update the electronic database. Patients can go through their own information easily through a portal provided to them, and this enables them to understand the treatment easily. This effective technology of collection and storage of information also proves to be a large source of patient

history for the scientists who are engaged in research for new technological innovations.

3.2 Doctors Adopting Flexibility

Because of portable gadgets like smartphones and tablets, doctors can easily access online medical databases and other medical information over the internet from anywhere they go. Patients can easily contact and consult doctors through different online apps and portals. Reports can be shared easily via emails, messages or other chatting apps like WhatsApp, Telegram etc. This has proven to be a boon for villages and remote areas. Second opinions can be taken from the specialists without the need to move the patients.

3.3 Technology in Healthcare refines Testing and Imaging

The medical tests nowadays are highly advanced and capable of detecting critical illness in relatively less time. We now have advanced screening, monitoring and imagining technologies like ECG, digital X-ray, Sonography, MRI and CT scans, that enables the pathologist to detect illness accurately without requiring any invasive surgeries. These approaches let doctors to even create precise 3D images of the anatomical structures and then plan the treatment accordingly. As a result of quick and accurate diagnosis, the critical illness can be controlled and treated at an early stage.

3.4 Search based trends

Several medical websites are available on the internet. Nowadays it's a trend that people search their symptoms on the internet and self-diagnose their sickness before going to the doctor. By gathering and analysing the searches of the users on the internet, search engines like Google can predict trending symptoms, thereby helping the doctors to prepare and be ready for the treatment of forthcoming epidemic of disease. Analysis of this search also helps to determine the demand for the medicines and ensure its availability. This trend of self-diagnosis also has its drawback because in most of the cases the patients misdiagnose their symptoms to be as critical as a brain tumour when all they have is a simple headache. This causes panic among the patients.

3.5 New Healthcare Technology helps avoid errors

Internet helps in reducing prescription medication errors that are responsible for the deaths of many people. Technologies like special bracelets containing information about the treatment and medication of the patients are linked to the hospital database. The hospitals are able to track the dosage of medicine of the patient wearing the bracelet. The vital signs of the patients, especially the elderly or people suffering from cardiological disorders can be monitored remotely by the doctor with the help of monitoring devices worn by the patients.

4.HOUSEHOLD HEALTHCARE DEVICES

New technological gadgets like smartphones and tablets are being used as a substitute for traditional recording and observation techniques. People can now have a full check-up effortlessly without having to leave the comfort of their houses. To monitor the medical condition few vital signs like body temperature, blood pressure, blood glucose level, pulse rate, respiration rate and body weight needs to be checked at constant intervals or daily. The benefits of regular monitoring are that some diseases can be diagnosed at a very early stage as soon as they show fluctuations in vital signs. To help the consistent tracking of the primary signs of the body the following health monitors have become must-have medical devices in most of the household.

4.1 Blood Glucose Monitors

It is mandatory for people having diabetes to keep a record of the sugar levels in their blood. This has been highly simplified with the help of a device called a blood glucose monitor. With the help of this device, patients can regularly check their glucose levels and can instantly inform any major variations in the sugar level in their blood to their doctor and curative medication can be provided by him instantly.

4.2 Pulse Oximeters

For the organs in the body to function normally adequate amount of oxygen must be supplied through the blood cells to them. A pulse oximeter is a healthcare device that detects the absorption rate of oxygen in the blood using light to observe the state of haemoglobin. An insufficient amount of oxygen can cause the failure of organs like the heart and brain due to hypoxemia. Due to this pulse oximeters are widely used in the home for everyday health monitoring. New pulse oximeters are smaller and lighter in weight.

4.3 Blood Pressure Monitors

A blood pressure monitor is also known as a sphygmomanometer is used for or measuring blood pressure in the body. Blood pressure fluctuations can cause many serious problems like cardiac arrest or paralysis. It used to be difficult to keep a daily track of

the blood pressure of the patient suffering from hypertension (high BP) or hypotension (low BP). It also helps to identify the effectiveness of the treatment given by the doctor. The normal range of blood pressure is 120/80. These days the demand for blood pressure monitors has increased in household healthcare. Due to technological advancement, various types of blood pressure monitors are available like the upper arm blood pressure monitor and easy to use digital wrist blood pressure monitor that have features like small set size and longer battery life.

4.4 Weighing Scales & Body Composition Analyzer

Weighing machines are used to calculate the weight of the body. Any unusual increase or decrease in body weight can be a symptom of a severe chronic illness. Body composition analyser calculates the body mass index of the body i.e. the ratio of body fat to height and weight. It is used to determine whether the person has a normal body weight as per his height. In today's world, due to the improve consciousness about the fitness of our body, weighing machines are becoming extremely prevalent not only in the medical field but also in regular houses.

4.5 Thermometers

Thermometers are now days utilized in more and more homes. This fundamental device is very vital in every residence, specifically in the monsoon and winter, when there is an epidemic of pyrexia, algid and flu. The thermometer can track if the body temperature is higher or lower than routine, thus availing to choose the congruous course of treatment and medicines ascertaining a strong improvement. The regular temperature of the human body is between 970F to 990F or 360C to 37.50C. They must be small, light in weight, consume minimum power and deliver an elongated battery life. Consumers also require an expeditious replication time for reading and precise quantification. Nowadays Advanced infrared thermometers are available that can be aimed at an object from a certain distance with the help of a laser and can quantify the infrared thermal radiation emitted by the object and displays its accurate temperature. This is done by concentrating the infrared radiations on a detector through a lens and changes that into an electrical signal and showed as temperature.

4.6 Activity trackers

Fitness organizing gadgets like smartwatches have been magnetizing attention as a home healthcare wearable gadget in the latest times. These watches are worn by the user on his arm and it monitors the pulse rate of the person while doing regular activities like walking, running, etc. These gadgets also include a pedometer that counts the steps the wearer has walked and also calculates the number of calories burned in the process.

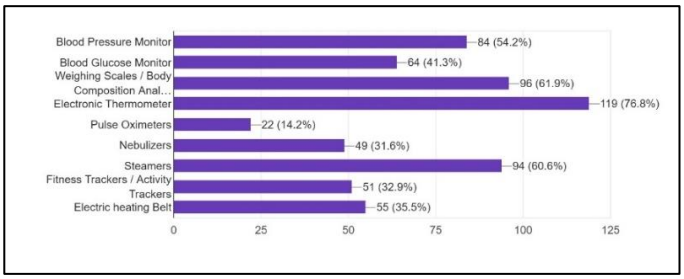

Chart -1: Popular Household Healthcare Devices

The above Chart -1 Shows the result for the survey that was conducted asking people about the household healthcare devices that they have in their houses. 52.4% of people have Blood Pressure Monitor in their house. 41.3 % of people use Blood Glucose Monitor regularly. 61.9% of individuals are using Weighing Scales to keep track of their weights constantly. 76.8% of people, which is the maximum number of individuals keep Electronic Thermometers in their house. Pulse Oximeter is present in the house of 14.2% people. 31.6% of people possess Nebulizers in their house for the treatment of respiratory disorders. Steamers are there in 60.6% of houses. 32.9% of individuals wear fitness trackers. Electric Heating belt is used in 35.5% houses.

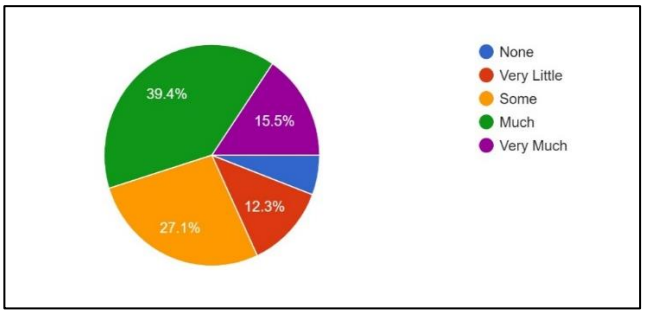

Chart -2: The usefulness of Popular Household Healthcare Devices

The above Chart -2 Shows the statistics to the feedback of the question that how the use of the household healthcare devices has improved and simplified the monitoring and quick treatment of their health in day to day life. 12.3% of people have said that very little amount of improvement is provided by the use of

household healthcare devices. 27.1% have given their feedback that it has brought some amount of improvement in their regular monitoring. 39.4% of people feel that it has brought much improvement in their regular monitoring of the vital signs. 15.5% of people have said that it has a significant impact on improving and simplifying the regular monitoring of their health.

5.RECENT BEST TECHNOLOGICAL ADVANCEMENTS OVER THE YEARS

Technology and medical science have developed together over many years. Constant advances in medical technology have saved and improved countless lives. As more and more years pass and technology continue to progress, no one can predict the upcoming advancements. In healthcare, technology is playing a significant role in almost all fields, like patient history collection, lab tests, surgical instruments, devices for post-surgical care and self-care tools.

The following are a few technological advancements in healthcare that have emerged over the past few years:

5.1 Computer navigation in joint replacement

In surgery, accuracy is extremely important, especially in complicated joint replacement surgery requiring a high level of skill. Computer-aided navigation technology is the latest technology for supporting surgeons to perform joint replacement surgery with complete accuracy and avoid any human mistakes.

When doing a joint replacement surgery using conventional techniques, even the most experienced surgeons can make errors in the degree of alignment of the metallic or plastic components with respect to the bone. Surgical accuracy can also decrease due to factors such as obesity, bone density, previous surgeries etc. An error of more than 5 degrees in the alignment can cause poor recovery of the patient.

Computer Navigation is a tool for performing knee replacement surgeries that make use of the latest Infra-red technology that helps to reduce surgical errors. It does so by showing optic data about the precision of the bone cuts, placing implants and the proper limb alignment.

Computer Navigation includes the three main elements: computer platform, tracking system, and body marker or tracker.

5.1.1 Computer Platform

The main function of the computer platform is to control the synchronization of inputs from the surgery and is programmed to mathematically interpret the information, and display the result on the monitor. It consists of a software that can automatically recognize the shape and placement of the instrument, pointer probe, and cutting block adaptor.

5.1.2 Tracking System

The tracking system comprises an optical camera or an electromagnetic coil to receive the infrared light or electromagnetic pulses, respectively, that are transmitted by the trackers. With the help of a computer platform, the tracking system provides digital data and tracks the motion of the body markers within the three-dimensional space.

Optic tracking systems require multiple cameras attached to some active emitters or passive reflective balls to recognize and receive the infrared light from the trackers. Optical cameras function best when they are in a range of 1.8 to 2.5 m from the trackers. Studies suggest that this method is very precise and reliable. Electromagnetic tracking systems require multiple transmitter and trackers. No cameras are needed in this system. Studies have shown that the EM method is less reliable as many times there are errors of few degrees in the occasional outliers.

5.1.3 Marker or Tracker

Dynamic reference base (DRB), Cutting block adapter and Pointer Probe are some examples of body markers or trackers. In order to track the target, they need to be attached to the bones of the patient or to the tools used for the surgery. It resembles the DRB then the target is the patient's bone, and cutting block adapter when the target is the surgical tools Active markers are powered by a battery and emit light from a bulb while passive markers reflect infrared light. The tracking system and the computer platform use various algorithms to detect the spot of each marker.

Following are the benefits of Computer navigation technology:

- Negligible human errors
- Precise alignment of implants
- Reduced blood loss during the procedure
- Quick recovery of the patients
- Saves a lot of time during surgery

5.2 Robotic Surgery

Robotic surgery is used in small incision surgeries to help the surgeons to perform the surgery with increased accuracy. It enables surgeons to carry out compound actions easily. Robotic surgery can be collectively used with 3D imaging that helps the surgeons to view real-time significant images of the patient during the operation. The robotic arm analysis the 3D model and creates a pattern for the surgeon to work thus avoiding the surgeon from damaging any veins or tissues. This technology has raised misapprehensions like it will eventually take place of a surgeon or that the operation is done completely by a robot. This is completely false. The surgeon is in complete control of the surgery and is only assisted by a robotic arm. The sole purpose of this is to increase the efficiency and accuracy of the surgeon. Since Robotic surgery is a smaller incision surgery & has high accuracy it disturbs fewer bones & tissues, this results in the faster recovery of the patient. This type of surgery reduces the recovery time to almost half of that taken in traditional surgery. Traditional surgeries have risk like blood clots, infections, damage to the nerve allergic reactions, etc. The same risk can also be there in the robotic surgery but due to the smaller incision and high precision, these risks are mitigated to a great extent.

5.3 Smart Inhalers

Asthma is a very common disease and inhalers are a very effective treatment for it. Smart technology has begun to collect information about its symptoms and treatments. A small sensor is attached to the inhaler which maintains the time chart of the patient every time he has consumed the dose. It also tracks the triggers causing the asthma attacks and the medications used. This is connected to an app and it generates a report of the dosage that is taken by the patient and is sent to the patient's doctor. The benefit of this inhaler is to track the frequency of the asthma attacks & also how constantly the patient is taking the medicine which helps in the improvement of their health.

5.4 3D Printers

3D printers are one of the latest technologies. Implants and joints required in surgery are created with the help of these printers. Due to the high digital features of the 3D printer prosthetics that are created are exactly equal to the dimension of the patient which gives them a lot of movement and ease. 3D printers are used to create solid and dissolvable items. 3D printers are used to print pills that contain many medicines for e.g. A medicine called Spritam which is used for the treatment of epilepsy is created by the 3D printer to make it dissolve faster than regular pills. 3D printing is also used to make tales of different shapes like dinosaurs and other animals to make it simple to give it to children. Soon 3D printed medicines will be available everywhere easily at a reasonable price.

5.5 Health Wearables

After the invention of Bluetooth, the popularity of wearable devices has increased rapidly. Nowadays, these devices are connected to the smartphones and help in monitoring the heartbeat, the number of steps taken, calories burnt and even the sleeping pattern of its wearer. With the advancement in these technologies, it is being turned into health wearables that can detect and monitor symptoms related to even chronic illness like diabetes and cardiac problems. In 2018 Apple integrated electrocardiogram into its Apple series 4 watch, that enabled it to detect and monitor the heartbeat wave pattern of the wearer. Thus, enabling it to detect any cardiovascular disease well in advance. Apple also integrated an API called the Movement Detector API to their watches. This API enabled the watches to monitor the changes in the symptoms of Parkinson's disease on a regular basis. This feature proved very helpful for patients diagnosed with this disease. This API aims at keeping a record of the symptoms like the frequency and duration of the seizures and is sent to the physician in a graphical format with an hourly breakdown or even to the accuracy of minute by minute change in the symptoms.

5.6 Virtual Reality

Virtual reality has many applications in the healthcare industry, from evolving new life-preserving techniques to providing training to medical students. Traditionally students learning medicine practice and study on corpses, but these are difficult to obtain and also this technique does not give the same experience as a live patient would give. Using advance technology like VR gives a hands-on experience to the students. VR provides access to even those areas of human anatomy that would otherwise be impossible for the human eyes. This is done by 360-degree computer-generated image (CGI) reconstruction of any part of the body and training sessions of common surgeries are conducted. VR provides great aid for not only the doctors but also to the patients. The 360-degree CGI reconstruction of the part of the body that needs to be treated, not only helps in the diagnosis and the treatment plans but also helps the patient to gain a better understanding of his condition and the proposed treatment procedures. This increases patient satisfaction and trust. VR has also been used to

treat psychological problems like PTSD and memory loss by recreating scenarios of past incidents with just a click of the mouse.

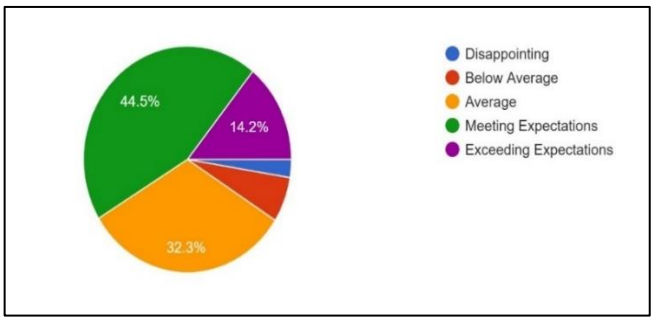

Chart -3: The satisfaction of overall Advancement of Technology in Healthcare

The above Chart -3 Shows the statistics to the feedback to rate the overall technological advancements in healthcare over the years. 32.3 % of individuals have responded that according to them the technological advancement is average. 44.5% of people have responded that according to them the technological advancement in healthcare is meeting their expectations. 14.2 % of individuals believe that technological advancement in healthcare is exceeding their expectations. 6.5 % of people believe it to be below average and 2.6 % of people find it disappointing.

6.UPCOMING TECHNOLOGICAL ADVANCEMENTS IN HEALTHCARE

6.1 Digital Tattoo

Nowadays with the advancements of 3D printing and circuit printing, the technology called digital tattoo is rising rapidly. Digital tattoos are temporary tattoos that consist of electronics such as sensors of near field communication (NFC) chips. These tattoos have rubber backing with gold nanorods graphene or other polymers, so it can be applied up to a week on the skin without causing irritation. Digital tattoos are made of elastic and water-resistant constituents and are tiny electrodes that are unaffected by bending and can monitor and send data to the connected gadgets. MC10 launched a digital tattoo which consists of a sensor called BioStampRC, a Bluetooth and a mini battery, is a water-resistant cover that can be pasted like a band-aid. It is capable of tracking muscle functions and activity of the heart. Most of the digital tattoos use gold in electronic constituents, graphene-based electronic tattoo uses graphene which makes it thinner and almost transparent. It has the unique electric property that makes it more conductive and enables it to be used as a patch to monitor the electrical functioning of the brain and heart. In future, if graphene becomes cost-effective, then it will be used more often. Smart tattoo ink has been developed in such a way that they measure the amount of glucose and sodium present in the skin cells, reacts with it and changes colour in case the amount of glucose or sodium increases or decreases. Digital tattoos can monitor the vital signs and even insomnia throughout the day without a need to charge and can send emergency signals and data to the doctor. In the future, these patches will be so advance that they will be able to precisely detect the indications of the brain and even command a computer.

6.2 Artificial Organs

As there is a scarcity of organs in the world, 3D bioprinting that creates synthetic tissues would help in creating artificial organs. A paradigm has been created to generate fully functional skin cells that can be used for skin transplant for burn patients. Successful experiments have been carried out to print tissues and blood vessels of synthetic liver and pancreas. While this technology is still developing, its advancement will help us to create synthetic organs suitable for transplant that the patient's body will definitely accept. This will in turn help to save millions of lives.

6.3 Nanotechnologies

Nanotechnology is a rapidly flourishing branch of science which manipulates particles below the size of 100 nanometres i.e. it works at a molecular level. It involves the creation of microscopic gadgets that are not visible to the human eyes. It is not very far when nanodevices will be used in every sector in the world. In modern medicine, nanotechnology is being developed to be used as a drug delivery system effective treatment of cancer and HIV. Research and experimentations are being conducted to use nanotechnology for the advanced diagnosis of the disease, drug delivery system and to monitor the symptoms. For e.g. Quantum dots are being developed, that are nano semiconductors which work as biosensors used to detect illness. Nanoparticles will help in sharpening the resolution in medical imaging techniques and thereby making it simple to detect illness. Nano capsules are cases that will encapsulate the medicine which will enable it to release medicine little by little. Nanorobots that can swim in blood and supply drugs to the targeted affected area, this will be used for highly effective cancer treatment such as chemotherapy and will reduce the side effects on other cells of the body.

There are endless possibilities for the advancement of nanotechnology in healthcare.

6.4 Telesurgeries via 5G networks

Brain surgeries are highly complex and any minor error can cause surgery failure. Today we can't imagine a surgeon performing a brain surgery remotely on a patient from miles away because in such a scenario many technical requirements like zero latency with the very high-resolution screen are required. These are not possible to achieve with the current available network speed. With the development of 5G networks, such remote surgeries can be envisioned. Successful experimentations have been started to perform remote telesurgeries via 5G networks. A Chinese lab performed a surgery where the lever of a lab animal has been removed from a distance of 30 miles with the help of a surgical robot and 5G network. Experiments on conducting brain telesurgeries using 5G networks from more than 1000 miles are progressing towards success rapidly.

6.5 CRISPR and Genomics

Genomics is that branch of genetic engineering where genes are modified or edited by adding or removing DNA in a genome of any living being. There are many techniques for gene editing that are being developed, among them CRISPR is the most advanced gene-editing technique. CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats. It cuts out the DNA strand which is infected by the attacking virus and that is detected by the natural process of the immunity system. This DNA cutting can bring about a significant change in the techniques of treatments of chronic diseases like cancer and HIV. Successful experiments have been done using genomics and creating a mosquito that is almost completely resilient to the malaria-causing parasite. The aim of genomics is to edit the genes in our immunity system and make them stronger and capable to kill the cancer cells. While genomics has the power to change the face of healthcare, it is also a very controversial technique. Gene editing is not considered safe as we do not fully understand its possible consequences. CRISPR is still in the early stages of development and research on gene therapy is going on at a rapid pace and it will unlock infinite possibilities in the future.

7.LIMITATION AND SUGGESTION

While technological advancements in healthcare are doing wonders, it is still not able to reach the remote areas of the world. The modern advanced technology is very expensive, which makes it out of the reach of common middle-class and lower-class communities and they are not able to get the full benefit of the advanced techniques of treatment. In future the advanced medical technologies should be tried to make pocket friendly, only then people will be able to get its full benefits.

8.CONCLUSION

There is no denying the fact that technology has proven to be the backbone of the advancements of modern healthcare. Due to the excellent inventions of technology, improved diagnosis, treatment procedures and patient care has become possible. While we can only see the future tendencies in healthcare technological development, it will continue to develop in ways and fields that we think are impossible today.

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