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Research Article

Encoding IoT for patient monitoring and smart healthcare: connected healthcare system fostering health 6.0

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ABSTRACT

Internet of Things (IoT) has revolutionized the way healthcare and patient monitoring was done until now. The Next Generation era that this evolved to is called Health 6.0 which is secured by IoT devices, this smart play in healthcare landscape gives the swat-the-clock monitoring inkling fostering detection controls for them to turn antibiotics at razor-edge level precision results enhancing efficiency and effectiveness box between disease endowment/therapy alternatives. The obvious examples is that IoT devices like wearables or medical equipment will be able to send health data in real time back to healthcare providers so they can leverage the additional information for better diagnosis, treatment as well as care management. This ecosystem provides the plumbing and tools to flow data between different healthcare systems so physicians can quickly access all of the information they need at point-of-care. IoT can also be used in patient monitoring, so that healthcare providers have data-supported decisions on care processes and treatment strategies; by predicting the health problems before reaching critical levels. This paper deeply dives in the futuristic vision of Smart Hospitals and their potential to reshape the healthcare 6.0 landscape.

1. INTRODUCTION

Smart healthcare systems based on IoT enable patients to be proactive in maintaining their health. Patient can follow-up his health metrics along with receiving real time feedback and connect to tele medicine consultation[1-3] using simple mobile apps and smart devices effectively improvising the experience over all. There are, however a number of challenges including security data[4] could be intercepted and modified between the sender and receiver in an IoT network, privacy concerns (standards bodies have yet to fully address how patient-specific information should be gathered/stored) as well as regulatory issues[5]. These aspects are necessary to tap IoT innovation[6] further for improved healthcare delivery. It is expected that IoT will enable healthcare providers to provide better, more personalized and proactive care than ever before changing the climate of patient outcomes and supporting a new era in healthcare provision. As a result, the healthcare markets are receiving a multitude of new healthcare applications. Additionally, 'tailored preventative health coaches' (virtual health advisers) will develop to assist consumers in managing chronic and diet-related disorders using such apps. There are many consumer wearable devices and health apps available globally, with two main service sector categories: management of health conditions and wellness. Wellness-management applications frequently make it easier to track and alter lifestyle, stress, and diet choices including weight reduction[7], food diaries, stress management, quitting smoking, and moderate alcohol consumption. Apps for managing health conditions [8-11] provide information on illnesses and ailments, facilitate medical access, and facilitate treatment regimens like diabetes self-management, atrial fibrillation management, or treatment for mental disorders. Although ICT is used both within and outside of hospitals, it has improved considerably. The present healthcare system is focused on employing cell phones or wearable technology[12] to manage a specific ailment. Individual data sets only accurately reflect particular facets of an individual's condition; for example, glucose meters only accurately

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indicate a small portion of a person's overall health[13-15]. In addition, wearable devices like smart watches demand user initiative, which frequently results in a loss of interest over time, while retention rates for mobile apps tend to decline after the initial phase[16].

The application of machine learning approaches to track human activity[17-19] is a foundational asset, disrupting the way it perceive and take control over individual wellness with Smart Healthcare Informatics[20]. Using cutting-edge machine learning models, it allows for a continuous and detailed real-time observation of everyday activities[21-24] which in turn could be used to predict the need if necessary. Thus enhancing healthcare with more personal and proactive interventions. Data is gathered through a host of wearable sensors and smart devices in real-time, tracking different aspects of how an individual moves about, behaves under specific pressures or during certain activity periods[25]. This data is then run through advanced machine learning algorithms to detect complex patterns, outliers and trends that may be indicative of changes in health. By comparing this with other established medical information, we can identify activity patterns of likely injury or illness that correlate most closely with these abnormalities.

1.1 Significance and Relevance of the Study

One of the features of Smart Healthcare is its noteworthiness in healthcare delivery[26]. Improving patient workflows and communication with providers via digital platforms, stream-lining administrative processes, optimising resource allocations build a more flexible responsive health care system[27]. By using Technology, Telemedicine helps in consulting patients from a location which is far known as it breaks the geographical barriers and bridge an access to healthcare services. The primary concern is around data security and privacy, as well as interoperability across the many disparate healthcare systems and devices[28-30]. In addition, healthcare professionals must be sufficiently trained to effectively use this technology and put the insights into meaningful context. Smart Healthcare is a disruptive technology and regulatory frameworks must be sensitive to the ethical, legal as well technical implications. It combines the breakthrough power of technology with cutting-edge medical knowledge directly at your fingertips to improve patient outcomes and opportunities for health care operations, ultimately leading up to a more adaptive and personalized healthcare ecosystem[31-34]. Applications in Smart Healthcare are reforming the healthcare spectrum, as it increases operational efficiency via embedding technology legitimating digital care for patients diagnosis and health management[35-37]. Such steps promise a future wherein not only is healthcare more clinically demonstrable, accessible and efficient but ensures that wellness becomes less reactive in nature reaching gym-goers before they lapse into their unhealthy living patterns. With the advancement in technology, Smart Healthcare applications have endless potentials and hence it is opening up a new era of revolutionary healthcare solutions. The promise of improved diagnostic capabilities[36] and safer, more effective treatment from intelligent healthcare devices is great but a number of hurdles remain. Protecting patient data[37]: Given that these devices acquire clinically relevant medical information[38], ensuring the privacy and security of protected health information (PHI)[39-40] is also paramount. Other considerations are ensuring the devices meet regulatory compliance and interfacing with existing healthcare systems to ensure seamless integration into the healthcare ecosystem. If Implemented in Healthcare Sector: If an individual is monitored after he/she leaves the hospital[41], it will provide better control over his/her vitals signs and online monitoring can make sure that patient is following a prevention plan by taking medications on time along with doing exercises which will lower down the re-admission rate hence there won't be any emergency visit[42]. Intertwining of IoT[43], artificial intelligence (AI), big data analytics[44] and cloud computing[45] represents the digital Health 6.0 era that is coming next in healthcare industry.

2. IOT AND DEEP LEARNING UTILIZATION TO SMART HEALTHCARE 6.0

The possibilities are endless with this technology[46]. Applications range from tracking sleep and physical activity to monitoring cardiac rhythm, automatic fall detection giving a machine learning based holistic view on an individual health. Additionally, this data-driven approach offers healthcare providers insights they can act upon to enable them to identify when fast interventions[47] are required or how you construct personalized treatment programs[48]. However, some challenges must be addressed to extend the benefits of this practice. Since these are highly sensitive health data that is being recorded and analyzed, it is one of the most critical aspects to ensure security in its collection[49]. Adhere to regulations and implement encryption. Organizations need to ensure they are in compliance with the law[50-52], which includes implementing transparent policy regarding data security for all patient information stored on-premises or within a cloud storage service. Improving machine learning algorithms to reduce false positives and account for individual differences, on the other hand[53]; will increase precision and performance of insights produced. The use of machine learning based methods for tracking human activity has a long history in healthcare informatics. Where health meets technology, combining with a personalized proactive monitoring and management for better patient outcomes through healthy life. In the case of using hardware as a service, in order to collect enough data from many users privacy is always an issues with privacy. Keeping track of a number of various spots can come to be virtually monitoring the regimen practices from every day and this style from monitoring possesses lots far fewer advantages. The legitimacy and defense of individual rights[54-56] should be taken into account at the most fundamental level. Going a step further, however, individuals should be able to accept and embrace the idea of healthcare services in a magical realm of existence. Only when monitoring offers the user a comfortable life and

meets their needs and wants is this conceivable. Thoughts about security are necessary, but it is much more crucial to concentrate on the patient's preferences and create products that cater to those preferences[57-59]. Numerous services are presently offered that concentrate on smart gadgets, but the ultimate objective for people using these technologies is their own health and desires, not the device and its "smartness" in and of itself. Instead than having humans becoming more dependent on technology as machines become smarter, a system must be created where smart devices and related technology are designed to bring enjoyment. Only when a device's unique intelligence successfully connects users with the environment around them and focuses on human desires can this be done at a cost effective[60-62].

But, the implementation of smart healthcare is not without challenges. Data security and patient privacy remain paramount concerns[63], necessitating robust cybersecurity measures[64] to safeguard sensitive medical information[65]. Additionally, interoperability issues between various healthcare technologies and systems must be addressed to ensure seamless data exchange and communication[66-68]. Smart healthcare represents a transformative shift in how healthcare is delivered and managed. By leveraging technology and data-driven insights, it holds the promise of improving patient outcomes[69-71], enhancing operational efficiency, and making healthcare more accessible and personalized than ever before. As the world continues to embrace digital innovation, smart healthcare is poised to revolutionize the industry and pave the way for a healthier and more connected future. Personal health information is being actively collected, analyzed[72], and used for medical services through platform research. In the realm of medical information and IoT-based medical devices, there is a movement toward creating standards for technology and information integration[73] that may be widely used. Applying existing standards based on usage is challenging for makers of smart wearables because they cover a wide range of technological fields. To adapt to standards more rapidly, different use cases for medical information and devices are being created. Organizations that provide a standardized application method and an open platform[74] customized to each use case are available. These groups are creating standards for smart clothing[75] and applying them naturally. Even while IoT-based healthcare for the enchanted life space minimizes human interaction, it is still a human-friendly environment. The existing regulatory framework mandates that subjects give their active, informed consent before any data collection or use in those spaces can take place. 'Lifelog data' is a term used to describe data that typically uses wearable technology or mobile devices to capture and chronicle an individual's life[76]. However, there are no separate regulations for lifelog data, the line between personally identifiable data and non-personally identifiable data is hazy, and there are still a number of legal accountability issues to resolve. A tailored service requires information gathered from various areas, thus various acts and rules must be taken into account since there is no one universal legislation for such services[77].

The smart health paradigm is also aiding the progress of quality initiatives. This parity of up-to-date information allows administrators to keep tabs on essential performance indicators, monitor patient safety protocols and continually improve upon treatment quality using evidence-based approaches. If a healthcare establishment exits regulatory piste, the needs of automated reporting technology can also maintain... Automated Reporting Technologies[78] Offers Industry Adherence - Automated reporting technologies inside Continuous Improvement Programs end to control adherence. The move to smart health, however, is far from easy. Data Protection Several security rounds are necessary for the protection of data Interoperability Stay hydrate and saw teeth Workforce Intense boot camp training is required in capacity building. It will be pre-eminent to meet technology experts, politicians and healthcare practitioners halfway for a smoother transition into the smart health ecosystem. The introduction of smart health technologies in the management and care practices is a major leap towards making healthcare more efficient, patient-focused and data-driven. With the power of AI, IoT and data analytics healthcare may have a chance to change how they allocate resources handle patient engagement, quality management and possibly even service delivery. The evolution of this process is likely to be accomplished by the help of healthcare administration with smart health utilization more adeptly, responsively and creatively. The future of the healthcare sector is related to data and much data can be obtained from various IoT devices[79]. Utilizing big data analytics along with AI algorithms for processing huge amounts of IoT device-generated raw data to identify trends, patterns, relationships Strategies are data driven and focus on disease discovery, personalised therapeutic interventions and trend forecasting. Also, artificial intelligence can help healthcare professionals more quickly and accurately diagnose medical imaging (X-ray or MRI) when this technology is combined with diagnostics tools[80]. Nevertheless, applying IoT in healthcare to can have challenges and constraints as well. As IoT devices are mostly networked, data security and patient privacy should be a top priority to avoid unidentified access attempts or even leakage of health record information. To protect all this sensitive patient information, healthcare institutions need to implement strong cybersecurity measures such as encryption and access controls.

This is an important consideration in the IoT universe, as it many devices and platforms must be able to freely speak with each other while cohesively linking into existing healthcare solutions. Efficient standardization and open data exchange protocols are required to ensure the compatibility and continued operation of IoT devices across different healthcare environments. This convergence of IoT and healthcare can bring a disruptive change in the functioning of entire health ecosystem. By enabling remote patient monitoring, promoting preventative treatment and improving operational efficiency as well as offering data-driven insights - the Internet of Things (IoT) is already changing healthcare. The result is turning healthcare into a proactive, individualised and economic system. Individuals face hurdles, no doubt, but the benefits of IoT in healthcare are equally undeniable with a future that sees more accessible and successful care tailored directly to patient

needs. Despite the ongoing proliferation of technology, little has truly reached ultimate scope for what IoT in healthcare is capable of. But it offers a look into that future where medical services become networked and tailored to individual patients.

3. SMART HOSPITAL: ADVANCED SOLUTION TO MANAGE THE HEALTHCARE AND SERVICE CENTRED PATIENT IN FUTURE

Smart Hospital indicates an evolutionary form of health administration in which the management and treatment processes are designed to adapt respectively and automatically play video. The study also suggests the transformative potential of Smart Hospitals, moving from what constitutes a smart hospital to its building blocks and benefits, challenges as well as future implications in healthcare. Through real-world deployments and case studies, these insights are directly considered in our analysis of the transformative role that Smart Hospitals play across patient care, operational efficiency, and healthcare delivery. Technology has evolved, bringing up the Smart Hospitals that use IoTs, artificial intelligence (AI), data analytics & automation to establish a connected and streamlined arena in healthcare. These are a set of interconnected entities in any smart hospital as:

1. IoT enabled healthcare equipment: Implementing various IoT devices to enable real-time patient monitoring, asset tracking and data collection enforcements
2. Electronic Health Records (EHR) Systems: These systems allow for patient records to be centralized and digitized in manner that can only be accessed by authorized healthcare practitioners
3. AI-Powered Decision Support: Here, we can implement one or more types of advanced algorithms made by IBM where doctors will be benefited using machine learning enabled to diagnose medical conditions either plan treatments and execute predictive analytics phase.
4. Patient-Centric Applications: Mobil applications and wearables designed to improve patient engagement, help with appointment scheduling etc.
5. Data Analytics and Insights: Using big data analysis to uncover trends, make resource allocations profitable and improve healthcare.

3.1 Benefits and Challenges of Smart Hospitals

Patient care improvement: benefits to patients with real-time monitoring, personalized treatment plans and increased communication between the patient and healthcare providers.

1. Operational Efficiency: The deployment of robotic process automation for administrative tasks, development optimized workflows and managing resources.
2. Data Analytics: It is used to drive evidence-based decision-making and more proactive healthcare management).
3. Improved Patient Experience: Applications and services designed with patients in mind that cater to patient needs, thus enabling them better engagement and ease-of-use as well enhancing their overall experience of healthcare coverage
4. Sustainability and Cost Savings: Energy-efficient infrastructure, less paper usage which helps to save on operational costs.

3.2 Challenges and Important Considerations

1. Security and privacy of data: Keeping all patient records safe from digital threats and ensuring that patient health information is always protected according to the existing data protection law
2. Interoperability: makes sure that each system or device (component) commutes smoothly, effectively and becomes harmonious with another.
3. Workforce Training: Equipping healthcare workers with the requisite skills to adequately use and manage smart technologies.
4. Initial Investment: The cost concerns the set-up and maintenance of infrastructure / technology needed to operate a Smart Hospital.

Future Health of the Ecosystems Smart Hospitals have technology as a main enhancer and with such advance there is an expectation for groundbreaking solutions, better results among patients and new model businesses health care in the future. Smart Hospitals represent a new and progressive method of administration & management, which is driven by value-based care systems that are being increasingly offered in the health sector. This study investigates how the emergence of Smart Hospitals may disrupt traditional healthcare delivery and what this means for the future, covering key elements to creating successful smart hospitals - from accelerated decision-making, improved patient care experience at a lower cost with better outcomes as well as challenges in implementing these new innovations. The domain of pharmaceutical research and development is at the forefront of scientific advancement, constantly expanding humanities understanding to develop innovative treatments for unmet medical needs. In this review, we consider the intricate and dynamic landscape of modern drug discovery with a specific focus on current technologies, strategies and innovation that are changing the game. After

having examined the barriers, advancement and future perspectives it will here strive to detail much of the terrain that affects pharmaceutical solutions are sought. Drug discovery starts with the identification and validation of novel targets for therapeutic intervention. This process has been rapidly accelerated by advancements in genomics, proteomics, and bioinformatics that permit systematic analyses of biological pathways and disease mechanisms. High-throughput technologies that allow manipulation of biological pathways, such as CRISPR-Cas9 gene editing, thus supporting the validation and utility for targets. High-throughput screening (HTS) methodologies have transformed the time-consuming hit identification from large chemical libraries. Quest for Rapid High-Throughput Screening (HTS): Automated robotic technologies and microfluidic platforms enable rapid testing of numerous drugs in homeostatic closed-loop or patient-specific disease assays. Additionally, advances in computer algorithms make virtual screening a more fruitful route to finding potential drug candidates with the desired characteristics. Structural biology, which has a number of senses from the use of X-ray crystallography to cryo-EM for determining three-dimensional disposition of biological molecules. The Rational drug design employs computer simulations and molecular modeling to estimate where the compounds will interact with the binding of drugs candidates in target protein, aiming at improving their on-target engagement (substrate efficiency) as well off-target selectivity. Profile. Artificially intelligent learning machines providing data for drug development: initiating giant datasets, faithfully desirable chemical activity predictions and insight on medication interactions thus revolutionizing the pharmaceutical industry. The company specializes in using advanced techniques for rapid, efficient lead optimization to support the R&D of new medicinal products.

Personalized medicine relies on biomarkers that help select therapies tailored to the unique genetic makeup of each person. The advent of omics technologies, such as genomics, transcriptomics and metabolomics has enabled the identification of biomarkers that predict a change in diseases or distinguish how patients will respond to therapy. This in turn supports the development of personalised medicine. The introductions of biologics, which include monoclonal antibodies and gene remedies have significantly multiplied the remedy alternatives available. Phage display and hybridoma technology have simplified the method of therapeutic antibody design which targets a specific antigen, making them more precise in disease management. Fragment-based drug discovery (FBDD)[81] is a popular strategy for identifying small molecular fragments that are able to bind to specific target proteins. They provide an essential first step in their path to become highly potent drug candidates. A key method of determining fragment binding modes at atomic level resolution is NMR spectroscopy complemented by X-ray crystallography, which provide valuable information on the biophysics underpinning protein-fragment interactions guiding drug discovery.

New paradigms for effective cancer therapies are emerging with the rediscovery of natural products and drug-repurposing as untainted sources of potential therapeutic agents. Modern technology enables the separation, identification and development of bioactive compounds from natural sources Mathematically approaches predict possible new uses for already existing drugs. Drug development research is a rapidly evolving field, and making use of state-of-the-art technologies and data-driven approaches in tandem with interdisciplinary collaborations are central to this progress. It is an unrelenting pursuit to unearth next-in-class medicines that could change patient care, confounding diseases and the course of medical progress. As this is happening - with monumental scientific and technological progress around the corner for discovering new therapeutic treatments, it all starts to look a little bit more harder, cooler and goddamn exciting [82][83].

The adoption of Smart Healthcare can bring a vast impact on patients' outcomes and delivery healthcare. With it come a number of complex legal challenges that will need to be negotiated carefully to protect the rights of patients, ensure data privacy and address ethical dilemmas. Key legal hurdles pertaining to smart healthcare include the another point which makes the Smart Healthcare a big deal is its reliance on collection, storage and analyzing of sensitive patient data e.g. medical records, personal health data may be aspects of biometric information therefore here comes privacy & security issues in to lime light Some of the most important factors to consider are implementing robust data encryption, access controls and compliance with any kind of confidentiality requirement (e.g., GDPR in Europe or HIPAA in US) which will ensure patients privacy is preserved from unauthorized users. Consent surrounding smart healthcare is a complex area to navigate with an increasing range of technologies and data analytics systems in use, and researchers are stressing the need for informed patient consent. Patients must understand exactly how their data are being used, who will have access to it and what its implications might be. After all, healthcare professionals must make certain that patients are well-informed and afforded the ability to opt into - or out of - being data subjects. The incorporation of AI, machine learning and autonomous systems in health care gives rise to questions regarding liability and responsibility as well - who will be responsible for technical errors or the potential negative consequences? When it comes to the use of technology in medical decision-making or interventions, establishing responsibility and accountability is a legal challenge which requires clear frameworks and standards.

Medical Devices Regulation: A wide range of innovative healthcare solutions include medical devices, wearables and digital health applications. Often, these technologies need regulatory approval to ensure they are safe and effective.

Navigating the regulatory landscape around medical devices, especially in situations where software tweaks can influence their behavior is a complex process.

In smart healthcare systems, many devices and platforms need to interoperate with various providers for the purpose of exchanging health information. Making data available and still in compliance with stricter rules is not an easy activity. The key to unlocking the value of health data is in establishing standards as well as protocols that allow for seamless exchange but maintain patient privacy.
A significant point to consider when applying AI and machine learning algorithms in medical decision-making is ethically fraught territory, especially given they are often trained on historical data which may not always be free from bias. In order to prevent unfair outcomes, transparency, fairness and accountability need to be a priority in algorithms. Telemedicine applications and regulations pertaining to smart health care The waters of telemedicine that are so regulated, licensure requirements within a state and between states as they see fit (see what I did there?;), reimbursement- billing is involved which we will touch on this later but the answer to whether NP can be reimbursed for providing care via Telehealth again depends on location it appears.
The ownership of data created by smart healthcare systems such as a new type of electronic health record may be the subject of dispute, especially when various parties are involved - patients or citizens, health care providers and technology corporations. Key to this is defining Data Ownership and ensuring that IP issues are resolved. Addressing these legal barriers requires a concerted effort and partnership among healthcare providers, technology developers, policymakers, and lawyers. That means setting specific rules, standards and regulations that strike the right balance between innovation on one hand and patient rights/safety on the other is key to ensuring smart healthcare can be effectively integrated into our healthcare systems.

4. CRITICAL ASSESSMENT OF INTERNATIONAL HEALTHCARE ADMINISTRATION AND THE ROLE OF GOVERNMENT

The skills and knowledge of healthcare administration are essential in maintaining, managing, monitoring the whole mechanism serving citizens permanently. Government policies are key drivers of healthcare through rules, funding allocation and standard enforcement to achieve expected output at the last stage in order for health systems overall. This paper aims to explore the complexity of governance practices followed by disparate governments in order to achieve optimum healthcare administration and effective service delivery. The responsibilities of the government in health management are:
Government has a number of Key roles in healthcare administration like:
Regulation and Standards: Governments dictate the regulation framework & standards as well as licensure requirement for various healthcare facilities, professions and services.
Funding and Resource Allocation: The allocation of funding, budgets and resources by Governments to ensure equal distribution prioritizing fair access for all societal groups b. Healthcare Services & Infrastructure Availability; segment name describes the service provision landscape available within a region in supplying medical services / physical facilities Planning and Policy Development- Governments develop healthcare policies, strategies, subsector development plans addressing public health concerns as well as society needs [31]
Healthcare Delivery Oversight: Governments monitor and evaluate healthcare delivery to ensure compliance with regulations, efficiency and patient safety.

4.1 Government approaches and healthcare systems

- Universal Healthcare: As seen in countries like Canada, the United Kingdom and Australia who uses Government Funded universal healthcare that involves provision of health services by their government to all residents through public facilities get service concession will only be used for necessary basic things.
- Multi-Payer Systems: Contrast with Germany and Switzerland, who work through a multi-payer system where public funds co-exist with private insurers that compete for business in a vast menu of health care options.
- System administered by the Government: There are countries, such as Cuba, where healthcare is state administered; that means (basically speaking) the state has authority over both services and facilities in healthcare more than any other actor possible
- Hybrid Model: Consists of aspects from both public and private healthcare system, which create a complex structure with differing levels of government involvement in the country (United States).

4.2 Obstacles and Resolutions

- Traditional Mechanisms for Funding and the Allocation of Resources: The need to balance healthcare spending with other public goals is leading us towards innovative approaches for funding health services as well resource allocation strategies that are both efficient but also assure equality outcomes throughout.
- Healthcare Access Disparities: Governments deal with healthcare access discrimination by creating policies that ensure there is a just distribution of resources especially for those in marginalized areas.
- Quality Assurance: To maintain and improve the quality of health care, governments are enforced with methods for Assuring Quality similarly to Implementing Accreditation Standards & Regulatory Bodies.
- Efforts to alleviate the pressures on healthcare stemming from aging demographics will necessitate extensive planning as well as targeted geriatric services and preventive interventions (Full Report, Executive summary-comm.) [17]

4.3 Overview of Representative Cases

- National Health Service (NHS)-Easily one of the pioneers in universal healthcare, governments have been assured that NHS initiatives can cover all types of comprehensive treatments.
- Germany: Social Health Insurance; Multi-Payer social solidarity, quality healthcare.
- Universal Health Coverage in Japan: That's an aggressive government-based model, the ultimate goal of which is to ensure quality health services that are affordable and accessible for citizens.

5. CONCLUSION AND FUTURE IMPLICATIONS

Consumer ideals take precedence over industry demands since modern society is dominated by consuming rather than production. The smart sector currently offers a variety of added features, but they don't seem to align with what consumers value. Smart healthcare is relevant for the enhancement of safe, effective, patient-centered, timely, efficient, and equitable healthcare quality. Until then, the healthcare sector's quality of life cannot be significantly improved by the smart technology sector. Despite the fact that there are many smart devices (such as smart watches and smart cars), not all of them can satiate human cravings or track the user's health (such as heart rate, activity, stress level, mood, etc.). Wearable, embedded, and touchless smart devices and technologies are restricted by the capabilities of their sensors and hardware. Therefore, it is crucial to consider what categories of smart devices are best suited to gratifying human aspirations. The functions of smart gadgets should be debated in light of their sensors and physical attributes, users' actions in their environments, and peoples' values and preferences at any given time, particularly with regard to good health. Establishing the functions of smart gadgets and their current state will help us identify any gaps in the provision of living space health services without disconnection. Personal genomes, clinical data, behavioral data, lifelogs, and health insurance are just a few of the several types of information and services needed for healthcare in the life space. Smart technology must be connected to and integrated with both current and future healthcare services in order to collect all the necessary healthcare data. All healthcare services for live spaces should be integrated and interfaced, including data collecting and analysis, standards, and regulatory considerations. In order for smart gadgets to be more successfully integrated into everyday healthcare, research on this topic is urgently needed.

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References

[1] I. Ansari and A. Singh, "Growth and Opportunity of Medical Tourism in the Indian Healthcare Sector: A Critical Review," in Impact of AI and Robotics on the Medical Tourism Industry, pp. 290-301, 2024.

[2] A. S. Poornima and S. Subramanian, "Fostering Global Wellness: Harnessing Social Media to Enhance Cross-Cultural Trust to Propel Medical Tourism Ensuring Economic Growth," in Proc. European Conference on Social Media, vol. 11, no. 1, pp. 216-224, May 2024.
[3] H. Dar and K. Kashyap, "Smart healthcare system (SHS): medical tourism delivering consumption and elevating tool in the ages of smart technologies," Tourism Planning & Development, vol. 20, no. 3, pp. 397-415, 2023.
[4] A. Xu et al., "Investigation of management of international education considering sustainable medical tourism and entrepreneurship," Heliyon, vol. 9, no. 1, 2023.
[5] M. Shabankareh et al., "Health tourism and government supports," International Journal of Emerging Markets, 2023.
[6] T. H. Sardar et al., "Machine Learning in the Healthcare Sector and the Biomedical Big Data: Techniques, Applications, and Challenges," in Big Data Computing, pp. 336-352, 2024.
[7] V. Khurana, "Accelerating Pace of Scientific Discovery and Innovation through Big Data Enabled Artificial Intelligence and Deep Learning," Emerging Trends in Machine Intelligence and Big Data, vol. 16, no. 1, pp. 38-53, 2024.
[8] W. Li et al., "A comprehensive survey on machine learning-based big data analytics for IoT-enabled smart healthcare system," Mobile Networks and Applications, vol. 26, pp. 234-252, 2021.
[9] E. Sejdic and T. H. Falk, Eds., Signal Processing and Machine Learning for Biomedical Big Data, CRC Press, 2018.
[10] J. Luo et al., "Big data application in biomedical research and health care: a literature review," Biomedical Informatics Insights, vol. 8, BII-S31559, 2016.
[11] M. Mohammadi, A. Al-Fuqaha, S. Sorour, and M. Guizani, "Deep learning for IoT big data and streaming analytics: A survey," IEEE Communications Surveys & Tutorials, vol. 20, no. 4, pp. 2923-2960, 2018.
[12] N. Scarpato, A. Pieroni, L. Di Nunzio, and F. Fallucchi, "E-health-IoT universe: A review," Management, vol. 21, no. 44, p. 46, 2017.
[13] S. Dash, S. K. Shakyawar, M. Sharma, and S. Kaushik, "Big data in healthcare: management analysis and future prospects," Journal of Big Data, vol. 6, no. 1, pp. 1-25, 2019.
[14] B. Singh, "Lensing Legal Dynamics for Examining Responsibility and Deliberation of Generative AI-Tethered Technological Privacy Concerns: Infringements and Use of Personal Data by Nefarious Actors," in Exploring the Ethical Implications of Generative AI, A. Ara and A. Ara, Eds., pp. 146-167, IGI Global, 2024.
[15] B. Singh and C. Kaunert, "Salvaging Responsible Consumption and Production of Food in the Hospitality Industry: Harnessing Machine Learning and Deep Learning for Zero Food Waste," in Sustainable Disposal Methods of Food Wastes in Hospitality Operations, A. Singh, P. Tyagi, and A. Garg, Eds., pp. 176-192, IGI Global, 2024.
[16] O. Y. Al-Jarrah, P. D. Yoo, S. Muhaidat, G. K. Karagiannidis, and K. Taha, "Efficient machine learning for big data: A review," Big Data Research, vol. 2, no. 3, pp. 87-93, 2015.
[17] S. K. Zhou et al., "A review of deep learning in medical imaging: Imaging traits, technology trends, case studies with progress highlights and future promises," Proceedings of the IEEE, vol. 109, no. 5, pp. 820-838, 2021.
[18] B. Muthu et al., "IOT based wearable sensor for diseases prediction and symptom analysis in healthcare sector," Peer-to-peer Networking and Applications, vol. 13, pp. 2123-2134, 2020.
[19] D. D. Miller and E. W. Brown, "Artificial intelligence in medical practice: the question to the answer?," The American Journal of Medicine, vol. 131, no. 2, pp. 129-133, 2018.
[20] D. Bhattacharyya, S. N. Joshua, and N. Thirupathi Rao, "Medical Image Analysis of Lung Cancer CT Scans Using Deep Learning with Swarm Optimization Techniques," in Machine Intelligence, Big Data Analytics, and IoT in Image Processing: Practical Applications, pp. 23-50, 2023.
[21] S. Malik and A. K. Tyagi, Eds., Intelligent Interactive Multimedia Systems for E-Healthcare Applications, CRC Press, 2022.
[22] M. Viceconti, P. Hunter, and R. Hose, "Big data, big knowledge: big data for personalized healthcare," IEEE Journal of Biomedical and Health Informatics, vol. 19, no. 4, pp. 1209-1215, 2015.
[23] Y. A. E. Ahmed, B. Yue, Z. Gu, and J. Yang, "An overview: Big data analysis by deep learning and image processing," International Journal of Quantum Information, 2340009, 2023.
[24] A. Panesar, Machine Learning and AI for Healthcare, pp. 1-73, Coventry, UK: Apress, 2019.
[25] S. Sengan et al., "Medical information retrieval systems for e-health care records using fuzzy based machine learning model," Microprocessors and Microsystems, 103344, 2020.
[26] B. Singh, "Blockchain Technology in Renovating Healthcare: Legal and Future Perspectives," in Revolutionizing Healthcare Through Artificial Intelligence and Internet of Things Applications, pp. 177-186, IGI Global, 2023.
[27] J. F. Rodrigues et al., "Big data and machine learning for materials science," Discover Materials, vol. 1, pp. 1-27, 2021.
[28] P. K. D. Pramanik, S. Pal, and M. Mukhopadhyay, "Healthcare big data: A comprehensive overview," in Research Anthology on Big Data Analytics Architectures and Applications, pp. 119-147, 2022.
[29] L. Zhou, S. Pan, J. Wang, and A. V. Vasilakos, "Machine learning on big data: Opportunities and challenges," Neurocomputing, vol. 237, pp. 350-361, 2017.

[30] S. Bahri, N. Zoghlami, M. Abed, and J. M. R. Tavares, "Big data for healthcare: a survey," IEEE Access, vol. 7, pp. 7397-7408, 2018.
[31] H. Kashyap, H. A. Ahmed, N. Hoque, S. Roy, and D. K. Bhattacharyya, "Big data analytics in bioinformatics: A machine learning perspective," arXiv preprint arXiv:1506.05101, 2015.
[32] M. Elbadawi, S. Gaisford, and A. W. Basit, "Advanced machine-learning techniques in drug discovery," Drug Discovery Today, vol. 26, no. 3, pp. 769-777, 2021.
[33] J. C. Cabello, H. Karimipour, A. N. Jahromi, A. Dehghantanha, and R. M. Parizi, "Big-data and cyber-physical systems in healthcare: Challenges and opportunities," in Handbook of Big Data Privacy, pp. 255-283, 2020.
[34] M. Chen, S. Mao, Y. Zhang, and V. C. Leung, "Big data: related technologies, challenges, and future prospects," Springer, vol. 100, Heidelberg, 2014.
[35] Z. D. Stephens et al., "Big data: astronomical or genomical?" PLoS Biology, vol. 13, no. 7, e1002195, 2015.
[36] S. K. Tiwari, J. Kaur, P. Singla, and P. N. Hrisheekesha, "A Comprehensive Review of Big Data Analysis Techniques in Health-Care," in Proc. International Conference on Emergent Converging Technologies and Biomedical Systems, pp. 401-420, Springer Nature Singapore, Sept. 2022.
[37] B. Singh, "Unleashing Alternative Dispute Resolution (ADR) in Resolving Complex Legal-Technical Issues Arising in Cyberspace," Revista Brasileira de Alternative Dispute Resolution-Brazilian Journal of Alternative Dispute Resolution-RBADR, vol. 5, no. 10, pp. 81-105, 2023.
[38] G. Devika and A. G. Karegowda, "Deep Learning in IoT: Introduction, Applications, and Perspective in the Big Data Era," in Deep Learning Applications and Intelligent Decision Making in Engineering, pp. 1-54, IGI Global, 2021.
[39] P. Sukeshini Sharma, M. Ved, J. Chintalapti, and S. N. Pal, "Big data analytics and machine learning technologies for HPC applications," in Evolving Technologies for Computing Communication and Smart World: Proceedings of ETCCS 2020, pp. 411-424, Springer Singapore, 2021.
[40] M. I. Jordan and T. M. Mitchell, "Machine learning: Trends, perspectives, and prospects," Science, vol. 349, no. 6245, pp. 255-260, 2015.
[41] B. Singh, "Social Cognition of Incarcerated Women and Children: Addressing Exposure to Infectious Diseases and Legal Outcomes," in Principles and Clinical Interventions in Social Cognition, K. Reddy, Ed., pp. 236-251, IGI Global, 2024.
[42] B. Singh and C. Kaunert, "Harnessing Sustainable Agriculture Through Climate-Smart Technologies: Artificial Intelligence for Climate Preservation and Futuristic Trends," in Exploring Ethical Dimensions of Environmental Sustainability and Use of AI, pp. 214-239, IGI Global, 2024.
[43] B. M. Reddy, "Amalgamation of Internet of Things and Machine Learning for Smart Healthcare Applications–A Review," Int. J. Comp. Eng. Sci. Res., vol. 5, pp. 08-36, 2023.
[44] P. Keikhosrokiani, Ed., Big Data Analytics for Healthcare: Datasets Techniques Life Cycles Management and Applications, Academic Press, 2022.
[45] H. Kashyap, H. A. Ahmed, N. Hoque, S. Roy, and D. K. Bhattacharyya, "Big data analytics in bioinformatics: architectures, techniques, tools and issues," Network Modeling Analysis in Health Informatics and Bioinformatics, vol. 5, pp. 1-28, 2016.
[46] J. Manyika, M. Chui, B. Brown, J. Bughin, R. Dobbs, C. Roxburgh, and A. Hung Byers, "Big data: The next frontier for innovation, competition and productivity," 2011.
[47] M. Hilbert, "Big data for development: A review of promises and challenges," Development Policy Review, vol. 34, no. 1, pp. 135-174, 2016.
[48] L. Jain, "Artificial Intelligence and Machine Learning for Healthcare," 2023.
[49] N. A. Ariffin, A. M. Yunus, and I. K. Kadir, "The role of big data in the healthcare industry," Journal of Islamic, vol. 6, no. 36, pp. 235-245, 2021.
[50] Y. Bao, Z. Tang, H. Li, and Y. Zhang, "Computer vision and deep learning–based data anomaly detection method for structural health monitoring," Structural Health Monitoring, vol. 18, no. 2, pp. 401-421, 2019.
[51] S. Zhou, R. Zhang, D. Chen, and X. Zhu, "A novel framework for bringing smart big data to proactive decision making in healthcare," Health Informatics Journal, vol. 27, no. 2, 14604582211024698, 2021.
[52] M. Padmaja et al., "Grow of artificial intelligence to challenge security in IoT application," Wireless Personal Communications, vol. 127, no. 3, pp. 1829-1845, 2022.
[53] F. Shah, J. Li, Y. Shah, and F. Shah, "Broad big data domain via medical big data," in 2017 4th International Conference on Systems and Informatics (ICSAI), pp. 732-737, IEEE, November 2017.
[54] B. Singh and C. Kaunert, "Salvaging Responsible Consumption and Production of Food in the Hospitality Industry: Harnessing Machine Learning and Deep Learning for Zero Food Waste," in Sustainable Disposal Methods of Food Wastes in Hospitality Operations, pp. 176-192, IGI Global, 2024.
[55] M. Marjani et al., "Big IoT data analytics: architecture, opportunities and open research challenges," IEEE Access, vol. 5, pp. 5247-5261, 2017.

[56] B. Singh, "Evolutionary Global Neuroscience for Cognition and Brain Health: Strengthening Innovation in Brain Science," in Biomedical Research Developments for Improved Healthcare, pp. 246-272, IGI Global, 2024.
[57] C. P. Chen and C. Y. Zhang, "Data-intensive applications, challenges, techniques and technologies: A survey on Big Data," Information Sciences, vol. 275, pp. 314-347, 2014. V. Mayer-Schönberger and K. Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Houghton Mifflin Harcourt, 2013.
[58] C. Thapa and S. Camtepe, "Precision health data: Requirements, challenges, and existing techniques for data security and privacy," Computers in Biology and Medicine, vol. 129, 104130, 2021.
[59] A. Behura, S. Sahu, and M. R. Kabat, "Advancement of Machine Learning and Cloud Computing in the Field of Smart Health Care," Machine Learning Approach for Cloud Data Analytics in IoT, pp. 273-306, 2021.
[60] E. Olshannikova, A. Ometov, Y. Koucheryavy, and T. Olsson, "Visualizing Big Data with augmented and virtual reality: challenges and research agenda," Journal of Big Data, vol. 2, no. 1, pp. 1-27, 2015.
[61] C. Rudin, "Stop explaining black box machine learning models for high stakes decisions and use interpretable models instead," Nature Machine Intelligence, vol. 1, no. 5, pp. 206-215, 2019.
[62] X. Wu, X. Zhu, G. Q. Wu, and W. Ding, "Data mining with big data," IEEE Transactions on Knowledge and Data Engineering, vol. 26, no. 1, pp. 97-107, 2013.
[63] M. N. Saadat and M. Shuaib, "Advancements in deep learning theory and applications: Perspective in 2020 and beyond," Advances and Applications in Deep Learning, vol. 3, 2020.
[64] R. Kitchin, "Big data and human geography: Opportunities, challenges, and risks," Dialogues in Human Geography, vol. 3, no. 3, pp. 262-267, 2013.
[65] Z. Shahid, "Distributed Machine Learning for Anomalous Human Activity Recognition using IoT Systems," 2021.
[66] A. C. B. Monteiro, R. P. França, R. Arthur, and Y. Iano, "An overview of medical Internet of Things, artificial intelligence, and cloud computing employed in health care from a modern panorama," The Fusion of Internet of Things, Artificial Intelligence, and Cloud Computing in Health Care, pp. 3-23, 2021.
[67] R. I. Qureshi, M. Irfan, H. Ali, A. Khan, A. S. Nittala, S. Ali, and T. Alam, "Artificial Intelligence and Biosensors in Healthcare and its Clinical Relevance: A Review," IEEE Access, 2023.
[68] P. H. Leung, K. T. Chui, K. Lo, and P. O. de Pablos, "A support vector machine–based voice disorders detection using human voice signal," in Artificial Intelligence and Big Data Analytics for Smart Healthcare, pp. 197-208, Academic Press, 2021.
[69] M. Faaique, "Overview of Big Data Analytics in Modern Astronomy," International Journal of Mathematics Statistics and Computer Science, vol. 2, pp. 96-113, 2024.
[70] T. Pradhan, P. Nimkar, and K. Jhajharia, "Machine Learning and Deep Learning for Big Data Analysis," in Big Data Analytics Techniques for Market Intelligence, pp. 209-240, IGI Global, 2024.
[71] B. Singh and C. Kaunert, "Future of Digital Marketing: Hyper-Personalized Customer Dynamic Experience with AI-Based Predictive Models," in Revolutionizing the AI-Digital Landscape: A Guide to Sustainable Emerging Technologies for Marketing Professionals, p. 189, 2024.
[72] B. Singh, C. Kaunert, and K. Vig, "Reinventing Influence of Artificial Intelligence (AI) on Digital Consumer Lensing Transforming Consumer Recommendation Model: Exploring Stimulus Artificial Intelligence on Consumer Shopping Decisions," in AI Impacts in Digital Consumer Behavior, T. Musiolik, R. Rodriguez, and H. Kannan, Eds., pp. 141-169, IGI Global, 2024.
[73] W. Kong, Z. You, S. Lyu, and X. Lv, "Multi-dimensional stereo face reconstruction for psychological assistant diagnosis in medical meta-universe," Information Sciences, vol. 654, 119831, 2024.
[74] A. Aghabiglou, C. S. Chu, A. Dabbech, and Y. Wiaux, "The R2D2 deep neural network series paradigm for fast precision imaging in radio astronomy," arXiv preprint arXiv:2403.05452, 2024.
[75] M. H. Wang, L. Xing, Y. Pan, F. Gu, J. Fang, X. Yu, and W. Liu, "AI-based Advanced approaches and dry eye disease detection based on multi-source evidence: Cases, applications, issues, and future directions," Big Data Mining and Analytics, vol. 7, no. 2, pp. 445-484, 2024.
[76] G. B. Dalkıran, "Health Tourism Components and Intermediary Institutions as Supplier Businesses in the Context of Health 4.0," in Health 4.0 and Medical Supply Chain, pp. 147-162, Springer Nature Singapore, 2023.
[77] D. W. M. Wright and S. Zascerinska, "Becoming immortal: future wellness and medical tourism markets," Journal of Tourism Futures, vol. 9, no. 2, pp. 168-195, 2023.
[78] P. Akhavan, N. Azizi, S. Akhtari, O. Haass, T. Jan, and S. Sajeev, "Understanding critical success factors for implementing medical tourism in a multi-case analysis," Knowledge Management & E-Learning, vol. 15, no. 1, p. 43, 2023.
[79] Z. Baran and Ş. Karaca, "Next-Generation Technologies in Health Tourism," in Global Perspectives on the Opportunities and Future Directions of Health Tourism, pp. 138-164, IGI Global, 2023.
[80] T. Gajić, L. A. Minasyan, M. D. Petrović, V. A. Bakhtin, A. V. Kaneeva, and N. L. Wiegel, "Travelers' (in) Resilience to environmental risks emphasized in the media and their redirecting to medical destinations: Enhancing sustainability," Sustainability, vol. 15, no. 21, 15297, 2023.

[81] S. N. mu Sahar and H. Dar, "Artificial Intelligence-Enhanced Global Healthcare: The Future of Medical Tourism," in Impact of AI and Robotics on the Medical Tourism Industry, pp. 194-216, IGI Global, 2024.
[82] M. M. Mijwil, R. Doshi, K. K. Hiran, O. J. Unogwu, and I. Bala, "MobileNetV1-Based Deep Learning Model for Accurate Brain Tumor Classification," Mesopotamian Journal of Computer Science, vol. 2023, pp. 32-41, March 2023.
[83] G. B. Mensah, M. M. Mijwil, M. Abotaleb, S. M. El-kenawy, M. M. Eid, and P. K. Dutta, "Assessing the role Ghana's Public Health Act 2012 (Act 851) can play in oversight of artificial intelligence healthcare systems to prevent medical errors and improve patient safety," Babylonian Journal of Artificial Intelligence, vol. 2023, pp. 24–32, June 2023.