

NAVIGATING THE CURRENT TRENDS IN HEALTHCARE SECTOR IN 2024: SMART TECHNOLOGY IN HEALTHCARE SERVICES, DEVICES AND MEDICATIONS

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ABSTRACT

The introduction of advanced technology in drugs and equipment is causing a radical change in the healthcare industry. A new age of patient-centered care marked by improved efficiency, efficacy, & patient outcomes is made possible by smart medicine systems, which include ingestible sensors and individualized drug delivery mechanisms, big data monitoring system and emergency alerts. These systems also enable exact treatment regimens and significantly improve patient compliance. In the meanwhile, real-time data gathering, and analysis are made easier by smart technologies like remote monitoring of patients and wearable health monitors, which enable people to actively control their health and vital parameters e.g. Blood glucose, BP, HR etc. The information gathered for the review sheds light on the significant effects of these advancements on the provision of healthcare, from raising diagnostic precision to lowering costs. Healthcare delivery paradigms are being redefined by developments such as sophisticated medication delivery systems and interconnected medical devices with smartphones and database systems for monitoring during emergency conditions. Healthcare stakeholders may effectively negotiate the intricacies of contemporary healthcare and leverage the whole potential of intelligent technology to enhance patient outcomes by adopting these new trends.

KEYWORDS: Smart technology, healthcare, patient care, patent, current trends.

Graphical Abstract



INTRODUCTION

The confluence of globalization and digitalization is a contemporary trend that is changing the global financial

environment and offering chances for new business.^[1] "E-health" refers to a method, including wearable technologies, big data, telemedicine, m-health (mobile

health), electronic health records (EHR), and artificial intelligence (AI).^[2] Digital transformation may facilitate workflow procedures, boost operational effectiveness, and strengthen a patient-centric approach.^[3] The healthcare industry is a complicated ecosystem where many players must communicate with one another. Digital transformation is giving these players new opportunities to work together & use of devices in the provision of medical treatment. The American Medical Association defines it as electronic platforms and solutions that interact with patients for wellness and health-related reasons, gather and utilize their clinical data, and monitor patient outcomes and treatment quality.^[4] AI is now a game-changer in healthcare and medicine.^[5] 74% of patients feel they can better deal with and control their diseases by adopting wearable technology and other mHealth tools based on data from Boston Technology Corporation. The research predicts that the market for healthcare services worldwide will rise to \$9 trillion by 2026, up from its current level of close to \$7.5 trillion in 2022. Additionally, the healthcare IT industry is expected to experience significant growth, reaching \$857.6 billion by 2030, up from \$320 billion in 2022.^[6] Technological innovations, changing demographics, and changing patient requirements are causing an unparalleled era of change in the global health care system. A number of significant changes are expected to cause the delivery of healthcare to change in 2024.^[7]

MATERIAL AND METHODS

The data was collected from: Elsevier-Science Springer Link, PubMed, Semantic Scholar, and Google Scholar, Google Patents to conduct a literature search mostly from 2023 to 2024. The reference articles selected for this work are those that describe the Current trends in healthcare, Smart technology used in medical devices and medicines (e.g., smart pills, Nanotechnologies), Latest techniques and devices used for diagnostic and management purpose, patient care, dispensing medicines, database collection in healthcare, Patented devices.

Current Trends in Healthcare

The World Economic Forum's annual gathering in Switzerland covered a variety of topics, including

pandemic preparedness, the digital healthcare revolution project, and novel medications to combat emerging infections and prevent antibiotic resistance.^[8] The sharing of patient data, speedy decision-making on treatments and outcomes, and communication with medical professionals have all been altered by the digitalization of healthcare. It lessens the expenses and challenges related to creating system interfaces. Devices for electronic health records and other technological support are becoming standard by enhancing doctors' access to and sharing of their patients' medical records. Medical personnel may monitor their patients while they are not there by using remote patient monitoring. Algorithms for AI mimic human thought processes to create intelligent-looking systems. The COVID-19 epidemic has demonstrated the significant improvement in patient care that telemedicine and telehealth services have brought about. Some of the digital technologies are presented in Table 1.^[1] The contribution of the Internet of Things (IoT) to the advancement of cognitive healthcare, preventing suicides, aids in depression for patients. IoT integration in healthcare integrates humans, networked applications, sensors and devices, communication technologies, and smart systems in one system to monitor, manage, report and store medical data for ongoing treatment. IoT-based smart healthcare frameworks are developing from simple systems used for data collection, preprocessing, transmission, and analysis into sophisticated and intelligent systems capable of intense processing, remote data analytics, and evidence-based decision-making.^[9] Blockchain science can reduce data security threats, streamline the interchange, processing, and administration of individual medical records, and support the digital transformation of the healthcare sector by simplifying management.^[3] Digital healthcare technology facilitates the monitoring of several vital indicators, including blood pressure, blood glucose, ECG, mood, and temperature. Implantable devices, wearable gadgets, etc are examples of the devices. Figure 1 illustrates the devices used in the healthcare industry using Internet of medical things.^[10]

TABLE 1: Digital technologies used in healthcare.^[1,9,11]

S. No	Technology	Description	Platforms
1.	Electronic Health Records (EHR)	Safe information exchange across healthcare providers	Greenway health, GE centricity
2.	Artificial intelligence	Early identification of future health risks with predictive analysis	Health applications and portals
3.	Telemedicine	Technology-enabled remote medical care	For healthcare professionals & patients through web portals
4.	mHealth	Remote observation, data administration, with analysis	Mobile, web based.
5.	Wearable Devices	Continuous monitoring of Vital sign and tracking for fitness and health.	AppleWatchOS, Google Wear OS,
6.	Robotic process automation	Automation automates healthcare routine activities.	Blue Prism, WorkFusion

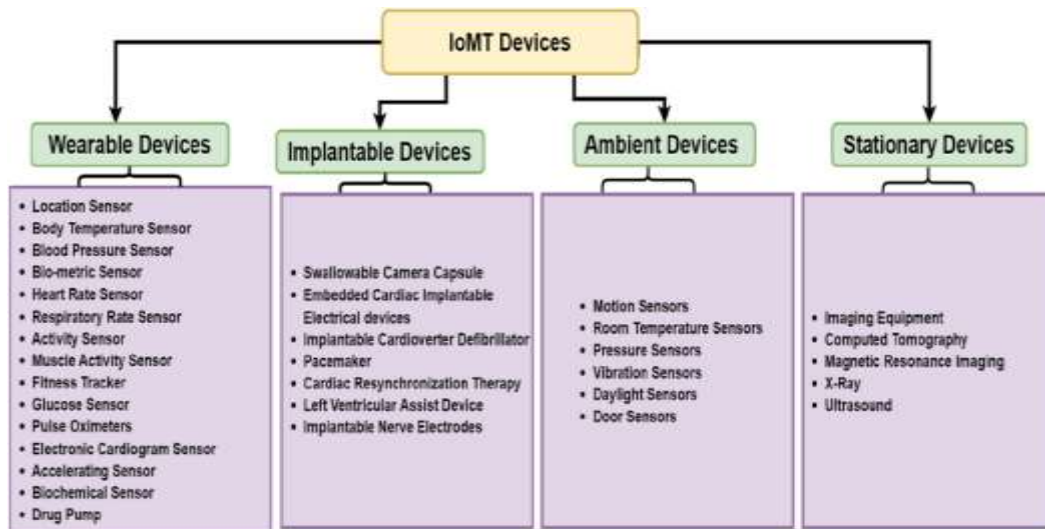


Figure 1: IoMT devices used in healthcare.^[10]

The Mechanics of Smart Technology: Operational Principles

The smart technology used in the healthcare system functions according to distinct principles. It integrates data from many sources; uses machine learning (ML) and other algorithms to provide the required output. Unsupervised and supervised learning are the two fundamental forms of ML working on algorithms. For

instance, random forest for supervised learning and K-means clustering for unsupervised learning. The 3 fundamental ML models are classification, clustering, and regression. In today's era, trained AI models with three primary layers, the sensing layer, the networking layer, and the application layer, measure vital signs and convey data and alerts to medical specialists.^[11,12] Figure 2 summarizes the operative principles.

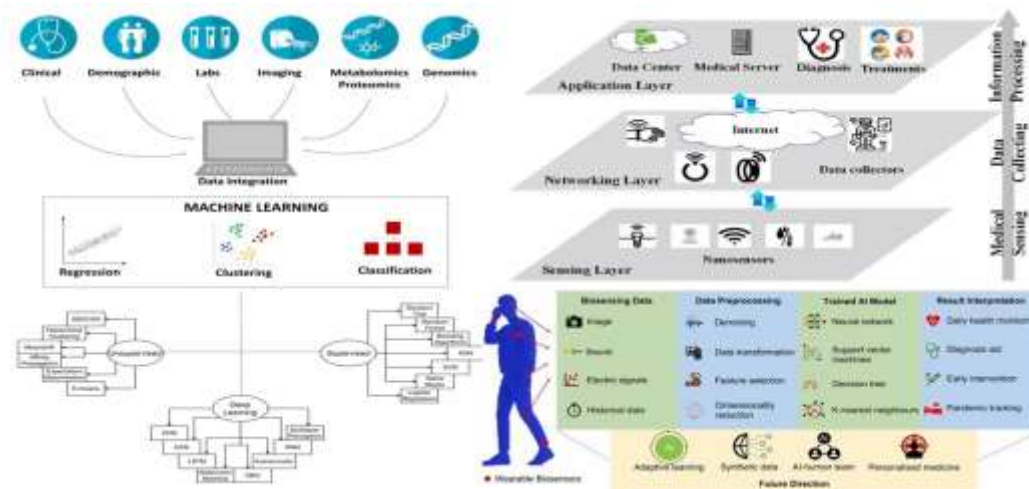


Figure 2: The working of smart technology in healthcare using machine learning and AI with biosensors.^[12-14]

Example of Current Trends in Healthcare for The Year 2024

The current trends in healthcare in the year 2023–2024 is achieving great heights for managing the healthcare system it includes: a) application of nanotechnology e.g., nano robots, biocompatible nanoparticles ,nanoelectronic devices for diagnosing and treatment e.g., a hunter for cancer cells or viruses can inject nano robots into a human blood vessel.^[15] In Interim Budget meeting , Sitharaman outlined measures for prevention, including the promotion of cervical cancer vaccination for girls between.^[10-15] With India facing a significant burden of cervical cancer cases, this proactive approach seeks to protect young girls from preventable diseases and deaths

which can be avoided by information through digital platforms and nanotechnologies robot in future era.^[16] AI algorithm within seconds can perform scans and identify diseases, IoT helps in patient awareness with collecting real time data for a healthier lifestyle add to receive alerts regarding emergency conditions.^[9] Remote patient monitoring enables the healthcare professionals to monitor a patient's condition online.^[1] After Covid-19 m-health and cloud technology is helping the healthcare professionals and patients to take a proactive approach to their health which is more cost effective with big data software. 3D bioprinting is also at heights to find new sophisticated versions of prosthetic treatments creating three-dimensional biological structures by layering

biomaterials and living cells. It is a sophisticated tissue creation method enabling the layer-by-layer printing of intricate structures with exact placement of various cell types. Extrusion bioprinting can print large-sized tissue constructs and complex organ models due to large build volume. By producing customized tissues and organs, bioprinting has enhanced bioengineering, to improved

transplantation methods and opened new possibilities for advanced drug testing and the development of in vitro models for disease study and therapeutic screening. Using MRI / CT scan data, 3D bioprinting produces 3D computer-assisted design (CAD) replicas of organs or tissues.^[17,18] Figure 3 gives the list of healthcare trends of 2024.



Figure 3: Healthcare Technology Trends From 2023-2024.^[6]

Patented Methods in Current Healthcare Sector

Patents are granted for developing a novel technology which will be beneficial to healthcare sector. Table 2

enlist examples a few patents granted to different countries.

TABLE 2: List of Patented techniques in healthcare sector in 2024.

S.NO	PATENT NO	TITLE OF PATENT TECHNIQUE
1.	US20240013926A1 ^[19]	Method and system for predicting adherence to a treatment.
2.	US2024008742A1 ^[20]	Device & method for capturing, analysing, sending still & video images of fundus during examination using ophthalmoscope.
3.	US20240013874A1 ^[21]	Healthcare Object Recognition, Systems and Methods.
4.	USW20240013899A1 ^[22]	Health data exchange platform.
5.	US20230414170A1 ^[23]	Implantable reporting processor for an alert implant
6.	US20230410209A1 ^[24]	Sensor-based systems and methods for evaluating activity.
7.	JP7401710B2 ^[25]	System and method for identifying cancer treatment from normalized biomarker scores.
8.	US20230398259A1 ^[26]	Cellulose nanofibrillar bioink for 3d bioprinting for cell culturing, tissue engineering and regenerative medicine applications.

Emerging Trends and Prospects

It takes careful planning, development, and operation of such nanoscale technologies to make it possible for people to live longer, healthier lives. To meet the needs and manage smart healthcare, developers must thus be conversant with the importance of these systems and their practical use. For such a wide variety of diversified studies and advances in smart healthcare systems, a complete spectrum of research gaps and restrictions must be addressed.^[10] We can create the best environment possible for implementing suitable, safe, and effective AI systems while lowering practitioner risk by addressing issues with financing, responsibility, and law.^[27]

Challenges Amidst the Current Healthcare Trends

Digitization adoption in healthcare has many challenges where cyber security-related challenges are of primary concern and highly costly^[1] Trust in data management and security is one of the main causes of the healthcare industry's late adoption of digital transformation.^[4]

Although new & essential medical devices and healthcare applications are essential to patient care, hackers often attack them. In addition, hackers are quietly gaining access to medical records.^[28]

CONCLUSION

The discovery of novel drugs for novel human targets and the incorporation of intelligent technology in devices are driving a dramatic revolution in the healthcare industry. The cybersecurity problem can be resolved by incorporating cryptographic techniques This trend is transforming the way healthcare is provided by offering cutting-edge technologies that improve treatment outcomes, empower people to take control of their health, and improve patient treatment by patient customized medicine. Smart drug adherence monitors such as smart pills, wearable vital sign trackers, and smart sensor-equipped pharmacy dispensing machines are just a few examples of the technological innovations that are reshaping healthcare by encouraging increased

accessibility, accuracy, and efficiency. The healthcare industry can keep evolving and adapting to meet the constantly changing demands of patients as well as communities throughout the world by making good use of smart technologies.

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