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INDIVIDUAL REPORT 1

INTERNET OF THINGS (IOT) IN HEALTHCARE

INTRODUCTION:

More than half (53%) of the hospitals in the United States of America (USA) have a remote patient monitoring system. In 2026, the number of internet of things (IoT) mobile connections worldwide will more than double from 2021. Medicine has long been driven by data, from making diagnoses to prescribing treatments. Now, healthcare is taking a major step forward in the collection and analysis of high-quality data. IoT can be thought of as a device (or a network of devices) that connects to the internet, allowing data to be sent to whoever needs to use it. On a grand scale, the IoT consists of billions of devices and sensors, that transmit a continuous stream of data. For business leaders in every industry, access to better, more accurate and real-time data enhances decision-making. This same premise applies in healthcare IoT, which can keep patients connected to their care providers after they leave the doctor's office or are discharged from the hospital. The global market for portable and remote patient monitoring has been increasing steadily. The market of IoT in healthcare is predicted to exceed $10 billion by 2024, according to a Brandessence market research.

IOT & HEALTHCARE:

IoT has the potential to create a pervasive environment for monitoring patient health and safety as well as improving how physicians deliver care. It can also boost patient engagement and satisfaction by allowing them to spend more time in the comfort of their home and interacting with their care centres whenever needed. There are multiple applications, such as continuous blood glucose monitoring. IoT is slowly getting traction and evolving alongside the new ultra-fast 5G mobile wireless, Artificial

Intelligence (AI), and Big Data. Combing these powerful technologies with the Internet of Things will likely revolutionize the healthcare industry. IoT in healthcare using 5G wireless and AI could, for example, completely transform the way patients are monitored and treated remotely.

WORKING OF IOT IN HEALTHCARE:

An IoT unit can be considered as a device with a sensor that can interact with the physical world and send information to the Internet. In healthcare, these devices can gather different patient data and receive inputs from health practitioners. An Internet of Things Healthcare example is continuous glucose monitoring for insulin pens that works effectively for patients with diabetes. All these devices are able to communicate with each other and in some cases take important actions that would provide timely help or even save a life. For example, an IoT healthcare device can make intelligent decisions like calling the healthcare facility if an elderly person has fallen down. After collecting passive data, an IoT healthcare device would send this critical information to the cloud so that doctors can act upon it, view the general patient status, see if calling an ambulance is necessary, what type of help is required, and so on. Thus, Internet of Things Healthcare can greatly improve not only a patient's health and help in critical situations, but also the productivity of health employees and hospital workflows.

THE IMPACT OF COVID-19:

The Covid-19 pandemic quickly accelerated innovation in the delivery of goods, services, and solutions. The same ramp-up in innovation occurred in healthcare with the explosion in telehealth since the pandemic began. Providers connected with patients via videoconference and used remote monitoring to avoid in-person doctor's office visits to avoid a potential contagion risk. This transition was further supported by insurance payers, including the Centres for Medicare & Medicaid Services (CMS), which issued waivers that would allow payment parity for care delivered in-person or via telehealth. Post-pandemic, virtual care will likely continue to be a mainstay. With greater acceptance by physicians and patients, alike, many office visits for routine

follow-up and feedback could be eliminated. As telehealth expands, hospitals, physicians and other clinicians will likely turn to healthcare IoT applications to monitor, collect and analyse patient data in real time. One example is Vheda Health, which uses its digital chronic management platform to manage high-risk, high-cost patients who are covered by Medicaid and Medicare. Its customized remote monitoring seeks to increase patient compliance in managing their chronic conditions, such as hypertension, diabetes, congestive heart failure, and asthma. Current Health, for example, specializes in remote patient monitoring for home health patients, such as those with chronic diseases or who have been discharged from the hospital and need ongoing care. Working with cellular platform, Current Health deploys IoT sensors that transmit data via cellular networks. This adds a layer of data security and provides greater connectivity, especially for patients who live in rural areas or do not have reliable Wi-Fi in their homes.

IOT PROCESS IN HEALTHCARE:

- A sensor collects data from a patient or a doctor/nurse inputs data.
- An IoT device analyses the collected data with the help of AI-driven algorithms like machine learning (ML).
- The device makes a decision whether to act or send the information to the cloud.
- Doctors, health practitioners, or even robots are enabled to make actionable and informed decisions based on the data provided by the IoT device.

IOT DEVICES IN HEALTHCARE:

Some of the companies that change the way IoT is used in healthcare are ZOLL Medical Corporation, Elemental Machines, AliveCor, Aclima, Nexleaf Analytics, Pfizer, SystemOne, Eight Sleep, Happiest Baby, AdhereTech, Aeris Communications, Otsuka America Pharmaceutical, Phillips, Stanley Healthcare, and Honeywell.

- **Smartwatch** - Wearables sold at consumer electronics stores come with a sensor and Internet connection. Some of them (like iWatch Series 4) can even

monitor your heart rate, control diabetes, help in speech treatment, aid in improving posture, and detect seizures.

- **Insulin Pens and Smart CGM (Continuous Glucose Monitoring)** - These devices can monitor blood glucose levels and send the data to a dedicated smartphone app. Patients with diabetes can use these devices to track their glucose levels and even send this data to a healthcare facility.
- **Brain Swelling Sensors** - These tiny sensors are implanted within the cranium to help brain surgeons keep track of severe brain injuries and avoid further deathly swelling. They measure pressure on the brain and are able to dissolve by itself in the body without further medical interference.
- **Ingestible Sensors** - Prescribed medication is swallowed with a tiny digestible medical sensor that sends a small signal to a wearable receiver on the patient, which, in turn, sends data to a dedicated smartphone app. This sensor can help doctors ensure patients take their medication at all times.
- **Smart video pills** - A smart pill can travel through a patient's intestinal tract and take pictures as it travels. It can then send the collected information to a wearable device, which in turn would send it to a dedicated smartphone app (or straight to the app). Smart pills can also help visualize the gastrointestinal tract and colon remotely.

BENEFITS:

- Treatment outcomes can be significantly improved or maximized, as the data gathered by IoT healthcare devices is highly accurate, enabling informed decisions.
- Health facilities and practitioners will be capable of minimizing errors because all patient information can be measured quickly and sent to a board of doctors or a healthcare cloud platform.
- AI-driven algorithms running on the IoT devices could also help make intelligible decisions or suggestions based on existing data.
- Another great benefit of IoT in healthcare is reduced costs. With IoT in healthcare, non-critical patients will be able to stay at home while various IoT

devices monitor and send all important information to the health facility, meaning less hospital stays and doctor visits.

- With detailed information received from lots of IoT devices, health facilities will also be able to improve their disease management. They will have more data in real-time coming in than ever before.

CHALLENGES:

Although IoT in healthcare provides many great benefits, there are also some challenges that need to be solved. The Internet of Things Healthcare solutions cannot be considered for implementation without acknowledging these challenges.

- **Massive inputs of generated data** - Having thousands of devices in a single healthcare facility and a thousand more sending information from remote locations, all in real-time, will generate huge amounts of data. The data generated from IoT in healthcare will likely make storage requirements grow much higher, from Terabytes to Petabytes. If used properly, AI-driven algorithms and cloud can help make sense of and organize this data, but this approach needs time to mature. So, creating a large-scale IoT healthcare solution will take a lot of time and effort.
- **IoT devices will increase the attack surface** - IoT healthcare bring numerous benefits to the industry, but they also create numerous vulnerable security spots. Hackers could log into medical devices connected to the Internet and steal the information or even modify it. They can also take a step further and hack an entire hospital network, infecting the IoT devices with the infamous Ransomware virus. That means the hackers will hold patients and their heart-rate monitors, blood pressure readers, and brain scanners as hostages.
- **Existing software infrastructure is obsolete** - IT infrastructures in many hospitals are obsolete. They will not allow for proper integration of IoT devices. Therefore, healthcare facilities will need to revamp their IT processes and use new, more modern software. They will also need to take advantage of virtualization with technologies like Software Defined Networking (SDN) and Network Functions Virtualization (NFV), and ultra-fast wireless and mobile networks like Advanced LTE or 5G.

CONCLUSION:

IoT in healthcare industry can improve components, such as medical gadgets or services. It can also enhance healthcare applications, such as telemedicine, patient monitoring, medication management, imaging, and overall workflows in hospitals. It can also create new ways of treating different diseases. The Internet of Things for healthcare will not only be used by hospitals or facilities, but also by surgical centres, research organizations, and even governmental institutions. IoT in healthcare industry does not stand alone. All IoT devices and their networks need to be combined with other technologies to help healthcare facilities transform in a meaningful way. As mentioned before, IoT will revolutionize the healthcare industry but it also needs data, high-speed communication, and proper security and compliance. 5G will provide the ultra-low latency speeds and mobility that the IoT in the healthcare industry needs. In turn, AI-driven solutions will make sense of the data gathered from a collection of devices. Big Data strategies will use such AI algorithms to analyse data in real-time and make critical health decisions. Virtualization will help to reduce or get rid of old infrastructure in hospitals. IoT along with medical ERP software will help healthcare to evolve, and this evolution will only continue. Sooner than later, healthcare and Internet of Things will become inseparable, completely transforming how we approach our healthcare.

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