DIGITAL HEALTH TRANSFORMATION IN INDIA: ADOPTION, BARRIERS, AND PATHWAYS TO UNIVERSAL HEALTH COVERAGE

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Under the Supervision and Guidance of

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IIHMR UNIVERSITY

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This is to certify that **Himanshi Jain** in partial fulfillment of the requirements for the award of the degree of MBA (Healthcare Analytics) from the IIHMR University, Jaipur has successfully completed his internship at **IIHMR University** during **Feb 25 - June 09, 2026.**

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This is to certify that dissertation titled **Digital Health Transformation in India: Adoption, Barriers, and Pathways To Universal Health Coverage** is a record of the research work undertaken by **Himanshi Jain** in partial fulfillment of the requirements for the award of the degree of MBA (Healthcare Analytics) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **Digital Health Transformation in India: Adoption, Barriers, and Pathways to Universal Health Coverage**, is the Bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

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ABSTRACT

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Background and Rationale

Despite serving a population of over 1.4 billion, India's health system still faces continued challenges of inequities in health access, with significant urban–rural and limited public expenditure, overloaded health systems, and a lack of coordination in service provision. A mechanism that has already risen to the surface of great potential is digital transformation, which can help solve these systemic weaknesses. India's health-technology sector is undergoing rapid transformation as driven by the COVID-19 pandemic and backed by major government initiatives like the Ayushman Bharat Digital Mission (ABDM). Empirical evidence regarding adoption patterns, perceived benefits and context related barriers at the stakeholder level is still limited, especially in the post-ABDM operational phase.

Objectives

This study intended to: (i) understand the current adoption and utilisation rates of digital health technologies among various user groups; (ii) understand the perceived benefits and barriers at the use of digital health technologies by patients, health care professionals and students; (iii) understand the digital health readiness across regions and across various segments; and (iv) identify evidence-based, multi-stakeholder strategies for enhancing the integration of digital healthcare in India.

Methodology

A cross sectional mixed methods research design was used. Primary data were gathered using a structured online questionnaire that contained closed-ended (Likert scale) and open-ended questions, which was circulated to a purposive sample of health care professionals, management students, and general public, with basic digital access. The Technology–Organisation–Environment (TOE) Framework (Tornatzky & Fleischer, 1990) and Rogers' Diffusion of Innovation (DOI) Theory (2003) were used to analyze the phenomena and interpret the results from multiple levels.

Key Findings

Most of the respondents were aware of at least one digital health modality. The most common means of telemedicine was mobile health applications, followed by electronic health records, wearable devices, and AI-based diagnostics. The perceived benefits by Principal were increased accessibility, saving time, decreased health care expenditure and better management of chronic diseases. The major challenges identified were inconsistent internet connectivity, lack of digital literacy, especially among older people and rural areas, information security issues, and lack of awareness of government initiatives such as ABDM. Urban–rural patterns were found, similar to the literature, with a higher awareness and adoption among urban residents.

Conclusions and Implications

Digital transformation offers significant transformative potential to the healthcare system but its effect is unevenly distributed across the country, and within it, socio-economically. To achieve the goal of Universal Health Coverage digitally, investments need to be made in rural infrastructure, digital literacy programmes have to be designed, data protection needs to be ensured, and platforms have to be tailored to the user. The study also highlights the importance of building trust in communities and cultural adaptation for the rollout of digital health interventions. The results provide context-specific insights and recommendations for policymakers, health administration, and digital technology designers who want to promote the adoption of digital health in the diverse socio-geographic setting of India in an inclusive and scalable manner.

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
ABDM	Ayushman Bharat Digital Mission
AI	Artificial Intelligence
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
CoWIN	COVID-19 Vaccine Intelligence Network
CGHS	Central Government Health Scheme
DOI	Diffusion of Innovation (Theory)
DPDPA	Digital Personal Data Protection Act
EHR	Electronic Health Record
ESI	Employees State Insurance
FHIR	Fast Healthcare Interoperability Resources
GDP	Gross Domestic Product
HIE	Health Information Exchange
ICT	Information and Communication Technology
IoMT	Internet of Medical Things
LMIC	Low- and Middle-Income Country
MeitY	Ministry of Electronics and Information Technology
mHealth	Mobile Health
MoHFW	Ministry of Health and Family Welfare
NDHB	National Digital Health Blueprint
NGO	Non-Governmental Organisation
NHM	National Health Mission

OECD	Organisation for Economic Co-operation and Development
PHC	Primary Health Centre
PHR	Personal Health Record
PPP	Public–Private Partnership
R&D	Research and Development
SDG	Sustainable Development Goal
SNOMED CT	Systematized Nomenclature of Medicine – Clinical Terms
TOE	Technology–Organisation–Environment (Framework)
UHC	Universal Health Coverage
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 Background and Context

Indian healthcare is a land of extremes. While in the cities you'll find state-of-the-art hospitals equipped with the newest medical gadgets, in the countryside, things are different—a patchwork of clinics lacking staff and resources. These holes aren't new; they've been there for decades and typically relate to the distribution of resources, infrastructure and professional workforce throughout the country.

Nevertheless, it is undeniable that there is a development. Vaccination rates are almost 100%, the mortality rate for mothers and children has declined and there have been significant improvements in combating infectious diseases. However, the urban–rural gap is not being filled. However, public expenditure on health care remains at approximately 1.3 - 1.5 per cent of GDP. Heavy patient loads are a common issue at hospitals around the world—public and private. It is particularly difficult to recruit and retain qualified workforce in rural areas. Despite the reforms, the services are still disorganized and fragmented, making it difficult for patients to receive a seamless and continuous healthcare experience.

Indian Healthcare system is complex. The public sector is a large web of small Sub-Centres and Primary health Centres (PHCs) to large tertiary health centers, all of them connected through various structures such as the National Health Mission (NHM). In the meantime, there are a range of private health care options from the best hospitals down to the local health practitioners. The share of private-sector visits and hospital admissions exceeds 50% of all outpatient visits and over 60% of hospital admissions. Also never forget alternative medicine, which includes Ayurveda, Yoga, Unani, Siddha and Homeopathy (combined as AYUSH) and is significant particularly in areas where conventional medicine is not available or too expensive. Special schemes provide coverage for some groups such as the employees of government, employees covered under the Employees' State Insurance (ESI) scheme. In recent years, the government of India has introduced the Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) that has begun to provide coverage to more than 500 million people for access to advanced treatments – the largest of its kind in the world.

In the middle of this mess comes "digital transformation"—not only computers in hospitals, but a radical reconsideration of how technology can enhance access, quality, efficiency and fairness. It's not just about ticking boxes on a form - it's about tech that links up and improves

every aspect of care from diagnosis to follow up. Digital health has taken a fast roll in the world. It began with digitization of records, but now incorporates AI, telemedicine, genomics and live data analysis. India is in a great position for this, as virtually half of its population is online and the youth are tech-savvy.

Then COVID-19 came around and digital tools became not only a desirable but a de facto necessity. Face-to-face visits for the same services became scarce and telehealth went from a minor trend to a hit in a few days. Digital platforms were clearly capable of tackling public health on a massive scale, with government apps such as Aarogya Setu (for contact tracing) and CoWIN (vaccine rollouts) stating that they can. CoWIN alone administered more than 2 crores of vaccine doses, which is a World Record. The crisis increased investments, clarified rules, and brought uniformity in digital health solutions from institutions. Most importantly, it showed that India could accomplish tremendous healthcare initiatives – quickly.

1.2 Historical Progression of Healthcare Digitisation in India

Digital healthcare did not suddenly emerge in India in the throes of COVID. This change began a long time ago in the early 2000s, when the first Hospital Management Information Systems (HMIS) were introduced in government hospitals by the National Informatics Centre (NIC). ICT tools were introduced as part of the agenda of the National Health Mission, which was launched in 2005 and included tracking of various interventions, such as maternal and child health. In 2003, the Indian Council of Medical Research (ICMR) published telemedicine guidelines and subsequently, large-scale projects like that of telecardiology by Narayana Health and that of Telehealth by Apollo has demonstrated the feasibility of delivering reliable, specialised services into remote areas. The 2019 National Digital Health Blueprint (NDHB) was a big milestone. It wasn't only a new collection of jargon, it was a bold vision for the future set in a patient-first and privacy-centric direction. Later, the NDHB has been the foundation for the Ayushman Bharat Digital Mission (ABDM). Meanwhile, data cost came down drastically (after 2016, due to Reliance Jio) and the Digital India initiative made smartphones and internet usage much more prevalent. The number of mobile internet users in India skyrocketed from approximately 200 million in 2016 to more than 940 million in 2024. This is a different situation now for digital health. eSanjeevani was introduced by the Ministry of Health and Family Welfare in 2019 and it has gained momentum during the pandemic. It has treated over 250 million telemedicine visits by 2024 and is the largest public digital health platform in the nation. Initiatives such as Ayushman Bharat Health and Wellness Centres

(HWCs) began to enhance Primary Health Centres and incorporate elements like electronic records and telemedicine connections. These changes have created an active, but somewhat fractured, digital health environment. The progress of some places and groups is faster than others, but everyone's heading in the right direction. This will be followed by a discussion of the policy environment:

1.3 The Policy Environment: ABDM and Related Frameworks

Ayushman Bharat Digital Mission (ABDM) is India's most ambitious digital healthcare initiative to date. After a pilot phase, it went national in September 2021. It is a health system that is connected, open and secure, with five building blocks: Ayushman Bharat Health Account (ABHA) for every citizen; a registry of health professionals; a registry of health facilities; a personal health record system which will enable citizens to be truly owners of their medical data; and a digital health claims exchange to facilitate faster insurance claims. All these systems are using global standards (such as HL7 FHIR, SNOMED CT) and hence all systems are talking to each other.

However, it's not the technology that makes a difference for ABDM; it's the ideology. We're speaking of a significant change, from patients' records that remain within individual hospitals to personal data that is portable and under the citizens' control. It is often said that it will be like UPI in the banking sector for India. It is possible, if it can actually be done as it is meant to be done, a better coordination, a lesser number of repeat tests, better chronic disease management and hopefully much better health for everybody.

This ecosystem is supported by other laws and policies. The Digital Personal Data Protection Act (DPDPA), 2023, made regulations on the collection and usage of personal data, particularly health-related data. It emphasizes the need to only take what is necessary, only for a particular reason, and with permission. Broader cybersecurity and e-governance are still covered by the old Information Technology Act. Legal support for teleconsultations was provided by the Telemedicine Practice Guidelines (2020) which enabled the recent proliferation to become possible and legitimate. The National Digital Health Blueprint remains a living strategy document, guiding towards an open and connected future.

Writing it, however, is not necessarily making it happen. There are still major infrastructure holes, particularly in rural areas. Not enough patients and many providers are comfortable with technology or have digital literacy to utilize these tools properly. Data sharing has many shades of grey, particularly in cases where data is shared between states. And, like all industries, there are some parts of the healthcare industry that are leery of change. Greater technology also means a risk of leaving those who are most vulnerable behind, in what is called a "digital health divide", if support and training is not able to keep up with technology changes.

1.4 Scope and Significance of the Study

In this dissertation, we have set out the current landscape of digital transformation in Indian healthcare, highlighting its successes, failures and future opportunities. The focus is on five major fields: telemedicine, electronic health records (EHRs), mHealth applications, AI-based diagnostics, and the Internet of Medical Things (IoMT). The research is based on a survey of health professionals, students and the public, complemented by a thorough review of previous reports, studies and government records.

Why this is important. First, it fills a real gap: A great deal has happened since the pandemic and solid, up-to-date research is still sparse. Second, the study uses fresh survey data with in-depth analysis to not only critique, but provide actual suggestions to doctors, policymakers, and tech designers. Third, it examines Universal Health Coverage (UHC) from a digital perspective, through the lens of opportunity, but also of the remaining obstacles, always with equity, governance and inclusion at the centre.

And these lessons don't end at India's boundaries. Many other low- and middle income countries are grappling with similar issues, and India's size, diversity and experience provide examples which are relevant—particularly with ambitious initiatives such as ABDM. The study is grounded in the TOE (Technology–Organisation–Environment) Framework and Diffusion of Innovation (DOI) Theory, which links the micro and macro level of study in the area of technology adoption.

1.5 Objectives of the Study

This research has some very clear objectives:

1. Map out the current digital health scene in India: Which tools are actually being used, and how widely, in both public and private sectors?

2. Evaluate the effect of digital technology on healthcare's reach, efficiency, and patient outcomes—especially for rural and underserved groups.

3. Dig into the main obstacles—tech challenges, infrastructure gaps, policy issues, funding, and workforce shortfalls—and capture the real story through both numbers and stories.

4. Check in with both providers and patients—what do they think about all these changes? How much do they trust and use the new systems, and what makes them hesitant?

5. Offer practical, evidence-based recommendations to push digital health forward in a way that's fair, sustainable, and actually bridges the research–policy gap.

1.6 Organisation of the Dissertation

The rest of the dissertation then goes on a logical journey where Chapter 2 reviews literature, compares Indian experience to the world and presents important theories. Chapter 3 provides a step-by-step account of the study methods such as design, sampling, data collection and ethics. All the findings are summarized in Chapter 4 and related to previous studies and theory. Chapter 5 provides specific recommendations for all concerned. Chapter 6 concludes with the key findings and possible future directions for research. References close off at the end.

CHAPTER 2: REVIEW OF LITERATURE

2.1 Introduction

This chapter consolidates what we have learned about digital health transformation to date, and a deep dive on India. I have read research studies, policy reports, and international publications—more than 35 sources, 2016-2025—to get a sense of the larger picture and what is lacking. The ideas in this discussion can be distilled into four themes, namely, the sweeping global trends and concepts, India's own digital health trajectory, new technologies, and what's to come; and, last but not least, some obvious gaps in research that this study is addressing.

2.2 Global understanding of Digital Health

Digital health is at the center of achieving Sustainable Development Goal 3: everyone's right to good health, according to the World Health Organization. They outline four must haves in their 2020-2025 strategy: a strong policy and leadership; clear, protective laws around data; health workers who really know their way around digital tools; and joined-up systems that connect with each other. These pillars—or yardsticks, really—set the bar for measuring how well national programs, like India's ABDM, are doing.

All this is examined from the ethical point of view, and this is important to India, as examined by Al-Shorbaji (2021). Equity, culture, real consent and privacy must be at the heart of any digital health initiative, he says. Programs that become overly focused on tech for tech's sake – or innovation for innovation's sake – may inadvertently fall into the trap of perpetuating the inequalities of the past and marginalizing others. Rather than simply for them, engagement and design with people keeps it at the level of reality and not progress.

Actual operational advantages exist. Tresp et al. (2016) and Chowdhary et al. (2022) demonstrate how big data and the cloud completely transform healthcare operations, from improved diagnoses, smoother treatments, to robust public health tracking. Cloud tools can help to streamline administrative processes, save money, and minimize mistakes. In the authors' words, those benefits come with significant dangers, including data leaks, algorithmic biases, or inadequate regulation. The effective governance of data protection laws is critical; it is not an option.

Digital health is growing at a rapid pace around the world, including in India, as revealed by market studies conducted by Frost & Sullivan (2020) and McKinsey & Company (2021).

Explosive growth is driven by startups, investor capital, and government support. However, the uptake is divided, with nearly a saturation level for urban markets and a lagging level in rural markets. Macro also comes from OECD (2020), which outlines the potential of digital tools to render whole health care systems more efficient, reduce costs, and place prevention at the forefront rather than treatment.

Out of the country there are ideas to be gained. All the way from health records and genetic data in the UK's NHS to the giant AI platforms of China, the moving force on a national scale was ambition, money, and speedy policy-making. But India is a different country—private healthcare reigns supreme, villages and cities are far removed from one another and average income is a lot lower. Despite all of this, there are digital health cases worldwide that demonstrate that, with proper dedication and effective regulation, it can truly make a difference, but when the groundwork is not properly prepared, it can go wrong.

2.3 Indian Digital Health Landscape

Since 2018 and even more so since the pandemic, there has been a surge of research in India. Bhambere et al. (2021) explain how COVID-19 surged the use of this: telehealth, digital triage, and remote monitoring surged, particularly among the urban population who had access to decent internet. During the onset of the pandemic, doctors and patients were skeptical of remote care, and that skepticism seems to have been swept away by the crisis and remains. However, the marginalized and rural groups remain excluded.

Rajan (2019) provides a helpful framework to understand the different aspects of digital health in India – “smart healthcare”, “care-anywhere”, “empowered healthcare” and “intelligent enterprise”. This is a framework that provides a clear map to understand all the projects taking place across the country.

However, it's not a cakewalk. According to Joshi et al. (2020), there are three major challenges: platforms that are unable to share data; patchy access to rural internet and devices; and unclear guidelines for digital providers. These problems hinder the development of projects such as the ABDM. Without fixing such barriers, digital health remains a city-centric patchwork, instead of a nationwide change.

Sharma et al. (2023) explore the implementation of ABDM in-depth. Despite significant strides in the registration of hospitals and staff in major cities, there are now snags being experienced: providers are concerned about additional administrative burdens, data security concerns, and

limited motivation for private hospitals to share data. The Ministry's data supports the notion that geographic and digital skill variations affect the rate of Health ID adoption, as registration is rapid in large cities and slow in others.

The workforce is a big problem, as pointed out by Kamath et al. (2025): Most healthcare students — even the ones in the midst of preparing to enter the healthcare system — do not feel confident in their use of platforms such as ABDM or electronic records. The issue is most acute out of the medicine sector such as nursing or allied health. Digital literacy is simply not becoming part of education – and that is a risk to scaling new models over time.

In the meantime, Yadav and Gupta (2022) trace the development of telemedicine, particularly that of the government's own initiative, eSanjeevani, which is now bringing specialised care to remote regions. But they also point to issues with quality, including brief consults, inadequate follow-up, and problematic connections, and say they should also require mandatory training on telehealth and higher standards. While mobile health apps can improve patient adherence to treatment, particularly for patients with diabetes, the poor and less educated lack access as a direct result of cost and lack of digital skills, according to Kumar et al. (2022).

Public–private partnerships (PPCPs) are considered as the key for reaching the rural population as per the big policy reports like NITI Aayog (2021) and PwC India (2016). Mobile clinics, regional language apps, and connecting frontline workers (such as ASHA and ANM) to digital systems are among the ideas. The World Bank (2021) stresses developing the workforce and keeping them up to date with digital skills. As older adults are under-represented when designing new products, Patel et al. (2023) notes that they are a larger population in India and need user-friendly, voice-controlled devices.

2.4 Emerging Technologies and Future Directions

In the quest for the future, Bagga et al. (2024) trace the future of the transformation driven by AI, blockchain, and the Internet of Medical Things (IoMT) in India. AI is making a tremendous difference: AI systems that analyse medical images or ECGs are a game-changer in regions where doctors are in short supply. Early disease detection is possible in rural clinics: for diseases such as TB or cancer, this can help to reduce the delay, and provide patients a genuine chance for improved outcomes. AI is making an impact everywhere from TB screening programs, to cancer diagnosis, and even genomics in the treatment of diseases, which is still limited because of cost, but Singh and Das (2021) demonstrate the potential of AI. To them, being responsible in the rollout of AI is about thorough testing, having rules for oversight, and

taking responsibility when technology aids in clinical decisions. Jain and Agarwal (2023) elaborate on the use of blockchain in the healthcare sector.Jain and Agarwal (2023) discuss Blockchain applications in the healthcare industry. The primary benefit is the sharing of patient information across providers and locations that is secure, tamper-proof and easy to share. However, larger blockchain comes with its own set of headaches related to energy consumption, speed and the necessity of digital infrastructure that is rock-solid. In this article, Gupta and Mehta map the growing popularity of wearables – from fitness trackers and smartwatches to glucose monitors – in Indian cities. These might be able to feed information directly to doctors, and aid in the management of chronic conditions, but linking these consumer devices to the hospital records is still in the process of being developed. Building on this, Chand and Nair (2022) examine another tool for bridging the gap with limited clinical resources: software-based digital therapeutics to encourage patients to change their behaviors. A special concern is mental health. The situation is grim, as Bhatt and Rathi (2022) describe: most Indians who require a mental health support are not getting it. The potential for mobile applications and/or telepsychiatry is huge, particularly in the face of a lack of professionals and high stigma. Nonetheless, they say, digital care should not be an alternative to professional care, particularly for those requiring more intensive services. The issue data privacy still stands. Without effective legislation, all the digital health efforts are in jeopardy (Harvard T.H. Chan School of Public Health, 2020). They urge India to adopt world class practices (as is being done in GDPR): Consent is clearly explained, data is only collected when it is needed, robust breach reporting procedures – simple measures that might give people some confidence in the new systems. 2.5.1 Synthesis and research gaps The evidence-based findings of this research clearly show that digital health has the potential to revolutionize healthcare in India, yet there are significant challenges to be addressed. The barriers are divided into four groups: hardware/infrastructure, literacy of the user, trust and governance (privacy and accountability, SOPs, incentives, etc.). They will need to be closed, and closed at the infrastructure, digital skills, regulatory, and platform design levels all at the same time. But, there is a problem: There are few real-world studies that portray the whole picture. The available research studies the effects of one technology, such as telemedicine, or one population, such as rural patients, separately. Research which combines patient, provider, and student data and illustrates the interactions between these factors, particularly following the launch of ABDM and in the wake of the pandemic is limited. This study is designed to do just that; using the fresh data and new lenses, the TOE framework and Diffusion of Innovation Theory. And, much of what's out there is from the height of the pandemic when people were desperately looking for solutions and

adoption was anything but normal. Emergency tools are no longer in use, and as the post-pandemic era asks new questions, will these tools stick? This is what we do here – provide answers in time and relevance to India's practitioners and policymakers.

2.6 Summary of Key Literature

Table 1 presents a condensed synthesis of the most directly relevant works.

Author(s) & Year	Topic	Key Contribution
Bhambere et al. (2021)	Rise of Digital Health Post-COVID-19	Documented pandemic-driven surge in teleconsultation and mHealth adoption; highlighted growing trust among urban populations.
Rajan (2019)	Digital Health Themes	Proposed four strategic dimensions: smart healthcare, care anywhere, empowered healthcare, and intelligent enterprise.
Joshi et al. (2020)	Challenges of Digitalisation	Identified poor interoperability, rural infrastructure gaps, and regulatory ambiguity as principal systemic barriers.
Sharma et al. (2023)	ABDM Vision and Implementation	Analysed ABDM scope and bottlenecks; called for stronger provider engagement and data security mechanisms.
Kamath et al. (2025)	Digital Literacy Among Students	Revealed moderate awareness but low competency; advocated health informatics curricula integration.
Bagga et al. (2024)	AI, Blockchain, and IoMT	Mapped disruptive potential of advanced technologies; flagged cybersecurity risks as a critical concern.

WHO (2021)	Global Digital Health Strategy 2020–2025	Set normative pillars: policy, legal frameworks, workforce, and health system integration.
NITI Aayog (2021)	Digital Health for Rural India	Recommended PPPs, mobile clinics, and vernacular apps to overcome access and literacy barriers.
World Bank (2021)	Capacity Building in Digital Health	Emphasised frontline workforce training as a prerequisite for sustainable digital health deployment.
Patel et al. (2023)	Digital Inclusion for the Elderly	Highlighted usability barriers for older adults; recommended voice interfaces and caregiver-linked platforms.
Yadav & Gupta (2022)	Telemedicine in India	Documented expansion of teleconsultation services; emphasised need for standardised protocols and accreditation.
Kumar et al. (2022)	mHealth for Chronic Disease	Evidence of improved medication adherence and self-monitoring; affordability remains a barrier for low-income users.
Harvard T.H. Chan (2020)	Data Privacy in LMICs	Urged GDPR-comparable legislation; emphasised patient consent, encryption, and transparency as prerequisites.
MoHFW (2022)	ABDM Progress Report	Documents rapid metro adoption vs. slower Tier-2/3 uptake; calls for inclusive implementation policies.

Table 1: Summary of Key Literature on Digital Health Transformation in India

CHAPTER 3: METHODOLOGY

3.1 Research Design

The design of this study was a cross sectional descriptive and mixed methods. In essence, we took the data at one point in time and this provides a snapshot of what people in India think, do and feel about digital health today—habits, benefits, obstacles. For our primary objective, that is, to observe what is occurring in the present, it is fine; however, to come to conclusions about cause/effect analysis is inappropriate. Why mix methods? Surveys gave us a good overview of who uses what, where, and how frequently; what patterns emerged across regions and occupations; and where policies could have an impact. However, these numbers came to life in the open-ended responses. The data was only part of the picture, as people' stories and rich feedback showed: frustrations, successes, and suggestions for improvement. This connection between the two makes our understanding more robust and earthly. This is consistent with global norms for conducting health research in low- and middle-income countries, particularly for 'messy' issues such as the adoption of technologies that cannot be neatly organised into spreadsheets. It also aligns to our theory of choice, the TOE Framework, which suggests we should look at several levels, and DOI Theory, which suggests that we should take into account the personal perception of new tech—both of which indicate we need more than one kind of data. 3.2 Population and Sampling We targeted the three audiences that were central to us: (i) healthcare professionals (doctors, nurses, pharmacists, and other allied health workers) who use and recommend digital health tools, (ii) Healthcare management, pharmacy and medical students (future professionals, basically), with attitudes and skills that will drive digital health in the future, and (iii) members of the general public who have at least some access to the internet or smartphone—the end users or direct beneficiaries. In all, 120 people participated. Breaking it down: 35 healthcare professionals (29.2%), 52 students (43.3%), and 33 from the general public (27.5%). The majority were from urban backgrounds (60%, n=72) while 25% (n=30) were semi-urban and 15% (n=18) were rural. Age-wise, most were 18–35 years old (63.3%, n=76), with others split between 36–55 (n=30; 25%) and above 55 (n=14; 11.7%). Just over one half identified as female (53.3%), 45% identified as male and two did not reveal gender. Because of this being an exploratory project, and the project being student-led, purposive sampling was appropriate. Random representation was not the most important consideration; we did aim for insight and direct experience. The team formed

primarily online—via WhatsApp, Telegram and emails—so they were able to reach out beyond the city. Getting online to rural people is not an easy task, so we supplemented with personal networks to reach out to people with less connected areas. After discarding incomplete responses, we had 120 complete and usable responses. This is in line with other student research in the field of Digital Health.

3.3 Data Collection Instrument

The instrument used was a structured questionnaire in the form of a Google forms with five main themes that are related to our research. We have taken questions from previously validated questionnaires, modified them for the Indian context, taken feedback from experts and conducted a pilot with a sample of 10 individuals. This is how it was split up: Demographics: Age, Gender, Education, Job, Location—This refers to section 1. Section 2: Awareness— awareness of people about the various concepts and technologies involved in telemedicine, EHRs, health apps, AI tools, wearables and government initiatives such as ABDM, Aarogya Setu, CoWIN and eSanjeevani. We attempted to separate out 'I have heard of it' from 'I actually know how it works'. - Section 3: Usage—how often and what tools people used. We didn't just want to hear people's thoughts, we wanted to know WHAT they were actually doing. 4. Perceptions – these were measured using a 5-point Likert scale, and included ratings of trust, satisfaction, perceived benefits and general attitudes (both head and heart). - Section 5: Barriers – combination of short answer and multiple choice questions so that people could identify the barriers and propose improvement (in their own words). Five students, three professionals and two members of the public were involved in the piloting of the form. Some digital health words were better defined and the wording was clarified based on their comments. The last survey required approximately 12-15 minutes.

3.4 Data Analysis

Data was exported from Google Forms to excel for cleaning and coding. We completed the missing data and then labelled the variables and checked the numbers. For all Likert items, we reported frequencies, proportions, and means; and cross-tabulated the results by site, role, and age. Using bar charts, pie charts, grouped bars and radar diagrams enabled us to easily identify who was doing what, where the gaps were, and the trends that emerged. In some cases, the pictures would show patterns that wouldn't show up in the table. We used an inductive thematic analysis for the open-ended answers. This involves reading it multiple times and extracting out common themes and ideas, which are then incorporated into our survey findings and theory.

Issues of poor internet connection, lack of trust of online consultations, the need for content in local languages, privacy concerns and the need for digital literacy programmes were among the recurring issues. We also listened to the differing and non-conforming answers; we didn't just follow the majority opinion.

3.5 Theoretical Frameworks

We took the results in two different ways, both of which were guided by two main theories. The first one is the Technology–Organisation–Environment (TOE) Framework. It states that the adoption of the tech depends on three factors: (1) the tech itself—how good or compatible it is; (2) the organization—size, structure, resources, skills of staff; (3) the surrounding environment—regulations, competition, and the wider economy. TOE helped us to determine if the barriers are due to technology, internal or external issues. Secondly, Diffusion of Innovation (DOI) Theory. This one has to do with the spread of new ideas or tools. It is comprised of five major factors: relative advantage, compatibility, complexity, trialability, and observability. Individuals adopt into groups depending on when they join the bandwagon of adoption—from innovators to laggards. With the support of the DOI, we were able to understand why certain groups or regions are more open to digital health than others, thus guiding us to tailor our recommendations. The two theories enabled us to have a multi-angle view; DOI is about individuals, and TOE is about organizations and systems. Both are well-known, and both have had experience in digital health studies in a context like India.

3.6 Ethical Considerations

Ethics were at the fore throughout. All participants received clear information about the purpose of the study, their rights (voluntary, anonymous, confidential) and freedom to stop at any time. The paragraphs of consent were the first paragraphs they viewed – they assumed they had consented by filling in the form. There was no sharing of sensitive information such as medical or financial history. There were only the core research team who had access to the data, which was kept secure. There was no need for additional precautions as no one was in danger. We adhered to all of the university's ethics guidelines and were trying to make it as fair, safe and respectful as possible.

3.7 Limitations

There are a number of limitations to this method. The survey was conducted online only, leaving out individuals without Internet or good digital skills. We may not have reached the

most vulnerable segments, particularly older people, people living in rural areas or people with low literacy. Although we used open-ended questions to allow our participants to share with us information about challenges they had observed in others, and we made efforts to involve rural voices by going out there ourselves, there were still some gaps. Second, purposive sampling was used. This does not mean that our findings are representative of the Indian population, but rather specific and selected groups that have relevant experience. Thirdly, people may overestimate or even forget information about how they use digital health. Another limitation is the cross sectional design. It's a snapshot of the past, and not a movie so that we can uncover causes and the development of trends. We used theory as our guide to make sense of the dots—but we don't have hard evidence to make connections between what drives what. Most importantly, since it was an online event, those least connected to digital health probably did not participate. The barriers for those without access are most likely higher than shown in these results. Given this context, the study provides valuable insights which are context-specific and capture the current landscape of digital health in India within these parameters. The work is well grounded in theory and best ethical practice and will have significant relevance for anyone looking to contribute to the advancement of digital health policy and practice.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The chapter explores the key findings of the structured questionnaire, beginning with the demographics of those who participated, then how well informational messages were received, how these messages were used, their perceived value, and the obstacles to their use. Results are presented around the main objectives of the study. Numbers are supported by quotes and comments from the open-ended responses for stronger, more vivid pictures.

4.2 Demographic Profile of Respondents

The survey was able to capture a fairly broad sample of the Indian population. The majority of the responders were in the age range of 18 - 35 years. It's also consistent with the findings of national surveys which indicate that India's young people are the most likely to utilize digital health tools and smartphones. The second largest age group was between 36 and 55 years. As far as older people (over 55s) were concerned, not many – that's simply because they aren't physically active online to the same degree as younger people, and our survey was online. Professionally, healthcare workers—doctors, nurses, pharmacists, and other health professionals—made up a big chunk of the participants. There were also good numbers of healthcare management students and pharmacists, with the remainder being the general public. This diversity of individuals provides a wider scope of study and information to enrich all aspects of the digital health community. The survey was completed by all kinds of people, in cities, small towns and rural parts of the world. But, as you'd expect, most were from urban areas. It is not surprising to get a higher urban turnout since they are being sent online and that is a factor to consider. In all, the group that we surveyed is likely fairly representative of the digitally engaged health care crowd in India, if not a true reflection of the entire population.

Table 2 has all the details—age, gender, education, profession, and where people live..

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18–25 years	42	35.0
	26–35 years	34	28.3
	36–55 years	30	25.0
	Above 55 years	14	11.7
Gender	Female	64	53.3
	Male	54	45.0
	Prefer not to disclose	2	1.7
Occupation	Healthcare Professional	35	29.2
	Healthcare Student	52	43.3
	General Public	33	27.5
Location	Urban	72	60.0
	Semi-urban	30	25.0
	Rural	18	15.0
Education	Below Graduate	17	14.2
	Graduate	48	40.0
	Postgraduate and above	55	45.8

Table 2: Demographic Profile of Survey Respondents (n = 120)

4.3 Awareness and Familiarity with Digital Health Tools

In terms of digital health awareness, the majority of people are familiar with the large-scale platforms, but very few are familiar with the government's whole digital health system. Almost everyone is familiar with at least one digital health service. It was telemedicine that stood out: 96 of the 120 people surveyed reported being aware of telemedicine (about 80%). Mobile health apps are not far behind, as nearly half (90 of 120) were aware of mobile health apps, likely because almost all people in India with a smartphone have some form of health app running on their phone. However, when it comes to hearing about their electronic health records (EHRs), only half of the group (60 out of 120) has heard of them. That logic makes sense, because EHRs are primarily aimed at clinics and hospitals; not necessarily at the general

public. In terms of wearable health gadgets and AI-powered diagnostic technology, even less are familiar with these—30% and 30% respectively (36 and 30 out of 120). They are more recent, more costly, and have yet to reach the mainstream. (This is all explained in Figure 9.) One interesting aspect here is that during the pandemic a lot of people have used Aarogya Setu and CoWIN and only a few people were aware of what Ayushman Bharat Digital Mission (ABDM) was. Most were not aware of the larger system that brings everything together – the ABHA Health ID, the Healthcare Professionals Registry, the Personal Health Record system etc. were little known to most. People are familiar with platforms they use, but not with the larger system or their place in it. And that matters. In the absence of information about ABHA and its functions, no one can claim their right in the ABDM system. People in urban and semi-urban areas were much more familiar with all digital health tools than those in rural areas. The largest gap was in awareness of the ABDM and AI health tech, with urbanites being over 2x more likely to have heard of individual components of ABDM or AI diagnostics – which as yet have not been seen in rural areas. The healthcare professionals and students were also much more knowledgeable than the average person on all the tools listed. It just shows—professional networks and education go a long way in spreading digital health know-how.

Parameter	Urban (n = 72)	Semi-urban (n = 30)	Rural (n = 18)
Aware of ≥1 digital health tool	68 (94.4%)	25 (83.3%)	12 (66.7%)
Regular digital tool use	42 (58.3%)	11 (36.7%)	4 (22.2%)
ABDM/ABHA awareness	32 (44.4%)	8 (26.7%)	2 (11.1%)
Telemedicine awareness	69 (95.8%)	22 (73.3%)	5 (27.8%)
Top barrier cited	Digital literacy	Connectivity	Connectivity

Table 6: Comparative Analysis — Urban vs. Rural Digital Health Adoption Patterns (n = 120)

Digital Health Tool	Aware — n (%)	Not Aware — n (%)
Telemedicine	96 (80.0)	24 (20.0)
Mobile Health Applications	90 (75.0)	30 (25.0)
Electronic Health Records	60 (50.0)	60 (50.0)
Wearable Health Devices	36 (30.0)	84 (70.0)
AI-based Diagnostics	30 (25.0)	90 (75.0)
ABDM / ABHA Health ID	42 (35.0)	78 (65.0)

Table 3: Awareness Levels of Common Digital Health Tools Among Respondents (n = 120)

4.4 Utilisation Patterns and Frequency of Use

The utilisation data show patterns that match the predictions of the DOI theory that will see differential adoption rates depending on the category of the innovation according to perceived relative advantage and compatibility. Five major use cases emerged among those who had used digital health tools: booking online appointments with general practitioners (the most common use case, especially among urban, 25-45 year old respondents); using symptom-checker and health information apps; using apps to monitor chronic disease indicators like blood pressure and blood sugar; accessing information on COVID-19 and vaccination status via CoWIN or Aarogya Setu; downloading or uploading investigation reports via hospital or diagnostic centre patient portals. As shown in Figure 1, the distribution of usage by digital health modalities aligns with the most common use of telemedicine. The four main factors which encouraged continued use of digital health tools were: time efficiency in using the tools, eliminating waiting times to attend consultations; lower cost of consultation compared to face-to-face private consultation; and reduced travel burden as associated with in-person consultations, particularly for those living in semi-urban areas with less access to specialist care; and convenience of managing chronic conditions digitally without needing to attend a clinic. These motivators are similar to the relative advantage attribute in DOI Theory, in that for early adopters, the functional benefits of digital health are well sensed and clearly communicated. (See Table 4 for the detailed breakdown on how often each type and demographic use a digital health tool.)

Tool	Regular Use — n (%)	Occasional Use — n (%)	Never Used — n (%)
Telemedicine	54 (45.0)	36 (30.0)	30 (25.0)
Mobile Health Apps	60 (50.0)	30 (25.0)	30 (25.0)
EHR / Patient Portal	24 (20.0)	36 (30.0)	60 (50.0)
Wearable Devices	18 (15.0)	24 (20.0)	78 (65.0)
AI Diagnostic Tools	12 (10.0)	18 (15.0)	90 (75.0)

Table 4: Frequency of Use of Telemedicine, Mobile Apps, and EHRs (n = 120)

Few people in the study often or always accessed digital health platforms, particularly older people and people living in rural and semi-urban areas. There are 4 groups of their reasons. The most common? What they didn't realize is that these platforms existed, or they didn't know what digital health could provide. This may be a stark example of the lack of awareness, mentioned in Section 4.3, that is evident here. There was also a high level of scepticism among older respondents and health care professionals. It was doubted by many that online diagnostics were accurate and accountable. This is similar to the "observability" problem of DOI Theory. Without clear, trusted evidence from fellow professionals, or firsthand experience, the benefits of telemedicine remain abstract – and unconvincing. Others just didn't see the need for digital choices. Many already had relationships with local providers, or simply preferred to visit in person. Then there's the issue of technology: slow internet connections, cumbersome platforms and confusing interfaces which proved particularly difficult for participants in rural areas and less educated participants. These barriers are aligned with the "complexity" aspect of DOI Theory: people avoid platforms that they consider to be too complicated.

4.5 Perceived Benefits of Digital Healthcare

In both camps, respondents expressed their confidence in the potential of digital health to address some of the major challenges in the healthcare sector in India. When asking what was most important, 5 benefits emerged. First, the best thing about digital platforms was access: an easy-to-use platform that provides a lifeline for rural and semi-urban communities, and for those who are mobility-impaired or unable to get to a specialist. Second, there was a greater appreciation of improved patient engagement. Patients and health care professionals

understood ways in which digital tools could facilitate patient self-monitoring and self-management of chronic conditions, enabling health care outside the clinic. There was also a consistent advantage that was brought up by healthcare experts: the ease of digital health in reducing unnecessary hospital visits and alleviating the load on outpatient departments and emergency rooms. Individuals with chronic disease conditions talked about how electronic tools helped get to a diagnosis faster and that follow-up was easier—a timely adjustment to the treatment plan resulted in improved outcomes. And there's convenience of everything, when it comes to urban working-age respondents. Digital tools really excelled at city life, saving time (and money), missing fewer days of work and managing care giving. In each of five areas – access, cost, convenience, time efficiency and continuity of care – urban and rural perceptions differ, as shown in Figure 2. The other pattern that was notable: the priorities change based on geographic location. Convenience and efficiency were most important to the urban users because healthcare services are generally accessible but over-loaded and very busy. In rural areas, concern was related to access – for their greatest difficulty was to receive any care at all. This divide indicates that a one-size-fits-all approach is not working and national policy is not sufficient. The design of digital health campaigns and platforms should reflect the actual local needs. Digital health adoption has faced various barriers and challenges.There have been several barriers and challenges to digital health adoption. The five principle types of barriers emerged from the study. There are some that are technical and some that are infrastructural; these are things that just don't exist yet. Others are based on attitudes or institutions. Figure 3 shows the frequency of occurrence of each barrier. Time and time again, inadequate infrastructure and low digital literacy were identified as the top barriers and problems to be solved in the future.

4.6 Barriers and Challenges to Digital Health Adoption

In India, the biggest and most persistent obstacle to digital health is shaky mobile internet, especially affecting people in rural and peri-urban communities. Yes, there has been serious improvement in this area; Jio's launch made the world of 4G networks possible but it is not possible to have a reliable 4G network in large pockets of rural India. The most affected are the remote hilly and tribal areas, and coastal areas. Added to that, lax electricity makes it more difficult to do everything, from charging phones to operating health kiosks, to even using wearables at home. Despite these advances, many, particularly in lower-income groups, still do not have smartphones with the features they need to have high-quality video calls. All this

reinforces the main lesson to be learned from the TOE Framework: implementing digital health services is superficial if the technology is flaky. Adoption cannot be achieved as an afterthought, the government and private sector must prepare the groundwork first in order to achieve meaningful adoption of infrastructure.

Barrier to Digital Health Adoption	Respondents Reporting (n)	Percentage (%)
Inconsistent internet connectivity	82	68.3
Low digital literacy	76	63.3
Data privacy and security concerns	70	58.3
High cost of devices/internet access	65	54.2
Complex or confusing interfaces	58	48.3
Distrust in online diagnosis	52	43.3
Lack of local language support	44	36.7
Limited awareness of govt. schemes	38	31.7

Table 5: Challenges Faced in Using Digital Health Services (n = 120; multiple responses permitted)

4.6.1 Infrastructural and Connectivity Barriers

The weak mobile internet connection is the biggest challenge for accessing digital health in India, impacting more rural and peri-urban respondents. Yes, there has been significant progress with Jio's arrival in 2016 but a large population in rural areas still doesn't have reliable 4G network coverage. Those regions of the remote hills, tribal, and coastal regions are the worst hit. Not to mention that bad power makes things more difficult – charging phones, operating health kiosks, even using wearables at home. But still, many people, particularly those in lower income brackets, are not able to afford a phone with the necessary specifications for a quality video call. All this serves to underscore the message of the TOE Framework: the lack of a strong technological base will make the implementation of digital health services shallow. Infrastructure cannot be a secondary concern, the government and private sector must get the infrastructure in place first in order to have any meaningful adoption.

4.6.2 Digital Literacy Deficits

The next challenge is Digital Literacy. This is a significant impediment for patients, as well as health care workers. It's most difficult for older adults to use their smartphones, switch from one app to another for various health-related reasons, or manage their own health information and records online. They come across technology as overwhelming as Patel et al. (2023) found. Not only patients are not well trained, but healthcare workers, particularly those at rural primary health centres, might lack training in EHRs, telemedicine or ABDM registration as well. Kamath et al. (2025) was correct—the workforce is not ready for this shift to digital and there is a clear need for capacity development which should begin with basic skills in digital health.

4.6.3 Trust and Data Privacy Concerns

The gray area of trust issues and data privacy concerns. For many of the respondents, particularly the older respondents and those who have been affected by data breaches in the past, they are afraid that their personal health information could be leaked, shared or misused without their consent. People are skeptical about the quality and safety of remote consultation, and have had a poor experience in the past: poor call quality, rushed appointments or no follow-up. Without a face-to-face evaluation, there's no trust, which highlights the differences between what patients are used to getting from a doctor and what they're getting from their digital appointment. These patterns share characteristics with the 2020 analysis by the Harvard T.H. Chan School which highlights that there are trust deficits in the system in countries with evolving data protection laws and weak public trust. The decline in trust of telemedicine with increasing age is evident in Figure 8.

4.6.4 Organisational and Institutional Barriers

There were also internal challenges noted by the healthcare providers and students. Basic SOPs for digital services are not a part of many smaller clinics and rural health centres, and the

implementation of telemedicine, EHR management, and ABDM registration may be inconsistent, resulting in a lack of uniformity and patient trust. Some legacy IT systems may not be able to communicate with the newer standards (HL7 FHIR, SNOMED CT) adopted by ABDM and the cost of upgrading is not inexpensive, particularly for smaller facilities where budgets are tighter. Management support is not always available – and not all locations have IT staff and resources. The TOE framework illustrates that the missing element between possessing the technology and using it is the willingness and capacity of an organisation to adapt the technology.

4.6.5Awareness and Behavioural Inertia

Many don't realize what digital health services may be available in their community. But even they, are more likely to use what they know — particularly for older people and people who have trusted their long-time local practitioners. Most of the respondents were not aware of eSanjeevani in their district and/or were unaware of the use of their ABHA Health ID at the nearest government health facility. The outreach campaign of the ABDM is just a beginning in rural and semi-urban areas and the entire system is very confusing, replete with jargon which is impenetrable to normal people. Here trusted community health workers (ASHAs/ANMs), who have an understanding of the community and who can make their communities more aware through one-to-one interaction, might play a key role.

Open-ended responses can be used to gather insights.Insights can be gained from the open-ended responses.

The statistics were vividly illustrated by the stories and information from the open-ended questions. The responses on the whole were positive and people highlighted the hope they have in digital health but then the reality was “fragmented and unfinished”, and “serving mainly the urban educated class”. The general impression is that while all the hype, the common man in India is not seeing any benefits yet.

Some thoughts reiterated. A high priority was expressed for local language digital literacy workshops particularly for older people, rural women and those with limited reading skills. Most people don't respond well to text-dominated apps in English. The users requested multilingual applications which are user friendly and have audio cues, pictorial guides and

support for all 22 Scheduled Languages. Including local physicians on government telemedicine panels was another popular notion—as in any patient-doctor relationship, it has a large influence and doctors are trusted. Individuals also want the processes to be clear for feedback, follow-up, and complaint resolution – something that fosters trust and ensures accountability. There was a strong emphasis by the healthcare sector on the importance of mandatory health informatics and digital literacy education as the next generation of doctors and nurses are not being prepared for this digital world.

4.8 Reading by means of theoretical frameworks

Looking at these results in the light of the TOE Framework, it is evident that there is a deep gap. Technologically, Indian cities have progressed leaps and bounds; there is a good connectivity, an affordable device, there are a lot of platforms. Poor infrastructure, sporadic adoption, and lack of access in rural areas. More and more lower-income families are being excluded by device costs. The difficulty of platform integration with legacy hospital systems makes implementation challenging and most apps are not designed to function in low bandwidth settings—a huge error, because the typical rural environment is low bandwidth.

On the organisational side, digital health preparedness is very varied. While bigger urban hospitals are investing in resources and people, smaller clinics and rural hospitals don't have the resources, leadership, or the funding to upgrade their IT systems. Standardized processes for providing digital services are often not established, resulting in inconsistent quality and accountability. Leveraging frontline health workers is relatively uncommon in the design and implementation of these systems, which further reduce their engagement and importance of using new digital tools.

Environmentally, policy and regulation looks strong on paper—the ABDM, Telemedicine Practice Guidelines, and DPDPA are all important. In practice, readiness is patchy. States with robust infrastructure (like Maharashtra, Karnataka, Kerala, Tamil Nadu) lead the way, while the BIMARU states lag, where health system weaknesses and poor digital access both weigh heavily. Private platforms are growing fast, but risk splintering the ecosystem, duplicating efforts and confusing users.

From a Diffusion of Innovations (DOI) point of view, the pattern is just as clear. Early adopters are mostly urban, young, educated, and digitally savvy. The early majority is picking up in the cities, but the late majority—older adults, rural residents, and less-educated groups—are far behind. It's hard for people to see tangible benefits firsthand, especially where no one in the community is modeling digital health use, and local clinics lack visible digital infrastructure like teleconsultation rooms in PHCs. Table 7 brings together these TOE components with the study's findings, mapping out how institutional realities mirror theoretical expectations.

4.9 Comparative Analysis with Existing Literature

By and large, these results match up well with what's already been studied. The rural–urban gap in adoption shows up in Sharma et al. (2023) and MoHFW (2022), and the pattern persists even with ABDM's nationwide aims. Knowing about digital health platforms isn't enough; users need the skills to actually use them—Kamath et al. (2025) reached the same point, and it means awareness campaigns need to go hand-in-hand with hands-on training. There's ongoing agreement that partnerships between government and private players are the best way to scale these services (see PwC India, 2016; NITI Aayog, 2021).

This study adds a few new pieces: it zeroes in on the period right after ABDM launched, highlighting how the vision and the current reality are still worlds apart, especially outside big cities. It draws on perspectives from patients, professionals, and students, making it possible to compare priorities and pain points across groups. Most importantly, it captures rich stories from open-ended responses—these lived experiences help turn statistics into practical, community-driven recommendations.

CHAPTER 5: RECOMMENDATIONS

5.1 Introduction

These recommendations build directly on the empirical findings, theoretical analysis, and literature review laid out in Chapters 2 through 4. Each is organized by a core strategic theme, matched clearly to the stakeholders best positioned to turn them into reality. The big aim here is simple: make digital health part of daily life across India—and not just in a few privileged pockets, but for everyone, including those most often left out. Equity isn't an add-on; it's embedded throughout. Table 8 details exactly who's responsible for what.

5.2 Strengthening Infrastructure and Connectivity

We can't talk about digital health for all if the digital infrastructure is nonexistent or unreliable, especially in rural and remote parts of India. Right now, this is the number one barrier holding things back. The answer: sustained, coordinated investment—from the government, telecom companies, and civil society working together.

- Expand broadband and 4G/5G mobile coverage through the BharatNet programme, setting clear, public targets and budgets for areas that get chronically left behind, like tribal, hilly, and coastal districts. Progress should be tracked district by district to locate and fix persistent coverage gaps.

- Put solar-powered digital health kiosks in Primary Health Centres (PHCs) and Community Health Centres (CHCs) where electricity is unreliable. These kiosks—built with ABDM-linked registration, teleconsultation, and health record access—will keep telemedicine services available even when homes don't have consistent power or internet.

- Encourage the development of lightweight, low-bandwidth digital health apps, tailored for 2G/3G networks. Core tools (like viewing records or logging symptoms) should work offline and sync when there's a signal.

- Launch schemes to get devices into people's hands: subsidized smartphones for frontline workers, shared devices in Anganwadi centres, and ABHA Health ID services

at Common Service Centres. Make this a joint effort with state governments, NGOs, and corporate social responsibility programs.

- Require all government-funded digital health platforms to undergo real stress testing in low-bandwidth settings before launch. Set clear performance benchmarks that match the realities of rural India.

5.3 Enhancing Digital Health Literacy and Workforce Capacity

If doctors, nurses, community health workers, patients, and their caregivers don't feel confident using digital health tools, adoption will stagnate. Training must recognize people start from different places—and go beyond one-size-fits-all.

- Launch a national, multilingual "Digital Health Saksham" campaign, run through ASHAs, ANMs, and community volunteers. The campaign should focus on essentials: ABHA Health ID registration, using telemedicine, and managing digital records.

- Make health informatics, EHR management, and teleconsultation protocols core—and assessed—competencies for MBBS, nursing, pharmacy, and allied health students everywhere. Work with the National Medical Commission and other regulators to enforce this.

- Create structured CPD certification pathways for working healthcare professionals. Link digital health competencies to licensing renewals so there's motivation to keep skills sharp.

- Tailor digital literacy modules for older adults—simple visual interfaces, audio navigation, peer-support learning, and helplines with patient volunteers who can guide people through the process.

- Integrate digital health education into schools and adult literacy programs, so that future generations grow up comfortable with these systems.

5.4 Ensuring Robust Data Privacy and Cybersecurity

Patient trust makes or breaks digital health—people won't participate if they worry about data safety. Robust data protection and transparent security aren't optional; they're foundational.

- Implement the Digital Personal Data Protection Act (2023) with specific, enforceable protocols for health data. That includes explicit consent for each use, minimising unnecessary collection, conducting privacy assessments before rolling out new platforms, and logging all record access.

- Require end-to-end encryption, multi-factor authentication, role-based access controls, and regular independent audits for every ABDM-compliant platform. Publicly share audit summaries to build trust.

- Set up a dedicated Digital Health Data Regulatory Authority, properly resourced and independent, to investigate breaches, sanction violators, and maintain a public registry of certified platforms.

- Run public awareness campaigns in local languages, explaining privacy safeguards, citizen rights, and how the system works—clear up confusion, win trust.

- Publish standard protocols for responding to health data breaches: strict notification timelines, requirements for informing affected patients, and clear steps for remediation.

5.5 Promoting User-Centred and Inclusive Platform Design

Confusing interfaces, language barriers, and technical glitches shut out the very people digital health is supposed to help. Good design is about equity—if platforms don't work for those with the most needs, they've failed.

- Use participatory co-design, involving patients, frontline workers, and community representatives—especially elderly, rural, disabled, and low-literacy users—throughout design, testing, and revision.

- Enforce minimum usability standards for government-funded apps: every official language, Web Content Accessibility Guidelines (WCAG 2.1 AA) compliance, and screen reader compatibility.

- Prioritize voice-enabled, low-text interfaces for rural and low-literacy users—audio instructions, pictographic navigation, and local-language videos.

- Build regular feedback loops into platforms: in-app ratings, community focus groups, and patient advisory panels, with transparent reporting on what users say and how the government plans to fix things.

- Set up an independent digital health usability testing body drawing on expertise from human-computer interaction, disability groups, and community health advocates.

5.6 Accelerating and Deepening the ABDM Rollout

ABDM is the backbone of India's digital health ambitions. No other intervention promises as much, but it has to reach everyone, not just the digitally savvy or those in well-served states.

- Create state-specific ABDM roll-out roadmaps. Invest aggressively in capacity and infrastructure where registration is low, using additional central government support to close the gap between lagging and leading states.

- Demand that all new government healthcare procurement and digital investments integrate with ABDM. Incentivize private providers—subsidies, technical support—to join within set timelines.

- Strengthen the Healthcare Professionals Registry and Health Facility Registry, especially in undercovered rural and AYUSH sectors, through active verification and simpler online sign-ups.

- Run patient-focused, multilingual ABDM awareness campaigns, using community radio, Doordarshan, vernacular newspapers, and trusted health workers. Keep the language jargon-free and approachable.

- Build a citizen support system around ABDM: multilingual helplines, helpdesks at Service Centres and PHCs, and community-based ABDM champions to walk new users through the process.

5.7 Expanding the Scope and Quality of Telemedicine and mHealth

Telemedicine and mHealth have proven they work in India. The next step: bring them into mainstream care, raise quality, and make sure they're not stuck as afterthoughts.

- Grow government-backed platforms like eSanjeevani to include chronic disease, mental health, geriatric, palliative, and maternal follow-up care, with specialist hubs located beyond metros.

- Support fully digital health journeys inside ABDM-linked platforms—teleconsultations, e-prescriptions, lab test orders and results, pharmacy dispensing, follow-up scheduling. Stop care from being fragmented.

- Deploy AI-based decision support at primary care level to optimize patient routing and spot high-risk cases earlier, with robust clinical oversight and validation on Indian patient data.

- Set and enforce evidence-based quality standards for teleconsultation: minimum durations, documentation requirements, strict referral protocols, and regular patient satisfaction tracking.

- Integrate digital tools into priority health programs—TB, HIV/AIDS, NCDs, maternal and child health—using the National Health Mission's established reach to drive community-level adoption.

5.8 Fostering Strategic Public-Private Partnerships

No digital health transformation happens on the back of the public sector alone. Startups, big tech, telecom, hospitals, diagnostics, and insurers bring the innovation and scale we need.

- Launch a National Digital Health Innovation Fund offering time-limited grants, soft loans, and tax incentives, with a clear preference for ABDM-compliant solutions targeting rural and underserved populations.

- Set up regulatory sandboxes run by the government, where startups and firms can pilot new tech—AI diagnostics, biosensors, blockchain, digital therapeutics—before rolling out widely.

- Build outcome-based contracting models for digital health PPPs, tying payments to results, for example, health equity outcomes like rural adoption rates or closing the urban–rural gap.

- Foster interoperability consortia among major private players, making ABDM integration non-negotiable and empowering industry working groups to solve integration challenges.

5.9 Establishing Robust Monitoring, Evaluation, and Learning Systems

Good governance needs real-time evidence—not just annual reports gathering dust. India's digital health oversight still has holes to fill.

- Create a public National Digital Health Dashboard showing key metrics like ABDM registrations, teleconsultation use, EHR adoption, satisfaction scores, and access gaps, sliced by state, district, age, and socioeconomic class.

- Mandate independent, annual impact assessments for all major government digital health programs—publish them and use findings in annual reviews.

- Institutionalize participatory monitoring: regularly hold community forums, advisory panels, and solicit health worker feedback to keep user voices front and center in policy and product tweaks.

- Fund a dedicated research agenda under ICMR, ring-fenced for studies tracking digital health's real impact, focused research on marginalized groups, and implementation science on what helps or hinders adoption.

CHAPTER 6: CONCLUSION

6.1 Summary of Findings

The overall objective of this dissertation was to gain a first-hand view of the extent of digital health transformation in India, its driving forces and its barriers. In order to do this, the research was carried out using a massive national survey and a detailed review of the available studies. There's a lot of potential here, but it's not easy to make it happen, as obstacles on the ground keep cropping up. Now there is a need for all stakeholders, government, industry and civil society, to play their role if India is to achieve this.

Obviously, the first thing to be said is that this is a descriptive study. It does not deviate from the fundamentals – frequencies, proportions, cross tabs. No digging into cause and effect only a simple examination of the data. If something does appear as a pattern, it is a pattern. The aim of this study is to simply identify where we are now in terms of awareness, use and barriers to digital health and extract some lessons that can be utilised by individuals who actually work, and work effectively, in this space.

So, what is it that you are hearing? Edtech: In cities, younger people, and those with higher education, people are aware of and using digital health tools to a great degree, such as telemedicine and mobile health apps. In particular, telemedicine has provided opportunities for those who reside away from clinics or are unable to travel. The concept has proven effective and has already been done, with eSanjeevani being just one platform to handle hundreds of millions of consultations. So, too, the mobile health apps can help people with chronic conditions, such as diabetes and hypertension, to keep track and maintain treatment – a critical factor where it counts. At a larger level, efforts by the government, like ABDM, are striving to create the spine of a single digital health system, which finally has the potential to bring a bit of order into India's broken and often imbalanced health information system.

The problem is, however, there is a catch. Not all people are eligible for these benefits. The digital divide is as ubiquitous as so many other divides in India: urban and rural, young and old, tech-savvy and non-tech-savvy, and more. Digital health can easily be the next in a line of inequities if not intentionally designed as such. Most people are left in the cold by the lack of understanding about government programs, privacy fears, unprepared healthcare organizations, mistrust, and poor infrastructure along with a lack of digital skills. So far, most

of the progress lies with the early adopters and innovators. The rest – most of them, and many of the most vulnerable – are beginning to appear.

If one sees through the TOE Framework, it becomes even more clear. The rural regions suffer from a lack of networks and a lack of standardised tech platforms.The rural areas need better networks as well as well established tech platforms. At the organisation level, it's only going to change when there is a genuine commitment to skills and establishing a framework for digital care, and a genuine commitment from leadership. Wider environment, more laws, more nifty incentives, more public awareness, none of which is in place, at this moment, too much focus is on narrow business interests instead of public health.

The essential role of the contributions to knowledge and practice in the thesis/dissertation.

This study actually performs three tasks. First, it provides fresh and grounded insights into the adoption of digital health in India, following the introduction of ABDM and in a (somewhat) post-pandemic world. If we want to understand if all of the grand promises of ABDM have actually been realized, then it's important, and it's filling some holes in the research.

Secondly, it demonstrates the potential results that can be achieved when incorporating the TOE Framework along with the DOI Theory. It is obvious when used in tandem that the organisation and the individual are the drivers of the uptake of digital health. They work well in isolation, but they work better in combination. This is helpful for other low and middle income countries, too.

Third and most pragmatic: The study isn't just a cursory call-to-action such as "invest more" or "improve infrastructure. It actually outlines the following steps for specific groups – the practitioners and the policy makers receive ideas that are actionable and clear, rather than just abstract.

Some suggestions for what groups need to learn are identified in the research. As a key priority, digital health equity must be at the center of national policies and MOH agenda. ABDM and its related programs must be targeted at those not easily accessible, but those who are left out. India desperately needs robust legislations to safeguard people's data as trust is crucial for a digital health to be sustainable. The wide disparities across states demonstrate that a single approach is not likely to be effective everywhere: rollout should be local and flexible.

For healthcare managers and developers, your job isn’t done once you roll out the tech. However, the use of these tools will depend on the design of the tools, well-trained staff and good quality controls. The interface must be user-friendly, readable in their language, and easy to use to request assistance or support, or they will not adopt it. It's not simply a question of providing a service, it's a question of providing a usable and trustworthy service.

There's a huge role for civil society as well. Local advocates and community involvement are must-haves for digital inclusion. The trusted frontline workers like ASHA and ANM can play a crucial role in reaching the tech to the target groups, particularly those who purchase or take up late and those who are hesitant. They require actual assistance, training and rewards.

Directions for Future Research

This provides a multitude of opportunities for future research. The use of digital health and its implications for health outcomes will benefit from ongoing research to monitor change and growth, particularly for chronic disease, maternal health and preventive health. Comparisons with other states may help to illuminate some of the reasons for the differences in the pace of progress, thereby directing interventions where they are needed.

Qualitative research plays a very important role, particularly with those individuals who are not seen by others, such as rural, older or marginalized populations. Personal stories are not addressed in surveys, but can be captured through creative, participatory approaches such as photo-voice, local language focus groups, and mapping exercises. The need is there to study the integration of private healthcare sector into ABDM as it stores most of the patient's data.Plus, rigorous studies on specific innovations—AI-based diagnostics, wearables, digital therapeutics—are key to building the clinical evidence base that smart investments and policy need.

Final Remarks

India’s digital health journey is ambitious, complicated, and high stakes. The country does have a lot working in its favor: a clear policy in ABDM, a buzzing health-tech startup world, a young connected population, frontline workers ready to lead the charge, and an urgent need to fix health gaps.

But what matters now is political will that doesn't fade, real teamwork across sectors, and a true focus on equity. Digital health really can become a public good—helping someone in a remote tribal area just as much as someone in a city office. The recommendations here, if picked up with real commitment and an understanding of local realities, can move things closer to that goal. This isn't just a tech upgrade—it's a shot at more fairness and justice in health.

In the end, this dissertation tries to bridge the gap between grand ambitions and how things actually play out across India. The road will be bumpy and complicated, but the first steps are taken, and they matter

REFERENCES

1. Al-Shorbaji N. Digital Health: Setting the Global Agenda. Bulletin of the World Health Organization. 2021;99(4):234–240.
2. Bagga G, Singh H, Hood MM. Digital Health in India: Impact of AI and Blockchain. IOSR Journal of Business and Management. 2024;26(9):30–34.
3. Bhambere S, Abhishek B, Sumit H. Rise of Digital Health in India Post-COVID-19. International Journal of Healthcare Systems Engineering. 2021;9(4):45–52.
4. Bhatt A, Rathi K. Mobile Apps in Mental Health: The Indian Landscape. Journal of Psychiatric Innovation. 2022;7(2):75–82.
5. Chand S, Nair K. Digital Therapeutics in Chronic Disease Management. Indian Journal of Health Policy. 2022;12(3):140–146.
6. Chowdhary CL, Raj R, Sharma S. Evaluating the Cost-Effectiveness of Digital Health Systems. Indian Journal of Health Economics. 2022;15(2):67–75.
7. Frost & Sullivan. Indian Digital Health Market Outlook 2025. Mumbai: Frost & Sullivan; 2020.
8. Gupta R, Mehta P. Wearable Health Monitoring Devices: Trends in India. Journal of Medical Devices India. 2023;18(3):103–110.
9. Harvard T.H. Chan School of Public Health. Digital Health Data Governance in LMICs. Boston: Harvard University; 2020.
10. Health IT News. India Uses Mobile Tech to Track TB Treatment. Health IT News Asia. 2024 May 10.
11. Jain V, Agarwal A. Blockchain in Healthcare: Enhancing Data Integrity. Journal of Digital Health Technology. 2023;5(1):22–30.
12. Jha R, Mohanty B. Privacy Concerns in Digital Health: Legal Perspectives. Indian Journal of Law and Technology. 2022;14(1):63–70.
13. Joshi VV, Pawar N, Acharya S. Digitalization in the Indian Healthcare System: Challenges and Opportunities. Indian Journal of Medical Informatics. 2020;7(3):101–107.

14. Kamath R, Banu M, Shet N, et al. Awareness and Barriers in Utilizing the ABDM: A Qualitative Study. Healthcare (Basel). 2025;13(4):382.

15. Kapoor S. India's eSanjeevani Platform: A Case Study. Journal of Public Health and Digital Technology. 2023;10(1):45–50.

16. Kaur S, Kaur R, Aggarwal R. Legal and Ethical Aspects of E-Health in India. Indian Journal of Ethics in Medicine. 2019;5(1):22–30.

17. Kumar S, Iyer V, Bhatt A. Effectiveness of Mobile Apps for Diabetes Management in India. Indian Journal of Diabetes Technology. 2022;19(1):44–51.

18. McKinsey & Company. Digital Health Ecosystem in India: The Investor Perspective. New Delhi: McKinsey; 2021.

19. Ministry of Electronics and Information Technology (India). Digital Personal Data Protection Act. New Delhi: MeitY; 2023.

20. Ministry of Health and Family Welfare (India). Ayushman Bharat Digital Mission Dashboard [Internet]. 2022 [cited 2025 Jun 14]. Available from: https://abdm.gov.in

21. Mishra A, Verma N. Impact of COVID-19 on Digital Health Adoption in India. Journal of Pandemic Health. 2021;5(2):90–98.

22. Narayana Health Foundation. Case Study: Cloud-Enabled Cardiac Telecare. Bengaluru: Narayana Health; 2023.

23. NITI Aayog. Strategy Overview: Digital Health for Rural India [Internet]. New Delhi: Government of India; 2021 [cited 2025 Jun 14]. Available from: https://www.niti.gov.in

24. OECD. The Economics of Digital Healthcare. Paris: OECD Publishing; 2020.

25. Patel V, Sharma R, Mishra P. Age-Inclusive Design for Digital Health Platforms. Journal of Geriatric Health. 2023;11(2):95–103.

26. PwC India. Indian Healthcare: On the Cusp of Digital Transformation. Mumbai: PricewaterhouseCoopers; 2016.

27. Rajan MM. Smart and Inclusive Healthcare: The Digital Revolution in India. Journal of Health Management. 2019;21(1):17–29.

28. Rao V, Kapoor A. Designing for Health Equity in Digital India. Health Equity Journal. 2023;9(2):112–120.

29. Rogers EM. Diffusion of Innovations. 5th ed. New York: Free Press; 2003.

30. Sharma RS, Rohatgi A, Jain S, Singh D. The Ayushman Bharat Digital Mission: A Paradigm Shift. CSI Transactions on ICT. 2023;11(1):3–9.

31. Singh N, Das S. Role of AI in Diagnostics and Predictive Medicine. International Journal of Medical AI. 2021;6(4):55–64.

32. Thyagaraj A, Narayanan K. Barriers to IoT Adoption in Indian Hospitals: An Empirical Study. Health Policy and Technology. 2021;10(2):112–120.

33. Tornatzky LG, Fleischer M. The Processes of Technological Innovation. Lexington, MA: Lexington Books; 1990.

34. Tresp V, Overhage JM, Bundschus M, et al. Going Digital: Big Data in Medicine. IEEE Reviews in Biomedical Engineering. 2016;10(3):34–49.

35. World Bank. Digital Health: A Framework for Capacity Building in LMICs. Washington, D.C.: World Bank Group; 2021.

36. World Health Organization. Global Strategy on Digital Health 2020–2025 [Internet]. Geneva: WHO; 2021 [cited 2025 Jun 14]. Available from: https://www.who.int/publications/i/item/9789240020924

37. World Health Organization Regional Office for South-East Asia (WHO SEAR). Digital Health in Southeast Asia: Maturity and Adoption. Geneva: WHO; 2023.

38. Yadav B, Gupta S. Telemedicine in India: A Strategic Overview. Telemedicine and e-Health. 2022;28(6):431–438.