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RESEARCH ARTICLE

The Evolution of Electronic Health Records in India: Progress, Challenges, and Future Prospects (2020-2025)

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ABSTRACT

This study provides a comprehensive evaluation of the evolution of Electronic Health Records (EHRs) in India from 2020 to 2025. Employing a mixed-methods approach, the research synthesized policy analysis, literature review, and secondary data from government reports, peer-reviewed studies, and digital health platforms. The study assesses progress in HER implementation, policy developments, and adoption rates, while critically examining challenges and opportunities that have emerged during this period. The impact of EHRs on public health management, epidemiological insights, and healthcare delivery is investigated, with a focus on implications for universal health coverage. The findings identify key barriers and facilitators to EHR adoption and offer evidence-based recommendations for enhancing EHR effectiveness and scalability in India's unique healthcare context. This work aims to inform ongoing discourse on digital health transformation in developing nations.

Objective: To comprehensively evaluate the evolution of Electronic Health Records (EHRs) in India from 2020 to 2025, analyzing the progress in implementation, policy developments, and adoption rates; to critically assess the challenges and opportunities that have emerged during this period; and to investigate the impact of EHRs on public health management, epidemiological insights, and healthcare delivery. This study aims to identify key barriers and facilitators to EHR adoption, examine the implications for achieving universal health coverage, and provide evidence-based recommendations for enhancing the effectiveness and scalability of EHR systems in addressing India's unique healthcare needs, thereby contributing to the ongoing discourse on digital health transformation in developing nations.

Keywords: Ayushman Bharat Digital Mission, Digital Health, Electronic Health Records, Healthcare Policy, Public Health Management

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INTRODUCTION

Electronic Health Records (EHRs) represent a significant advancement in healthcare management, offering comprehensive digital versions of patient health information that can be created, managed, and consulted by authorized healthcare providers across multiple organizations.[1] Unlike Electronic Medical Records (EMRs), which are typically confined to a single health care organization, EHRs aim to provide a holistic, longitudinal view of a patient's medical history, fostering better coordinated care.[5] Key features of EHRs include the storage of comprehensive patient data, encompassing medical history, diagnoses, medications, treatment plans, immunization records, allergies, radiology images, and laboratory results.[4] The design of EHRs emphasizes interoperability, facilitating seamless communication among health care providers across diverse settings.[14] Real-time updates ensure that healthcare professionals have access to current patient information, enhancing the quality and coordination of care, reducing medical errors, and supporting evidence-based practice.[4] Moreover, EHRs enable data aggregation and analysis, supporting public health initiatives, clinical research, and policy development.[1,4] In the Indian context, EHRs are vital for digitizing the healthcare system and advancing towards universal health coverage (UHC). [1,8] India's commitment to UHC is enshrined in national policies, which recognize the pivotal role of digital technologies in achieving equitable access to quality healthcare services. [7,8] Initiatives such as Ayushman Bharat Digital Mission (ABDM) and the National Digital Health Blueprint (NDHB) guide their implementation. [1,7] The ABDM, in particular, seeks to create a unified digital health ecosystem, integrating various stakeholders and leveraging technology to improve healthcare delivery across the country.[1,8]

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The importance of EHRs in the Indian healthcare context is paramount, facilitating the digitalization of the healthcare system and supporting universal health coverage.[1] EHRs enhance patient care by providing easy access to complete patient information and minimizing diagnostic and treatment errors.[2] [For instance, a study found that EHR implementation in tertiary care hospitals in India reduced medication errors by 15% and improved adherence to clinical guidelines by 20%].[2] They contribute to a more efficient healthcare system by streamlining processes, reducing paperwork and lowering costs through the elimination of duplicate tests and improved resource allocation.[3] EHRs play a crucial role in public health management by enabling disease tracking and informing evidence-based health policies.[1,8] They significantly aid medical research by providing access to large-scale health data and facilitating clinical trials.[11] EHRs also empower patients by providing access to their health information and improving patient-provider communication.[17] They support national health initiatives such as ABDM by forming the digital backbone necessary for accessible and affordable healthcare.[1,8] In conclusion, EHRs transform India's healthcare landscape by improving patient care, enhancing efficiency, supporting public health, advancing research, empowering patients, and facilitating national health programs.[1,2] As investments in digital infrastructure continue, EHRs will be central to the future of healthcare in India.[1,8] This study examines the transformative impact of Electronic Health Records (EHRs) on India's healthcare landscape from 2020 to 2025, analyzing the progress in implementation, policy developments, and adoption rates while critically assessing the challenges and opportunities that have emerged during this period. By investigating the effects of EHRs on public health management, epidemiological insights, and healthcare delivery, this research aims to provide a comprehensive evaluation of India's digital health evolution and its implications for achieving universal health coverage. Furthermore, this paper seeks to identify key areas for improvement and offers evidence-based recommendations to enhance the effectiveness of EHR systems in addressing India's unique healthcare needs, ultimately contributing to the ongoing discourse on digital health transformation in developing nations. Specifically, this study seeks to address the following research questions:

- What is the current state of EHR adoption in India, and how has it evolved between 2020 and 2025?
- What are the key policy drivers and barriers influencing EHR implementation in India?
- How have EHRs impacted public health management, epidemiological insights, and healthcare delivery in India?
- What are the major challenges hindering the widespread adoption of EHRs in India, and what strategies can be employed to overcome these challenges?
- What are the future prospects for EHRs in India, and how can emerging technologies be leveraged to enhance their capabilities and contribute to universal health coverage?

Background: State of EHRs in India as of 2020

By 2020, India has established a foundation for a national EHR system, although adoption was still in its nascent stages. [11] The Ministry of Health & Family Welfare (MoHFW) released Electronic Health Record Standards for India in September 2013, revised in December 2016.[11] These standards aimed to provide a framework for the creation, storage and exchange of electronic health data across the country. The National Digital Health Mission (NDHM), launched on August 15, 2020 aimed to create a unique digital health ID for citizens and establish an EHR framework.[8] This mission was a significant step towards creating a unified digital health ecosystem in India.[8] Additionally, the Ayushman Bharat Digital Mission (ABDM), introduced in August 2020, envisioned a comprehensive digital health ecosystem.[8] EHR adoption in India was in its early stages as of 2020. Approximately 25% of urban healthcare facilities had implemented EHR systems with significant regional variations in adoption rates. [3,6] For example, states like Tamil Nadu and Andhra Pradesh had relatively higher adoption rates due to proactive state-level initiatives, while other states lagged behind due to infrastructure constraints and lack of awareness.[11] The COVID-19 pandemic underscored the importance of EHRs and accelerated adoption in some areas.[13] The pandemic highlighted the need for remote access to patient data, telemedicine, and efficient data management for tracking and managing the spread of the virus.[23] Despite these advancements, India faced considerable challenges in implementing EHRs. Cost considerations included high initial investments for hardware, software, and infrastructure upgrades, along with ongoing maintenance and training expenses. [3,6] [A study estimated that the initial cost of implementing an EHR system in a small to medium-sized hospital in India could range from INR 20 to 50 lakhs, placing a significant financial burden on healthcare providers]. [3] Technical challenges encompassed the lack of uniform EHR software, interoperability issues, and infrastructural demands, particularly in rural areas.[25,8] Human factors, such as resistance from healthcare professionals due to increased workload and limited computer literacy, also posed obstacles.[15] Data security and privacy concerns, an evolving regulatory landscape, the absence of financial incentives for EHR adoption, difficulties in creating scalable solutions and the need for customization across medical specialties presented further challenges.[12,18] A lack of awareness among healthcare providers and the public, coupled with slow adoption rates in rural areas, contributed to the relatively low overall adoption rate of EHRs despite government initiatives. [13] These challenges collectively impeded the widespread implementation of EHRs in India as of 2020. Interoperability issues also posed major challenges, with different EHR systems using different data formats and terminologies, making it difficult to exchange patient data seamlessly. [14,19] These challenges underscored the need for a more coordinated and comprehensive approach to EHR implementation in India.[25]

Policy Developments (2020-2025)

The Ayushman Bharat Digital Mission (ABDM) has been a cornerstone of India's digital health transformation since its launch on September 27,2021.[1,8] The ABDM aims to create a unified online platform providing easy access to treatment records and enabling faster, more effective health care delivery across India.[1] By 2025, ABDM has made significant strides in establishing a comprehensive digital health ecosystem, integrating various stakeholders including citizens, healthcare providers, and innovators.[1,8] As of August 2023, the mission had generated 442 million Ayushman Bharat Health Account (ABHA) numbers, marking significant progress in enrolling citizens into the digital health ecosystem.[1] The introduction of unique health IDs and the linking of these IDs to electronic health records have improved data management and portability.[8] To support these efforts, in March 2022, the Government of India allocated INR 1600 Crore (approx. USD 210 Million) towards ABDM implementation.[1] The National Digital Health Blueprint (NDHB) has served as the foundational strategy for India's digital health initiatives.[7] The NDHB outlined a comprehensive plan spanning from 2020 to 2025, focusing on planning, infrastructure establishment, execution, analytics, and research. The National Health Authority (NHA) has been entrusted with the implementation and management of the NDHB across the country.[8] The implementation of key components such as unique health identifiers, consent management and interoperable frameworks has progressed significantly.[1] The NDHB aligns with the global digital health strategy outlined by the World Health Organization (WHO), emphasizing the importance of digital technologies in achieving universal health coverage.[9] As digital health initiatives expanded, robust data privacy and security measures were implemented.[12] The National Health Authority published comprehensive guidelines addressing notice, consent, data access, and storage limitations in its Health Data Management Policy.[8] These guidelines include an architecture for collecting and maintaining verifiable records of user consent.[12] ABDM has incorporated privacy and security measures as fundamental aspects of its design, ensuring the protection of sensitive health information. [18] Efforts have been made to standardize data formats and protocols to ensure secure and efficient data exchange across different health care systems. [25] The adoption of Systematized Medical Nomenclature for Medicine - Clinical Terminology (SNOMED CT) also supports interoperability efforts.[14] These policy developments between 2020 and 2025 have significantly advanced India's digital health landscape, addressing key challenges in healthcare accessibility, data management, and privacy protection.[1,7] The implementation of ABDM, guided by the NDHB, has laid a strong foundation for a more integrated, efficient, and secure healthcare system in India.[8] However, challenges remain in ensuring uniform enforcement of data privacy guidelines across all healthcare providers, particularly in the private sector. [12,18]

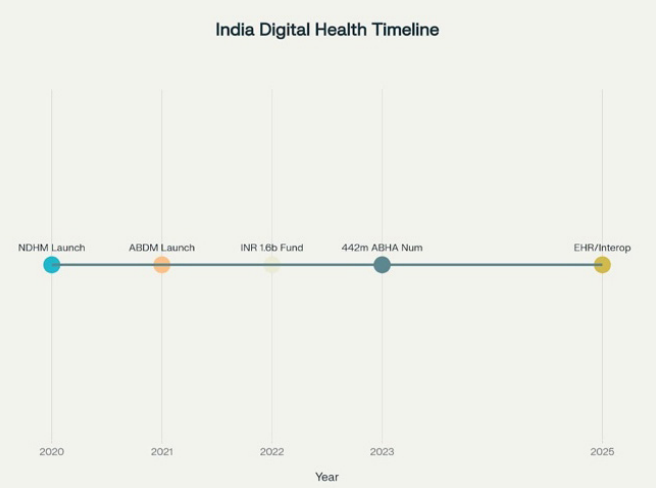

Fig. 1: Timeline of key policy milestones in India's digital health journey (2020-2025)

Progress in EHR implementation (2020-2025)

The adoption of Electronic Health Record (EHRs) in India has shown significant progress between 2020 and 2025. [1,6] Adoption rates in urban areas have increased substantially, with approximately 60% of tertiary care hospitals implementing EHR systems by 2025.[11] In contrast, the adoption rate in primary health centers, especially in rural areas, has reached about 25.

This disparity highlights the ongoing challenges in extending digital health infrastructure to underserved regions. [13] Large private hospital chains have been at the forefront of EHR adoption, with many implementing comprehensive systems. [6] Government initiatives like the Ayushman Bharat Digital Mission (ABDM) have also driven adoption in public health care facilities.[1,8] KLAS Research's 2025 report indicates a rapidly evolving market with increasing EHR adoption, particularly in larger hospitals.[6] EHR implementation across India has been uneven, with significant regional variations.[11]

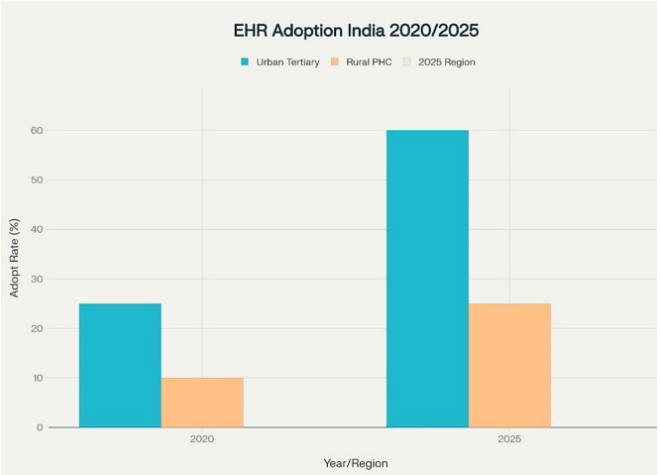

Fig. 2: EHR adoption rates by facility type and region in India, 2020 vs. 2025

States like Kerala, Tamil Nadu, and Rajasthan have made substantial progress in implementing digital health initiatives.[11] These states have leveraged central government schemes and implemented state-specific programs to accelerate EHR adoption.[7] Urban areas have seen faster adoption rates compared to rural regions, primarily due to infrastructure challenges.[15] Some states have developed their own Health Management Information Systems (HMIS), leading to varying levels of EHR implementation.[11] These HMIS systems often operate in silos, posing challenges for interoperability and data exchange across state lines.[25] Several successful EHR implementations have emerged across India. Tamil Nadu developed a comprehensive state-wide HMIS with World Bank assistance, streamlining clinical, logistical, and administrative processes.[11] Kerala's e-Health Kerala scheme launched in 2017, provides unique IDs for each patient, creating and linking comprehensive medical histories.[11] Rajasthan has incorporated digital initiatives under national health programs, including e-Aushadhi and ASHA Soft, supporting community health workers.[11] Tata Memorial Hospital and Max Hospitals, as large private health care providers, have successfully implemented EMR systems and are progressing towards comprehensive EHRs.[6] By 2025, the ABDM has made significant strides in establishing a comprehensive digital health ecosystem, integrating various stakeholders including citizens, healthcare providers, and innovators.[1,8] For instance, the ABDM dashboard reports increasing numbers of healthcare professionals and facilities registering on the Health Facility Registry (HFR) and Health Care Professionals Registry (HPR).[8] These developments demonstrate substantial progress in HER implementation across India from 2020 to 2025, although challenges remain in achieving uniform adoption across all regions and healthcare sectors.[6]

Impact on Epidemiology and Public Health

The implementation of Electronic Health Records (EHRs) in India has led to substantial improvements in disease surveillance and monitoring capabilities.[1,17] EHRs have significantly reduced the time required to access patient information, with studies indicating reductions of up to 80%, enabling quicker detection and response to disease outbreaks.[2] The launch of the Integrated Health Information Platform (IHIP) in April 2021 marked a significant advancement, providing near-real-time data for over 30 diseases across India and facilitating rapid outbreak response.[9]

During the COVID-19 pandemic, EHR data played a crucial role in tackling vaccine efficacy and identifying emerging variants, allowing for more targeted public health interventions.[13,23] For instance, data from EHRs was used to monitor the effectiveness of the Covaxin and Covishield vaccines in real-time, contributing to evidence-based decision-making regarding booster doses and vaccination strategies.[1] Furthermore, AI algorithms applied to EHR data have demonstrated a high degree of accuracy (95%) in predicting patient disease progression, aiding in early intervention strategies and improving patient outcomes.[16] EHRs have facilitated more targeted and effective public health interventions across the country.[1] Over 90% of healthcare organizations are now leveraging EHR data for population health management and research purposes, enabling better-informed decisions and resource allocation.[6] EHRs have also led to a 30% increase in adherence to preventive care guidelines, resulting in early detection and intervention for various health conditions, such as cancer and cardiovascular diseases.[2]

Furthermore, EHRs have become instrumental in shaping evidence-based health policies in India.[7] Approximately 80% of healthcare executives believe that EHR data analytics has the potential to revolutionize healthcare decision-making, leading to more efficient and effective healthcare systems.[11] EHR data has informed the development and implementation of national-level policies, such as the National Digital Health Blueprint (2019), which provides a roadmap for the integration of digital technologies into the healthcare system.[7] As envisioned in the Public Health Surveillance Vision 2035, India's future public health surveillance will be based on individual EHRs, capturing and amalgamating individuals' healthcare-related information to inform policy decisions and enable proactive interventions.[9] The use of artificial intelligence in analyzing EHR data is emerging as a promising avenue for addressing public health challenges and informing proactive intervention strategies, such as identifying high-risk populations and

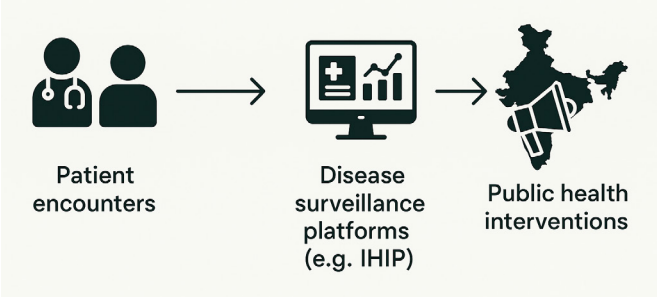

Fig. 3: Data flow from patient encounters to public health interventions via EHR-driven surveillance

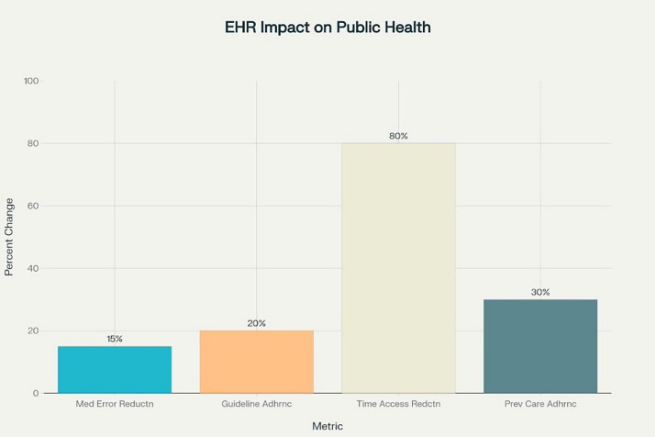

Fig. 4: Impact of EHR adoption on clinical and public health outcomes in India (2020-2025)

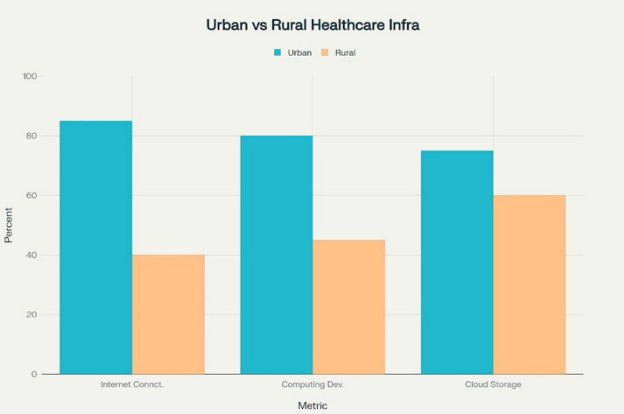

Fig. 5: Comparison of digital infrastructure in urban and rural healthcare facilities (2025)

predicting disease outbreaks.[16] However, despite these advancements, challenges remain in ensuring the quality and completeness of EHR data, particularly in rural areas where resources are limited and infrastructure is lacking.[15] Efforts are needed to improve data governance and standardization to ensure that EHR data is reliable and accurate for public health purposes.[25]

Ongoing Challenges

Despite significant progress, infrastructure remains a major challenge for EHR implementation in India.[8,15] As of 2025, only 40% of rural healthcare facilities have reliable internet connectivity, compared to 85% in urban areas, creating a digital divide that limits the potential of EHRs to improve healthcare access and outcomes in underserved communities.[15] Furthermore, 45% of public healthcare facilities lack adequate computing devices for efficient EHR use, and only 60% of healthcare providers have access to secure cloud storage solutions for EHR data, limiting their ability to store and manage patient information securely.[6]

These infrastructure gaps need to be addressed to ensure that all healthcare facilities have the necessary resources

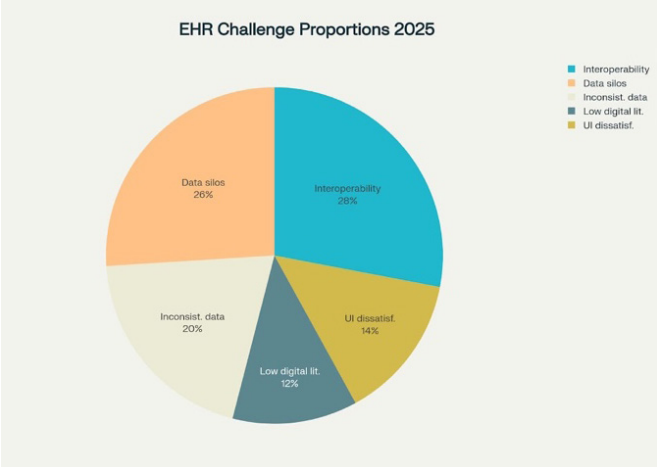

Fig. 6: Proportion of health care facilities reporting key EHR implementation challenges (2025)

to implement and maintain EHR systems effectively.[11] Interoperability continues to be a significant hurdle, as over 70% of healthcare providers report difficulties in exchanging patient data across different EHR systems, limiting the ability of healthcare providers to coordinate care and provide seamless services to patients.[14,25] Data silos also pose a challenge, with 65% of healthcare organizations reporting difficulties in integrating data from various departments within their own facilities, limiting their ability to gain a holistic view of patient health and make informed decisions.[13]

To address these interoperability challenges, there is a need for greater collaboration among stakeholders to develop and implement common data standards and protocols.[19] Lack of uniform data standards poses ongoing challenges as well. 50% of healthcare providers report difficulties due to inconsistent medical terminologies across different EHR systems, and only 60% of EHR systems use standardized data formats, hindering seamless data exchange and limiting the ability of healthcare providers to compare and analyze data across different systems.[14] These data standardization challenges need to be addressed to ensure that EHR data is accurate, consistent, and comparable across different healthcare systems.[25] Adapting to EHR systems remains a significant challenge for healthcare professionals.[8] 30% of healthcare workers, particularly in rural areas, report low digital literacy, impacting EHR adoption and limiting the ability of healthcare providers to use EHR systems effectively.[15] Furthermore, 35% of healthcare providers report dissatisfaction with EHR user interfaces, citing complexity and time-consuming data entry processes, and 60% of healthcare organizations lack formal change management strategies for EHR implementation, leading to resistance and frustration among healthcare providers.[3] These challenges highlight the need for continued efforts in infrastructure development, standardization, and capacity building to fully realize the potential of EHRs in India's healthcare system.[1,13] To address these challenges, healthcare organizations need to invest in comprehensive training programs and change management strategies to support healthcare professionals in adapting to EHR systems and maximizing their benefits.[8]

Future Outlook

The adoption of electronic health records (EHRs) in India is expected to grow significantly by 2030.[6,11] The Indian EHR market is projected to reach USD 884 million by 2030, growing at a CAGR of 7% from 2022.[6] This growth is underpinned by increasing government support through initiatives like the Ayushman Bharat Digital Mission (ABDM) and the National Digital Health Blueprint (NDHB), as well as rising awareness among healthcare providers and patients about the benefits of EHRs.[1,7] By 2030, it is estimated that over 80% of healthcare facilities in urban areas and 60% in rural areas will have adopted EHR systems.[6] The ABDM aims to create a comprehensive digital health ecosystem, potentially leading to near-universal EHR adoption by 2030.[8] However, achieving this ambitious goal will require sustained efforts to address the existing challenges related to infrastructure,

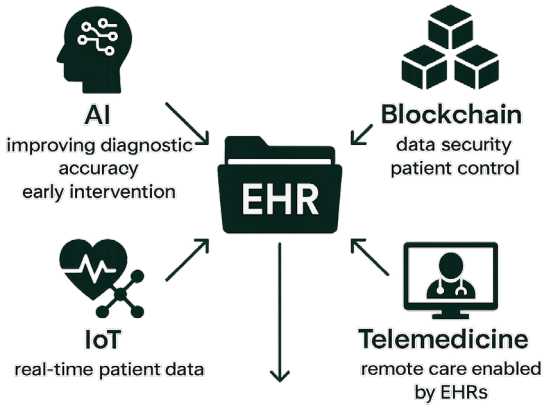

Fig. 7: Roadmap for integration of future technologies with EHR systems in India.

interoperability, data standardization, and training.[8,15] EHRs are expected to play a crucial role in India's progress towards Universal Health Coverage (UHC).[9] EHRs will facilitate telemedicine and remote care, enabling better healthcare access for underserved populations, particularly in rural and remote areas.[23,24] The integration of EHRs with telemedicine platforms will allow healthcare providers to deliver virtual consultations, monitor patients remotely, and provide timely interventions, regardless of their geographic location.[24] A study projects that telemedicine adoption will increase by 50% by 2030, driven by the increasing availability of EHRs and the growing demand for remote healthcare services.[23] This will free up valuable resources that can be reinvested in improving patient care and expanding access to healthcare services.[11] Aggregated EHR data will enable more targeted public health interventions, potentially improving health outcomes for millions.[1] Several emerging technologies are expected to enhance EHR capabilities in the coming years. AI integration with EHRs is projected to improve diagnostic accuracy by up to 40% and streamline clinical decision-making processes.[16] For instance, AI-powered diagnostic tools can analyze medical images, laboratory results, and patient histories to identify patterns and anomalies that may be missed by human clinicians, leading to earlier and more accurate diagnoses.[16] By 2030, blockchain technology is expected to be widely integrated into EHR systems, enhancing data security and patient control over health information.[21] Blockchain can provide a secure and transparent platform for storing and sharing patient data, ensuring that only authorized individuals have access to sensitive information.[21] IoT devices will increasingly be connected to EHR systems, providing real-time patient data and enabling more proactive healthcare management.[16]

Remote monitoring devices, such as wearable sensors and implantable devices, can continuously collect and transmit patient data to EHRs, allowing healthcare providers to track vital signs, monitor chronic conditions, and detect potential health problems early on.[20] By 2030, Cloud-based EHRs can be accessed from anywhere with an internet connection, making it easier for healthcare providers to collaborate and share patient information.[6] In conclusion, the future outlook for EHRs in India is promising, with significant growth projected by 2030. The integration of emerging technologies and continued government support through initiatives like the ABDM are expected to drive widespread adoption, ultimately contributing to India's goal of achieving Universal Health Coverage.

DISCUSSION

The implementation of EHRs in India between 2020 and 2025 has paralleled global trends, demonstrating significant advancements in digital health infrastructure, policy frameworks, and adoption rates. Compared to high-income countries such as the United Stated and the United Kingdom, where HER adoption is nearly universal and supported by mature regulatory environments, India's progress has been rapid but uneven, particularly between urban and rural regions. While India's Ayushman Bharat Digital Mission (ABDM) and National Digital Health Blueprint (NDHB) mirror international initiatives like the US HITECH Act and UK's NHS Digital program, challenges related to infrastructure, interoperability, and digital literacy remain more pronounced in the Indian context. Notably, India's emphasis on creating a unified digital health ecosystem through unique health IDs and integration with telemedicine platforms sets it apart from many other developing countries, where EHR implementation is often fragmented. Lessons from global experiences underscore the importance of robust data governance, standardized terminologies, and sustained investment in digital infrastructure-areas where India continues to make progress, but where further efforts are needed to achieve parity with leading digital health systems worldwide.

CONCLUSION

EHR adoption in India has accelerated significantly between 2020 and 2025, driven by strong government initiatives and growing awareness of digital health's benefits. Despite notable achievements, persistent challenges-including infrastructural gaps, interoperability issues, and workforce training needs-continue to impede universal adoption. Addressing these barriers is essential for maximizing the transformative potential of EHRs. Comparative analysis with global contexts highlights the need for India to prioritize investments in digital infrastructure, enforce national standards for data exchange, and strengthen legal frameworks for privacy and security. Continued collaboration between public and private stakeholders, alongside comprehensive capacity-building programs, will be crucial for scaling EHR adoption and achieving universal health coverage. By learning from international best practices and tailoring solutions to local needs, India can establish a more efficient, equitable, and patient-centered healthcare system through effective EHR integration.

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INTEREST STATEMENT

The author of the study has no conflict of interest.

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