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IoT, The Future of Healthcare

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ABSTRACT:*In striving to improve outcomes and reduce cost, health care providers have long struggled with several nagging problems – most notably, their interaction with the patient is sporadic and giving them little insight into the daily decision and activities that have a huge impact on patients health. Rapid advances in digital technology are redefining the way we deliver technology to people and make them comfortable with the use of tech function. . Digital technologies are transforming every industry and IoT is one of them. Internet of things (IoT) – enabled device has made remote monitoring in the healthcare sector possible, unleashing the potential to keep patients safe and healthy, and empowering physicians to deliver superlative. It is accelerating innovation, improving decision making, automating, and speeding up processes, and saving overall costs.*

KEYWORDS:*Internet of Things, Artificial intelligence, Machine Learning, Health Care Professional(HCP), UAV(Unmanned Aerial Vehicle), Robotics process automation (RPA)*
Chronic Obstructive Pulmonary Disease(COPD), Computer-aided design (CAD), Primary Health Centre(PHC),Community Health Centre (CHC) , Anganwadi workers(AAA)

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INTRODUCTION:

When two Industries Combine forces, something tremendous and life-changing is created. To better understand this new symbiosis, lets us find out what does it means and how it all started.

Internet of Things (IoT)-enabled devices have made remote monitoring in the healthcare sector possible, unleashing the potential to keep patients safe and healthy, and empowering physicians to deliver superlative care. It has also increased patient engagement and satisfaction as interactions with doctors have become easier and more efficient. Furthermore, remote monitoring of patient's health helps in reducing the length of hospital stay and prevents re-admissions. IoT also has a major impact on reducing healthcare costs significantly and improving treatment outcomes.

It is contributing to the transformation of the healthcare industry by redefining the space of devices and people interaction in delivering healthcare solutions. IoT has applications in healthcare that benefit patients, families, physicians, hospitals, and insurance companies. [1]

The growing trend of IoT in healthcare worldwide is preventive, predictive, personalized, and participatory and underlying these trends is the increasing digitization of healthcare. In healthcare, it refers to a network of connected medical devices that cannot only generate, collect and store data but also connect with a network, analyze the data as well as being able to transmit data of various kinds such as medical images, physiological and vital body signatures and genomics data.

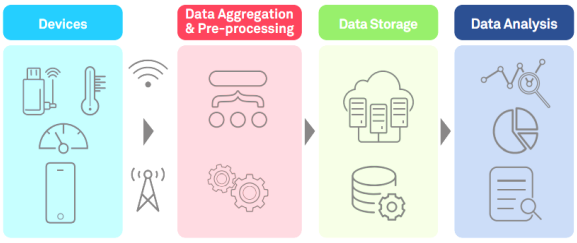
The IoT sector in Healthcare is growing at a tremendous pace and is estimated to touch US$158 billion by 2022 from US$41 billion in 2017-18 . [2] The recent COVID-19 crisis will hasten the process of hyper-growth of this sector.

The IoT sector has been broadly segmented into the following categories.

- Telemedicine and remote consultation
- Consumer healthcare including wearables
- Connected Imaging
- In-patient Monitoring
- Hospital Operations and workflow management

Redefining Healthcare

The proliferation of healthcare-specific IoT products opens up immense opportunities. And the huge amount of data generated by these connected devices hold the potential to transform healthcare.
IoT has a four-step architecture that is staged in a process (See Figure).



All four stages are connected in a manner that data is captured or processed at one stage and yields the value to the next stage. Integrated values in the process bring intuitions and deliver dynamic business prospects.

Step 1: The first step consists of the deployment of interconnected devices that include sensors, actuators, monitors, detectors, camera systems, etc. These devices collect the data.

Step 2: Usually, data received from sensors and other devices are in analog form, which needs to be aggregated and converted to the digital form for further data processing.

Step 3: Once the data is digitized and aggregated, this is pre-processed, standardized and moved to the data center or Cloud.

Step 4: Final data is managed and analyzed at the required level. Advanced Analytics, applied to this data, brings actionable business insights for effective decision-making.

IoT is redefining healthcare by ensuring better care, improved treatment outcomes and reduced costs for patients, and better processes and workflows, improved performance, and patient experience for healthcare providers.

The major advantages of IoT in healthcare include:

• ***Cost Reduction***: IoT enables patient monitoring in real-time, thus significantly cutting down unnecessary visits to doctors, hospital stays and re-admissions

• ***Improved Treatment***: It enables physicians to make evidence-based informed decisions and brings absolute transparency

• ***Faster Disease Diagnosis***: Continuous patient monitoring and real-time data helps in diagnosing diseases at an early stage or even before the disease develops based on symptoms

• ***Proactive Treatment***: Continuous health monitoring opens the doors for providing proactive medical treatment

• ***Drugs and Equipment Management***: Management of drugs and medical equipment is a major challenge in the healthcare industry. Through connected devices, these are managed and utilized efficiently with reduced costs

• ***Error Reduction***: Data generated through IoT devices not only help in effective decision making but also ensure smooth healthcare operations with reduced errors, waste, and system costs.

IoT explores new dimensions of patient care through real-time health monitoring and access to patient s' health data. This data is a goldmine for healthcare stakeholders to improve patient's health and experiences while making revenue opportunities and improving healthcare operations.

But if we turn our lens towards the rural health system in most countries, especially the developing countries, we realize that the healthcare infrastructure and services are not as green as the green landscape of rural sectors.

If we analyze the most common problems in the rural healthcare sector, we can probably get a direction to improve them and take the challenges in our stride. The most common issues are

- Care seeing pattern and need of sensitization
- Access to qualified/trained HCPs
- Nigh time access and transportability of patient
- Diagnostic facilities and on-time intervention
- Access to quality medicines, patient transportation system
- The dominance of RMPs (unqualified/self-declared HCPs)
- Continuity of therapy / follow up

Let us discuss each of these points in details so that we can head towards a feasible solution, especially in today's age of technology

1. Care seeking pattern: As per a study conducted in rural India in 2013, it was found that around 69% of the rural population opt for "some healthcare interventions" and around 83% of the care-seeking population depends primarily on local RMPs before going to formal facilities. However, with the advancement of Govt facilities, more and more people are coming out to formal healthcare facilities. However, through the implementation of technology, we can improve the care seeking pattern of rural populations and sensitize them to various health issues.

2. Access to qualified HCPs: This is a challenge and in most cases, qualified HCPs are not frequently available in RURAL HEALTH FACILITIES. Even if some of them are available, they don't reside in those villages (mostly travel from nearby bigger towns/villages).

3. Availability of HCPs at night is a bigger challenge and unfortunately, health emergencies don't know OPD hours. Due to risky and less frequently available transportation system, many patients can't reach the nearest secondary care hospital. Faster intervention through remote diagnosis/video consultation can save a life in these cases

4. Even in those cases, when you have an HCP, he/she also is helpless without proper diagnostic facilities and this really can be addressed by remote sensor-based IoT devices, at least for the primary diagnostics (post initial calibration of the devices)

5. In many cases, even on time diagnosis will not work if lifesaving medicines / medical devices are not available and this is absolutely a common problem, due to improper inventory management system or due to lack of an integrated and automated supply system. The supply system can be easily triggered through the implementation of IoT and AI.

6. The healthcare needs of many small villages have been historically dominated by local unqualified/self-declared HCPs called RMPs, whether we agree or don't even today they are one of the preferred first points for healthcare needs simply because THEY ARE AVAILABLE LOCALLY AND FAST ACCESSIBLE. Another big reason for villagers for not visiting PHC / CHC or formal care is the cost of travel and loss of daily wages. Today's technology like IoT can minimize this travel, if IoTs are placed in every Sarpanch office, central place, or in the home of the village heads for any time access, including night. The very availability of some devices to diagnose the problem and remote access to qualified HCPs will significantly increase the care-seeking pattern of the rural population. Early care-seeking, access to qualified HCP, remote diagnostics, and faster intervention can save lives.

7. Another big issue is the post-therapy follow-up/care giving pattern. Mostly adherence to therapy is not very encouraging due to cost, awareness, and availability. Again this follow-up, sensitization, and even availability of medicines can be improved through the implementation of technologies based on AI and IoT. [3]

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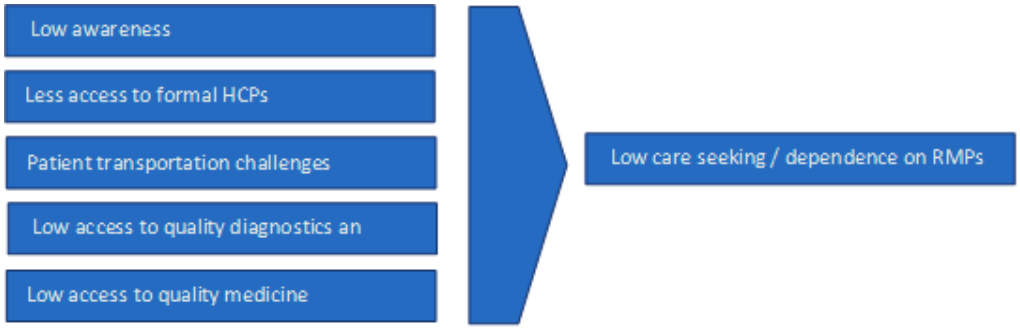
The Following Graphs Conclude the above Challenges in Rural Health sector



To get rid out of these problems one of the growing company Nijji Health Care is developing an integrated device that is based on IoT, AI, and ML technologies. The device has the great potential to improve the health sector in both developed and developing countries by enhancing access to health information and making health services more efficient; it can contribute to improving the quality of services thereby reducing cost. Patient information system, for example, the ability to track individual health problems and treatment over time, giving insight into optimal diagnosis and treatment of the individual as well as improving the delivery of services.

However, for chronic ailments like diabetes, COPD, Hypertension, CAD, Angina pectoris like conditions this has its best implementation. On the other hand for rural, where access to formally qualified HCP itself is a challenge, this can be the game changer and facilitate 24*7 remote treatment centers and can also be useful for training and guiding a 3A network of paramedical staff in rural.

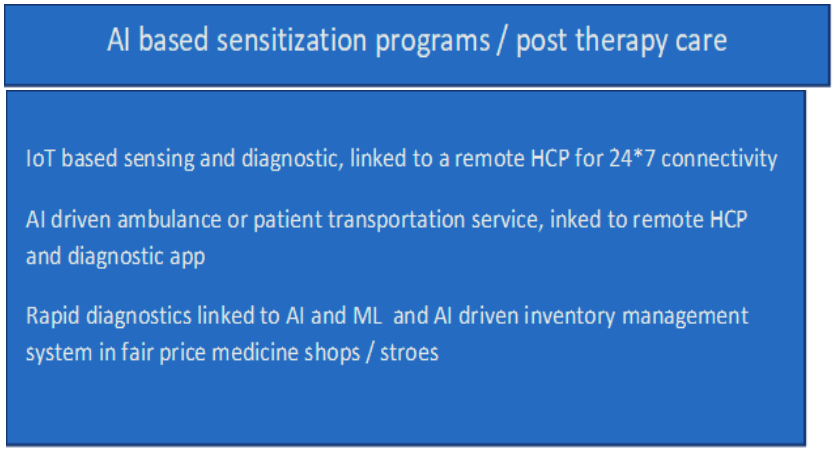
The device system analyzes unstructured clinical notes on patients, prepares reports, transcribe patient interactions, and conducts conversational AI conferencing. It also includes narrow AI where robotics process automation (RPA) works which don't involve robots only computer programs on the server

Their method does not replace the conventional treatment models but certainly complements through remote access features, and acts as an acceptable alternative to a qualified HCP. [4]

Future Vision –

One of the factors in the development of the medical services market in times of quarantine and beyond is the growing application of IoT like UAVs, Mobile tools for telemedicine, remote patients tracking technologies via wearables, etc. For example, the testing of UAV technologies in the medical supply chain is already underway. In particular, in Rwanda, drones are used to transport donor Blood. In the future, IoT functionality devices like drones will be used to deliver medicines to patients for home treatment . [5]

The following diagram shows how IoT+Human will ensure great synergy



Indeed with the help of IoT, Industry receives a lot of cutting edge opportunities

Telemedicine: With the help of the medical Internet of Things, a person can get advice remotely. Thus it is possible to save a patient's time and reduce the doctor's workload

Wearable devices: That transmit data directly to doctors. These are most often implemented in the form of watches, bands, bracelets, and other trackers that collect all the necessary information (heart rate, blood pressure, pulse, blood sugar, etc.) and send it to the doctor. There are already dozens of such IoT in healthcare examples already working as parts of healthcare services.

Diagnosis, preventive medicine: Devices for collecting medical information transmit it to the doctor, who can determine any deviation from the norm, and recommend appropriate treatment in advance.

CONCLUSION

By carefully mapping the core challenges and through the application of IoT in combination with AI and ML, we can potentially address many challenges of rural healthcare systems, often faced by HCPs, patients, and Govt.

- A remote sensing device for 24*7 availability of HCPs, even in remotest villages
- Rapid diagnostics for faster intervention
- IoT and AI linked patient transportation system for transporting a critical patient
- AI linked medical store management system for 24*7 availability of life-saving medicines
- Sensitization of care seekers and caregivers
- Post-treatment follow up and education through IoT and AI
- Attendance tracking and training of ground-level health or like AAA workers

Over the period of time technology will bring new ways to tackle the problems in Health Care but we have to develop an evidence base, measure the effectiveness of the new technology; implement them in phases, prioritize and focus on what people's need. Internet of Things and Artificial Intelligence will be the next waves in this transformation

REFERENCES

[1]. D. R. Karjagi, "Wipro," [Online]. Available: https://www.wipro.com/business-process/what-can-iot-do-for-healthcare-/#:~:text=IoT%20enables%20healthcare%20professionals%20to,and%20reach%20the%20expected%20outcomes.&text=The%20spread%20of%20infections%20is%20a%20major%20concern%20for%20patients%20in%2.

[2]. S. P. Dash, "The Impact of IoT in Healthcare: Global Technological Change & The Roadmap to a Networked Architecture in India.," Journal Of The Indian Institute Of Science, 2020.

[3]. A. Chaudhary, "TRANSFORMATION OF HEALTH SECTOR THROUGH ARTIFICIAL INTELLIGENCE," INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS, vol. 8, no. 9, pp. 2880-2883, 2020.

[4]. A. Chaudhary, "Artificial Intelligence in Health Sector," International Journal of Scientific & Engineering Research, vol. 11, no. 8, pp. 1141-1145, 2020.

[5]. D. TEAM, "Benefits of Using IoT in the Healthcare Industry," DIGITEUM , 2020. [Online].