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DIGITAL HEALTH LITERACY IN INDIA: A REVIEW OF ASSESSMENT TOOLS, INTERVENTIONS, AND POLICY IMPLICATIONS

Rahul Lad[1*], Prof. (Dr.) Bhawna Sharma Padroo[2]

[1*]Research Scholar, Amity Business School, Amity University Maharashtra, India, ORCID ID: 0009-0007-7282-7882, 2009rahulld@gmail.com
[2]Director -International Affairs & Programs, Professor – Amity Business School, Amity University Maharashtra, India, ORCID ID:0000-0001-7201-9446

ABSTRACT

Introduction: India is undergoing a significant digital health transformation, propelled by initiatives like the Ayushman Bharat Digital Mission (ABDM). A critical element in achieving accessible and equitable healthcare through this transformation is Digital Health Literacy (DHL)—the ability to seek, understand, and effectively use digital health information and tools. Despite the presence of global frameworks to assess DHL, India lacks validated, context-specific assessment tools, leading to an incomplete and fragmented understanding of DHL across diverse populations, particularly highlighting the rural-urban digital divide.

Methods: This review synthesizes existing evidence on the status of Digital Health Literacy in India by examining current assessment frameworks, interventions, and policy efforts. It explores the concept of the Digital Health Quotient (DHQ) to measure stakeholder readiness across patients, healthcare providers, institutions, and policymakers. A comparative analysis was conducted between international DHL assessment tools and the Indian context to identify gaps and challenges.

Results: Findings indicate that while interventions like government programs (Digital India, ABDM), educational initiatives, and awareness campaigns exist, they are insufficient in addressing the multilayered challenges faced by marginalized populations. Major obstacles limiting DHL in India include the digital divide caused by socio-economic and geographic disparities, usability and language barriers, technological apprehension, digital skill deficits, and systemic issues within existing health and education infrastructures. Current efforts are fragmented, leading to inequitable access to digital health services.

Conclusion: A fairer digital health future in India necessitates a strategic, national-level approach. Key recommendations include reducing the digital divide, developing equity-centered policy frameworks, embedding DHL into education and health systems, adopting user-centered design principles, enhancing multi-stakeholder collaboration, and ensuring inclusive research practices. Addressing these areas holistically is essential for building a resilient, inclusive digital health ecosystem.

KEYWORDS: Digital Health Literacy (DHL), India, Digital Health Quotient (DHQ), Health Equity, Digital Divide, Assessment Tools, Interventions, Policy Implications, Ayushman Bharat Digital Mission (ABDM), eHealth Literacy, Healthcare Accessibility

INTRODUCTION

The imperative of Digital Health Literacy (DHL) in India's evolving healthcare landscape

India is witnessing a digital health revolution, with drivers such as advancements in technology, policy initiatives, and the need for access, affordable, and equitable health care. Digital Health Literacy (DHL) plays a vital role in enabling people to use digital tools and information to make informed health decisions, and this is a key part of the transformation. With the growing reach of digital healthcare solutions under initiatives like Ayushman Bharat Digital Mission (ABDM), the relevance of DHL is increasing. The ABDM, which also known as Ayushman Bharat Digital Mission, initiated in 2021, works towards establishing a comprehensive digital health ecosystem, comprising Digital Health ID, Personal Health Records.[1] However, the efficacy of ABDM is intrinsically linked to the engagement of the public, which, in turn, ensures that citizens comprehend and have confidence in the digital health systems. Insufficient DHL, on the other hand, creates a risk of marginalization, and so such groups may become even more excluded, thus disproportionately increasing the digital divide.[2]

In general, DHL underlies the core focus for achieving India's health objectives, including Universal Health Coverage (UHC) and the Sustainable Development Goals (SDGs) of enabling access to teleconsultations, mHealth apps, and PM-JAY platforms.[3] It enhances patients' agency, lessens inefficacies, and incentivizes evidence-based health behaviors. India has more than 759 million users of the internet, which facilitates the usage of DHL;[4] however, DHL proficiency is uneven across demographic factors of socioeconomic class, language, and urban-rural divides. DHL is common among

older adults, those in rural areas, and those with low educational attainment.[5] But building more infrastructure alone will not close this gap — social equity is also a necessary component.

There is no common plan for how DHL is being promoted in India. Initiatives such as the Telemedicine Practice Guidelines and eSanjeevani are steps in the right direction but systemic integration of DHL in public health education in schools, medical colleges and communities is a must.[6] Incorporating this process in the National Digital Health Blueprint (NDHB) and Health and Wellness Centres (HWCs) under Ayushman Bharat would ensure digital access does not become a mere process or outcome product, but leads to empowerment. Bridging the DHL gap is contingent upon multisectoral collaboration, public-private partnerships, and culturally sensitive, multilingual content which is crucial for promoting inclusive digital health in India.

Defining India's Digital Health Quotient (DHQ) and stakeholder capabilities

The Digital Health Quotient (DHQ) is a holistic measure of the digital health literacy, readiness and engagement among the key stakeholder groups in India's evolving digital healthcare ecosystem—patients, healthcare providers, hospitals, and policymakers. Existing DHQ assess not only digital competence but also behavioral, infrastructural and systemic factors that influence digital health technology adoption and use. DHQ is indispensable in identifying gaps in readiness and informing context-specific interventions for establishing a unified digital health system with initiatives such as the Ayushman Bharat Digital Mission(ABDM), and the National Digital Health Blueprint (NDHB).[7,8] The success of these initiatives depends on user trust and digital capabilities, which is where DHQ becomes a critical policy instrument.

The DHQ framework scores indicators for each stakeholder group: for patients, it takes into consideration awareness and trust in platforms like CoWIN and eSanjeevani, usage of mobile health apps, and understanding of digital consent. Healthcare providers are judged on adoption and utilization of digital records, telemedicine capabilities, and ethical data management, while hospitals are assessed based on IT infrastructure, platform interoperability, and hospital management systems (HMS), the software hospitals use to manage a variety of tasks. Policymakers' DHQ concentrates on digital governance, infrastructure investment, and inclusivity strategies. Regions with low DHQ, including those with poor internet connectivity and low digital literacy, are at risk of digital exclusion. This is particularly the case for rural communities which continue to trail in both internet consumption and the utilization of digital health services.[9,10] It is high when the region has strong digital infrastructure and literacy, with active stakeholders engaged in digital health.

People use government apps, making informed health decisions, and interacting with national digital health programmes in such high digital literacy areas. Healthcare providers and hospitals use e-prescriptions, keep records interoperable and increase care efficiency.[11] States like Kerala and Andhra Pradesh showcase high DHQ, characterized by strong digital integration and qualified workforce to upscale e-health solutions.[12]

Aim and Objectives

The present aims to comprehensively review the current landscape of digital health literacy (DHL) in India, examining assessment methodologies, evaluating implemented interventions, identifying persistent barriers, and analyzing policy implications to understand the factors shaping India's Digital Health Quotient (DHQ) and inform future strategies for improvement.

Following are the objectives of the study:

1. To critically review and compare existing digital health literacy assessment methodologies
2. To evaluate the range and reported effectiveness of interventions employed in India
3. To identify and analyze the primary barriers
4. To synthesize findings on assessment, interventions, and barriers to analyze relevant policy implications

Assessing Digital Health Literacy in the Indian context

Review of global and national DHL assessment frameworks and tools

Internationally, there are several assessment frameworks and tools addressing the measurement of DHL across different population groups. Among the many eHealth literacy assessment tools have been developed, one of the earliest and the most extensively used is the eHealth Literacy Scale (eHEALS) developed by Norman and Skinner in 2006, which measures the consumers' perceived capabilities to search, evaluate, and use electronic health information. Although eHEALS has been validated extensively, it is mainly based on perceived rather than actual competencies. Later models have sought to integrate areas such as critical health literacy, and digital skills and interactive competencies in response to the changing digital health context.[13,14]

Various other countries like Germany, Canada and Australia have built a national strategies and a framework focused on promoting and indirectly evaluate DHL through digital health infrastructure. My Health Record, found in Australia as part of the Australian Digital Health Agency's digital health program (2020),[15] focuses on citizen access, literacy, and data usage capabilities. To overcome this challenge, Germany has provisioned systematic evaluations of digital health applications in the Digital Healthcare Act, which embeds evidence-based frameworks of usability and effectiveness.[16,17]

In similar way, Canada Health Infoway (2024)[18] integrates digital health competency measures into its modernization approach, which emphasizes interoperability, equity, and literacy. The emergence of electronic health records (EHRs) around the world has driven DHL in UK and USA, where both providers and patients had to adapt to digital platforms, however, differences in digital functionalities remain.[19,20]

On the other hand, India has only just begun earlier this year with its own digital health literacy (DHL) assessment. The essential role in the people-oriented system of digital health of India is played by the Ayushman Bharat Digital Mission (ABDM) which is expected to develop an integrated digital infrastructure in the form of personal health records and a

Health ID system.[21] Specific DHL assessment tools embedded within the mission are, however, under-developed. In India, the majority of available studies that investigate KAP on digital health platforms rely on context-specific surveys or modify existing global tools (eHEALS) to inform KAP, primarily focusing on KAP in rural and underserved settings.[22] Furthermore, although efforts to measure digital readiness and literacy among healthcare workers and users have emerged, particularly during the COVID-19 pandemic, these initiatives have lacked systematic DHL measurement frameworks.[23,24] The digital divide, compounded by regional, gender, and socio-economic disparities, continues to be a significant barrier to effective DHL outcomes in India.[25,26] Developing a culturally and linguistically adapted DHL assessment framework, informed by international models and tailored to India's unique challenges, will be crucial in ensuring inclusive and equitable digital health access.

Digital Health Quotient (DHQ) globally

Digital Health Quotient (DHQ) is a concept that assesses the capability of individuals, communities, or nations to effectively leverage digital technologies for health-related endeavors. There are various frameworks to assess digital readiness and literacy, as well as the infrastructure, which are critically important for health delivery at the community level, and also globally, DHQ is assessed on these dimensions. Many metrics to assess the DHQ have been developed by countries around the globe with a focus on digital health literacy, access to digital tools, and incorporation of digital health solutions in healthcare systems. For instance, in the United States, the implementation of the HITECH Act facilitated the widespread uptake of Electronic Health Records (EHR) in hospitals, leading to the rapid expansion of digital health infrastructure.[19] But there are still gaps, particularly assuring that smaller healthcare providers, such as critical access hospitals, can fully benefit from advanced EHR functions.[20] Likewise, with the support of the Australian Digital Health Agency in 2020,[15] Australia has also provided a concerted emphasis on electronic health records, telehealth, and other digital solutions, resulting in significant efforts towards diabetes management in the face of rural health barriers and poor health literacy.

Countries in Europe, for instance, Germany has implemented laws like the Digital Healthcare Act to promote the use of digital health applications, which enhances the accessibility and efficiency of healthcare.[16] Data up to October 2023 showed the Germany's Digital Health Literacy Index and the government-regulated directory of reimbursable health apps have demonstrated the significance of digital tools for the modernization of the healthcare system.[17] In underdeveloped regions such as India, the challenges are even greater owing to the primitive digital infrastructure and low literacy levels, although programs such as the Ayushman Bharat Digital Mission (ABDM) strive to fill the gap by creating the digital infrastructure for the recording of health data and supporting literacy in digital health.[21] On the other hand, China and the UAE are making advances in digital health: China is concentrating on telehealth and eHealth literacy initiatives,[27] while the UAE is executing the Smart Health Strategy to enhance DHQ through telemedicine and electronic health platforms.[28]

Current state of DHL assessment across stakeholders in India

The broader adoption of health technologies depends on Digital Health Literacy (DHL) since it determines health technology adoption rates and patient empowerment and digital intervention success rates. Current data in October 2023 demonstrates that digital health literacy in India displays significant heterogeneity because urban and rural demographic groups exhibit major discrepancies. Access to technology and limited digital skills remain significant barriers for these patients, particularly in rural areas and create inequities in its use.[21] It has been estimated that only a small proportion of rural patients are able to use telemedicine platforms effectively, and they only engage with a limited number of digital health resources such as telemedicine apps and health websites, which has been attributed to such factors as low health literacy, no internet access, and discomfort with technology.[29]

Most healthcare providers in India have low levels of digital health literacy. Although healthcare professionals in urban settings have increasingly trained on technological resources like electronic health records (EHR) and telemedicine, numerous providers in rural and underserved spaces do not have the training or infrastructure to leverage these digital tools appropriately.[21] According to a survey, 70% of urban physicians and 40% of rural practitioners were comfortable with digital health tools, which, arguably, exposes a rather wide gap in digital readiness.[30] Also, the digital preparedness of healthcare organizations is not the same, as large hospitals in metro cities have witnessed significant advancement in digital health solution adoption, supported by government programs such as the Ayushman Bharat Digital Mission (ABDM). On the other hand, many small hospitals in rural communities lack the infrastructure and capacity to drive the integration of digital health, with only 25% of rural healthcare facilities currently having EHR in place compared to 60% of urban locations.[29] In this regard, the Indian government has taken initiatives like the National Digital Health Mission (NDHM) and the ABDM, allowing for the establishment of frameworks to enhance digital health literacy and infrastructure in both urban and underserved areas, despite some marginalized communities in rural areas continuing to struggle with a lack of awareness of digital health services that are available to assist them.[21,22]

Challenges and gaps in existing measurement approaches

Though Digital Health Literacy (DHL) has gained increased attention in India, measurement tools which are internationally designed, are often different from local contexts. There are limitations with many of the global DHL assessment tools to account for India's socio-economic, cultural and technological features like digital divide, access to internet and low literacy rates across rural areas.[31] Moreover, several tools including the eHealth Literacy Scale (eHEALS) have not been validated for the demographic diversity of India, leading to misleading evaluations of DHL and lack of effective interventions.[13,19] In addition, evidence-based policy making is hindered by the fragmented data on the subjects of DHL, absence of a national database and non-representative samples of studies.[30] Recent tools often assess

access to digital technologies rather than evaluating the actual health literacy skills that are required to navigate digital health resources.[32]

The linguistic and cultural diversity of India makes measurement using DHL even more complex, since many tools are limited to English, or a few major languages, and thus miss out on large segments of the population.[21,33] Although initiatives like the Ayushman Bharat Digital Mission (ABDM) seek to strengthen digital health infrastructure, DHL is not part of a national programme to be tracked or strengthened, creating a disjoint in efforts.[21] DHL is still not often recognized as a core component of health promotion in policy, while interventions reach more towards digital access and basic skills, rather than critical thinking, and health-related decision-making, which are both crucial for promoting improved health outcomes.[24,33]

Strategies and interventions for enhancing DHL in India; Educational and skill development initiatives

Indian citizens must develop Digital Health Literacy because it enables effective use of Information and Communication Technologies (ICT) in healthcare among patients and providers. Telemedicine and electronic health records as well as mobile health applications represent important components of this framework since India becomes more dependent on mobile and internet-based devices. This will require collaboration between multiple stakeholder groups to build DHL to achieve equitable access to care and improved health outcomes. In response to these needs, a series of strategic interventions has been devised, such as training programs, public awareness campaigns, and policy-level interventions. Such interventions seek to address the digital divide, particularly in rural and underserved areas with limited access to technology and digital health services. [34]

An example of this list would be implementing training programs and workshops to boost healthcare providers' digital health competencies, one of the main approaches to improve the DHL. The National Digital Health Mission (NDHM) recently launched by the Indian government opens up a multitude of opportunities in this space, offering an all-encompassing framework to aid these initiatives, predominantly in getting healthcare professionals the required expertise to operate via digital platforms. These programs are aimed especially at health workers in rural areas, where the digital divide is the most glaring. Digital health tool workshops, like the Ayushman Bharat Digital Mission (ABDM), introduce healthcare providers to the latest telemedicine platforms, health ID systems, and electronic health records, so they can be effectively employed in patient care.[35]

Awareness campaigns are being conducted for patients to become familiar with digital health platforms, which not only build faith in these platforms, but also increase usage, especially in rural areas. A key initiative under this is the Ayushman Bharat Health Account (ABHA), which enables citizens to generate a unique health ID.[36] National programs targeting these groups are necessary to tackle such issues, particularly for rural[37] and elderly populations. Moreover, partnerships with academic institutions help to promote digital health literacy among students and other young adults through integration into mainstream education. A range of digital health tools are considered — including mobile health apps and outreach programs — that further supports these efforts and ensure rural populations are engaged with and able to use these digital health tools. These efforts are supplemented by policy measures like the Digital India Programme that seeks to expand digital infrastructure and internet accessibility, especially in rural regions.[38]

Awareness campaigns and public health communication strategies

India recently launched multiple initiatives to strengthen Digital Health Literacy (DHL) level among its population to fill Digital health access and utilization gap. These are aimed at creating awareness about digital health tools, facilitating the understanding of the benefits of such technology, and pushing for their large-scale adoption. Knowledge dissemination is driven by governmental campaigns and public health communication strategies that build a foundation of trust and encourage individuals to fully utilize online health resources. Among these one of the major initiative is Ayushman Bharat Digital Mission (ABDM) which seeks to create a unified digital health infrastructure. This undertaking comprises initiatives such as the Ayushman Bharat Health Account (ABHA), which enables citizens to digitally access and share health records and campaigns aimed at raising awareness of digital health IDs and the possible advantages of telemedicine, especially in rural regions.[36]

Digital India Programme is another big initiative of the government contributing to this with improved internet penetration, digital infrastructure and provisioning of digital literacy training, especially targeting the under-served communities. This initiative plays a key role in making the people access a variety of digital services, including healthcare services.[38] In parallel, public health communication strategies involve targeted outreach and engagement to communities, particularly present in rural and remote areas, facing barriers to engaging with and adopting digital health solutions in remote and rural areas to combat health misinformation. These hurdles involve limited digital literacy, poor internet accessibility, and apprehensions regarding privacy and data safety. Various avenues including television, radio, social media, and community outreach programs can be used to inform the public about the availability of digital health services and raise awareness about them.

Healthcare professionals and organizations are also looking for capacity-building measures to enhance the digital health literacy of not only providers but also patients. Telehealth services and mobile health (mHealth) applications have been integrated into healthcare systems, often accompanied by campaigns intended to orient users to using the tools.[39] Health literacy programs coupled with digital technology have improved overall health outcomes in higher adopting states (e.g., Kerala and Andhra Pradesh).[40] Stratified campaigns directed towards demographic segments such as older and lower socio-economic groups have also been noted, as these groups frequently face barriers for the uptake of digital health resources.[37] In addition, public health communication approaches focus on the importance of the protection of data and privacy to promote trust on digital health systems by increasing citizens' knowledge on the security systems adopted for

electronic health records.[21] These efforts have not been without challenges such as a significant digital divide, particularly among rural and older populations. To address these barriers, future interventions must prioritize community-based digital literacy initiatives and ensure accessibility to locally relevant and context-specific resources for marginalized populations.[41]

Role of policy levers in promoting digital literacy

India has made great progress in Digital Health initiatives to improve healthcare access and outcomes. But to leverage the advantages of these innovations fully, improving Digital Health Literacy (DHL) across the population is a prerequisite. DHL stands for Digital Health Literacy, which is the ability to access, understand, evaluate, and apply health-related information from digital sources. Acknowledging its prominence, the Indian government has rolled out a slew of policy measures aimed at countering challenges to digital literacy and enriching the digital health ecosystem. These initiatives are intended to enable people to access digital health platforms in a manner that can enhance healthcare delivery in the country.

The Digital India Program introduced by Ministry of Electronics and Information Technology (MeitY) is one important effort which aims to augment digital literacy across the country by making internet easily reachable and encourages individuals in remote areas to get engaged with technology.[38] This initiative is in line with our health policy goals especially the NDHM for integrating our health system digitally to improve health delivery via digital platforms.[1] The Ayushman Bharat Digital Mission (ABDM) is another important part of these efforts, aims to develop a consolidated digital health ecosystem in which citizens can manage their health records and use digital health services more efficiently.[35] These control policies are essential for improving digital literacy because they ensure that access to digital health products is facilitated while there is also an infrastructure in place to support them.

In addition to these national programs, digital health interventions tailored to rural and underserved populations have become a prominent strategy to address DHL. Research by Vasanthan et al. (2024)[40] highlights how mobile health (mHealth) interventions and telemedicine can help reduce access barriers and improve healthcare deliveries, particularly in remote parts of India. These initiatives are a driving factor in improving health literacy by increasing access to health information through smartphones and telehealth portals. Platforms like eSanjeevani, designed as part of the Ayushman Bharat initiative, directly target enhanced health literacy through virtual consultations and bringing medical expertise closer to populations in remote, underserved communities. This, along with policy initiatives like the Skill India Mission and the Pradhan Mantri Jan Dhan Yojana (PMJDY), which include provisions for digital skills training and financial inclusion for under-served sections of the population, would increase access for many through digital health tools.[42] However, the digital gap still remains despite these attempts, especially when it comes to rural and older citizens. Studies by Patel et al. (2024)[37] and Kamath et al. (2025)[43] emphasize the importance of interventions specifically designed to enhance eHealth literacy, thereby empowering citizens to proactively participate in digital health systems.

Evaluating the impact of current interventions

India is attempting to improve Digital Health Literacy (DHL), through vigorous national efforts and region focused interventions that strive to make its citizens – especially the marginalized – be able to access and utilize digital health tools. ABDM is the backbone for creating the digital health infrastructure by enabling an integrated digital health ecosystem. The mission involves the design of Ayushman Bharat Health Accounts (ABHA), allowing the retention and extraction of personal health information across digital mediums.[36] Concurrently, programs such as Digital India concentrate on bolstering digital presentation, including internet connectivity, digital devices, and chapters over health portals.[38] Research on community-specific mobile health (mHealth) applications, and health education programs to improve access to healthcare, are of utmost importance for rural and underserved populations. For example, studies found that using mobile phones to distribute health information (known as mHealth) works relatively better in these regions.[39] Training local health workers to educate communities on digital health services — a key strategy in raising DHL.

The other key aspect for improving DHL is the involvement of healthcare providers in the implementation of digital health applications. To guide patients through the digital health system, doctors and healthcare providers must undergo training programs on digital health records and telemedicine. Other strategies include Public Awareness Campaigns and workshops along with online tutorials to educate people on using DHL, especially in rural areas and among older people. An example is the Digital Health Literacy Program implemented by several state governments to equip citizens with the necessary skills to utilize digital health services.[37] Program evaluations show significant improvements in DHL in urban populations, while rural and underserved groups still lag behind due to challenges like low smartphone access, poor internet coverage, and basic digital literacy deficits.[40]

Although significant progress has been achieved, challenges still remain, particularly regarding rural and marginalized populations. Though the ABDM has further advanced the creation of a comprehensive health data system, the adoption of digital health tools has been as of yet uneven across different demographic strata, with adoption rates leading towards emergent digital illiteracy and technical difficulties.[44] Kamath et al. (2025)[43] states that the university students educated in coastal Karnataka had an awareness of the ABDM but at the same time their usage was low owing to digital illiteracy problems. Nevertheless, the success of training programs for providers and patients in encouraging digital health system use has been apparent, and not all urban-rural differences are insurmountable in terms of training and infrastructure.[40] In addition, issues of the digital divide and privacy as well as distrust towards digital health systems remain barriers to more widespread adoption, especially among older adults and low-income communities.[45] Policies aimed at addressing the gaps in digital literacy and health scene will need to not only prioritize vulnerable populations but also integrate privacy and security concerns into their existing health care frameworks and policies.[34]

Key barriers hindering digital health literacy advancement

The digital divide: Access socio-economic, and geographic Disparities

The digital divide greatly hinders the digital health landscape in India, as access to technology, internet, affordability, and regional variation in availability severely impact the uptake of digital technologies. Such a gap also prevents most of the digital health literacy from befalling marginalized populations. Inequitable access to devices and reliable internet connectivity is one of the key barriers to digital health literacy in India. Despite the fact that urban populations with high income (upper classes) have great access to smartphones, computers, and reliable internet services, the vast majority of the population is settled in rural areas, where insufficient infrastructure is a major barrier breaking the access of each class to the cyberspace. According to Sharma et al. (2023),[21] the digital infrastructure in middle eastern and underserved regions is clearly lacking in some areas, severely limiting the efficacy of health interventions in those regions, and creating a digital health literacy divide.

Socio-economic status is another major determinant of digital health literacy in the Indian context. Low-income populations have financial constraints that make it impossible for them to purchase smartphones or internet plans, or use data—essential tools for interacting with mHealth. Moreover, the underprivileged and socio-economically disadvantaged do not have the digital skills to effectively utilize online health resources. According to Nutbeam and Lloyd (2021),[31] as a social determinant of health, access to and benefits from digital health tools are inherently linked to health literacy. Unsurprisingly, there are lower literacy levels among those who engage in face-to-face or digital health interventions; these are in turn associated with widening gaps in access and outcomes to evidence-based health care.

The digital health divide also includes significant differences based on geographic location. However, access to such services is better in metropolitan cities, since rural and remote regions lack the infrastructure to support these technologies. As per the study by Dal Mas et al. (2023),[24] geographical inequalities are barriers to equitable access to digital health services, thus limiting the potential benefits of digital health literacy for populations outside of metropolitan areas. These geographical barriers are compounded by challenges of access to poor educational opportunities or limited health resources, thereby making it difficult to achieve wide digital health literacy. Another major concern was digital health affordability, as they mentioned that data packages, that would allow for the use of a health app or other digital tools to make access to care easier, are essential, yet prohibitively expensive for low-income families. Apathy et al. (2021)[20] propose that an increasing economic gap is a key determinant of disparities in access to technology-assisted health services, in that those at the upper end of the economic curve have greater access to more advanced technology-assisted health services. Indeed, it will take a concerted effort to fix these issues that include building digital infrastructure, lowering prices, and funding digital health literacy programs that reach a wider swath of the population. According to Sharma et al. (2023),[21] government efforts such as the Ayushman Bharat Digital Mission (ABDM) are essential in bridging these gaps, but require addressing the socio-economic and geographic disparities that might otherwise hinder their success.

Usability, language, and cultural appropriateness challenges

The spread of digital health literacy throughout India remains limited by three major obstacles to data enrichment including tool design, digital platform language accessibility, and cultural appropriateness. Digital health interventions along with their platforms encounter implementation difficulties when integrated with the existing social structures of India. One of the greatest barriers to health literacy is the poor design of many digital health platforms. Most of the existing tools lack user friendliness and are not aimed at the elderly and people with less digital experience. Challenges like confusing navigation, poor interface design, and missing intuitive elements prevent users from successfully interacting with digital-eHealth solutions.[24] The absence of accessibility features—like voice commands or adaptive designs that accommodate different levels of literacy— worsens these challenges. User interface simplification and mobile device compatibility — a necessary consideration for usability in India — are crucial modifications to this effect. India's linguistic diversity is a major challenge in the context of digital health. While the country has made significant strides towards providing digital health services, most platforms and resources are English- or Hindi-language based, excluding many non-English speakers in rural or underserved communities.[21] Examples include poor regional language support and medical translation that may not match local dialects or cultural interpretations, which may cause confusion and miscommunication.[31] Multilingual resources and ease of localization are key to bridging the gap.

Digital health tools rarely consider the cultural context and social milieu of India. "A health message that is seen as culturally irrelevant is simply less likely to connect with the target audience, and therefore lead to lower engagement and lower health programme participation".[23] Health practices and advice, for instance, may not always be in tandem with traditional beliefs and practices, particularly in rural or indigenous groups. This urges digital health platforms to incorporate culturally relevant content and health practices to be accessible and resonated.[33] Addressing these barriers requires a redesign of digital health platforms around better usability, multi-Language offerings, and cultural relevance. Tackling of these challenges could yield inclusive comprehensive engagement, whereby more of India can get benefits from these digital health solutions, in turn improving overall public health.

Technological apprehension, skill gaps, and systemic hurdles

Despite increasing focus on digital health in India, there are many challenges facing the development of digital health literacy (DHL), especially among socio-economically disadvantaged and rural populations. Such barriers can be broadly classified in terms of technological wariness, digital illiteracy, and a systemic integration issues. Many (client groups), particularly older adults and low-income groups, are unwilling to apply digital technologies to healthcare because of their unfamiliarity with the technology and their worries about data privacy and lack of trust in digital systems.[26,46] Other

reasons include cultural factors and the lack of experience with the technology that led to the low use of digital health interventions such as telemedicine and e-consultations .[21]

Digital health literacy needs more than access to technology, however; we also need to know how to use it effectively. Many people, especially women and low-education groups, do not have suitable digital skills to use health apps or access them through electronic health records.[14,31] These skill gaps prevent the patients to be active in assessing between informed health decisions and prefer digital health services. At the institutional level, providers often have had little training on how to enable digital interactions, and health systems are not always optimized for seamless digital integration.[47]

Additionally, programs such as the Ayushman Bharat Digital Mission (ABDM) face scalability constraints owing to infrastructure lacunae, patchy internet coverage, and fragmentation across states.[21,48] In addition, common solutions to overcome these challenges will require a multi-stakeholder approach, with a focus on capacity building, digital education at the community level, and improving the alignment of technology and health policy.[24,25] Until the barriers are overcome, India's promise of digital health inclusion may give way to the specter of a digital health divide.

Policy implications and recommendations for an equitable digital health future

Bridging the digital divide and ensuring inclusive access

Now, to ensure equitable digital health in India, the digital divide needs to be addressed. Policy actions that improve infrastructure, affordability, and inclusion will be critical to ensure that we do not inadvertently exacerbate existing health disparities. These investments can address problems like rural high-speed internet access, government programs (e.g. BharatNet) provides the digital connectivity required for the health sector.[21] There should be incentives for public-private partnerships to expand tele-health and health information systems in Tier II and III cities.[49]

Digital health solutions are only as good as they are accessible. Smartphone and data package subsidies for lower income groups, combined with health-specific support as found through campaigns like Digital India, can alleviate challenges. Based on worldwide experience, like the German Digital Healthcare Act, reimbursing selective digital health applications means giving support.[17] Programs must tackle challenges of socio-economic, literacy, and digital exclusion, with community health workers acting as digital health navigators.[21,50] Localized programs are needed that take into account language, culture and disabilities.

A national digital health literacy mission should be modeled after adult literacy programs focused on both technical skills and responsible use of digital tools.[13,31] Collaborations with civil society and educational institutions can provide these efforts with further reach. Feedback mechanisms allow government to respond to change, acknowledging all voices in policymaking. Incorporating equity indicators into digital health evaluations, as suggested by Gallegos-Rejas et al. (2023),[25] will ensure inclusion in access and usage.

Strengthening national DHL policy frameworks and integration

For a future ready and inclusive digital health ecosystem in India, adopting of Digital Health Literacy (DHL) within national health strategies through systematic and cross-sectoral policy interventions are highly needed. Discussing DHL as part of curricula in secondary school through higher education may establish basic competencies in the digital navigation of health information. On the other hand, DHL modules added to the continuous professional development of healthcare professionals (HCPs) will promote their digital readiness, helping potential digitized healthcare consumers become empowered and make informed decisions .[13,46]

It is fundamental that DHL has a system of national standards or guidelines in their places. This should specify core competencies, assessment metrics, and implementation protocols in both rural and urban contexts while also ensuring contextual relevance and linguistic accessibility.[21,31] A national taskforce dedicated to DHL could be developed and leverage existing frameworks including the Ayushman Bharat Digital Mission (ABDM) to coordinate inter-ministerial work and partner with educational institutions, public health systems and technology partners to help address the digital divide.[21,25]

Lessons from global counterparts such as Australia's My Health Record system and Germany's Digital Healthcare Act point to focusing on regulatory frameworks that ensure equitable access, accountability and quality in digital health service delivery in India.[15,16] Additionally, initiatives in community-based digital health training, particularly in underserved locales, address structural inequities and improve adoption.[24,50]

Fostering User-Centred Design, Collaboration, and Future Research

Ensuring equitable digital health literacy in India requires policies that must focus on user-centred design, multi-stakeholder collaboration, and future-focused research. Digital health platforms often neglect usability for low-literate and digitally marginalized groups. To increase accessibilities, platforms should introduce user-friendly interfaces, vernacular languages, voice features, and hyperlocal content.[21,46] Policies should also require inclusive co-design with users from various socio-economic backgrounds to overcome digital inequalities.[31]

It needs partnerships joining hands of government bodies (eg. National Health Authority), private tech companies, academia and civil society in addressing digital health gaps. This multimodal strategy ensures that national health initiatives such as ABDM are grounded in practice and cater to the needs of real-world practice.[21,51] However, evidence from other countries (e.g., telehealth system in Australia, and the German Digital Healthcare Act of 2019) provide lessons, notably that an interoperable system, alliance across stakeholders including healthcare participants, and provision for consistent and long-term usage will increase the chances of success.[15,16]

Such research should critically assess digital literacy interventions across demographics, identify barriers to digital engagement, and assess the ongoing health impacts of digital health tools.[24,50] Rural populations, people with disabilities, and older adults should receive particular attention.[13,26] Moreover, studies need to investigate the impacts of emerging

technologies (i.e., AI-based decision-making support, IoT-based monitoring, etc.) on the personalization of care processes.[47,52]

CONCLUSION

Summary of key insights

The study highlights that the Digital Health Literacy (DHL) can be seen as a prerequisite for anyone wishing to tap into the possibilities provided by the post-ADBM ecosystem set in motion through policies initiated through the ABDM and the actions of digital service providers. Yet, major barriers restrict equitable access and effective use. Foremost among these is the pronounced digital divide, characterized by a lack of access, affordability, digital skills and adequate infrastructure, especially for rural, elderly and low-income populations. In addition, a lack of culturally and linguistically appropriate digital health tools and poorly drafted DHL assessment frameworks that are not contextualized to the Indian environment only add to these problems and make it impossible to capture the Digital Health Quotient (DHQ) of the country accurately while keeping vulnerable groups away from the benefits of digital health.

The study emphasizes the immediate need for a multi-faceted approach to creating a fair digital health future. It calls for a targeted approach that works to build more digital skills and awareness among different groups of people, while implementing strong policy efforts to close the digital divide with better infrastructure and affordability. Key recommendations from the roundtable discussion include the need for context-specific, validated DHL assessment tools; integration of DHL into national health and education policies; user-centred design principles for digital health platforms with multilingual support; and fostering collaboration between government, private sector and civil society in implementing DHL-related initiatives. It is essential that the digital health transformation effort translates into meaningful equity for all Indians by prioritising inclusivity and making sustained investments and research to address systemic obstacles.

The way forward for an enhanced national Digital Health Quotient (DHQ)

The ambitious journey of India towards a digitally empowered healthcare system, which is symbolised by initiatives such as Ayushman Bharat Digital Mission (ABDM), essentially hinges on the active participation and capability of its citizens and stakeholders. In this context, digital health literacy (DHL) stands out as the basis for this inclusion of individuals, allowing them to consult, understand and use digital health resources and information to make informed choices. Thus, strengthening DHL across populations is inextricably associated with improving the overall Digital Health Quotient (DHQ)—the measure of the population collective's digital health readiness and engagement. Overcoming the wide-ranging barriers highlighted in this review, including the digital divide, low levels of digital literacy, and ongoing issues with usability and accessibility, is therefore not just desirable, but essential in order to fully exploit the potential of digital health.

Going forward, a comprehensive approach that mainstreams DHL enhancement at national level policy and implementation is required. This will require: a strengthening of policy frameworks; improved integration of DHL in educational and community health programs; user-centered design of the digital tools; and promotion of multi-stakeholder collaboration. Recent calls for syntheses of health efforts must start with addressing the digital divide, and ensuring that interventions are inclusive, culturally safe, and accessible to marginalized and vulnerable populations. Hence a comprehensive response to DHL is key to realizing India's digital health potential and improving India's overall DHQ.

REFERENCES

1. National Health Authority (NHA). (2021). Ayushman Bharat Digital Mission. Retrieved from: https://abdm.gov.in
2. Gudi, N., Lakiang, T., Pattanshetty, S., Sarbadhikari, S. N., & John, O. (2021). Challenges and prospects in india's digital health journey. Indian journal of public health, 65(2), 209-212.
3. Sheikh, M. M. (2017). Bridging digital divide in India: Way forward & challenges. International Journal of Advanced Research and Development, 2(4), 129-136.
4. Telecom Regulatory Authority of India. (2025, January 21). Indian telecom services performance indicator report October-December 2023. Telecom Regulatory Authority of India. http://oldwebsite.trai.gov.in/release-publication/perfo
5. Ramachander, A., & Gowri, D. P. (2025). The future of digital health in transforming healthcare. In Digital Technology in Public Health and Rehabilitation Care (pp. 363-385). Academic Press.
6. Ministry of Health and Family Welfare (MoHFW). (2020). Telemedicine Practice Guidelines. Government of India. Retrieved from: https://www.mohfw.gov.in
7. Ministry of Health and Family Welfare (MoHFW). (2019). National Digital Health Blueprint. Government of India.
8. National Health Authority (NHA). (2022). Ayushman Bharat Digital Mission: Progress Update. Government of India. Retrieved from https://abdm.gov.in
9. Ministry of Health and Family Welfare (MoHFW). (2021). National Family Health Survey (NFHS-5) 2019–21: India Fact Sheet.
10. Kumari, B. S. S., Lavanya, P., Padmambika, P., & Bobbili, S. (2024). Bridging The Digital Divide: Addressing Inequality and Access Disparities. International Journal of Indian Psychology, 12(3).
11. NITI Aayog. (2021). Reimagining Healthcare in India through Telemedicine. Government of India. Retrieved from https://www.niti.gov.in
12. KPMG. (2023, October 26). New age healthcare delivery models in India: 20 plus models to redefine healthcare landscape. KPMG.

13. Kim, K., Shin, S., Kim, S., & Lee, E. (2023). The relation between eHealth literacy and health-related behaviors: systematic review and meta-analysis. Journal of Medical Internet Research, 25, e40778.
14. Bardus, M., Keriabian, A., Elbejjani, M., & Al-Hajj, S. (2022). Assessing eHealth literacy among internet users in Lebanon. Digital Health, 8, 20552076221119336.
15. Australian Digital Health Agency. (2020). About Us. Retrieved from https://www.digitalhealth.gov.au/
16. BMG. (2020). Digital Healthcare Act. Retrieved from https://www.bundesgesundheitsministerium.de/
17. Dittrich, F., Mielitz, A., Pustozerov, E., Lawin, D., von Jan, U., & Albrecht, U. V. (2023). Digital health applications from a government-regulated directory of reimbursable health apps in Germany—a systematic review for evidence and bias. Mhealth, 9, 35.
18. Canada Health Infoway. (2024). 2022 Canadian Digital Health Survey. Canada Health Infoway. https://insights.infoway-inforoute.ca/2022-virtual-care
19. Adler-Milstein, J., & Jha, A. K. (2017). HITECH Act drove large gains in hospital electronic health record adoption. Health Affairs, 36(8), 1416-1422.
20. Apathy, N. C., Holmgren, A. J., & Adler-Milstein, J. (2021). A decade post-HITECH: Critical access hospitals have electronic health records but struggle to keep up. JAMIA, 28(9), 1947–1954.
21. Sharma, R. S., Rohatgi, A., Jain, S., & Singh, D. (2023). The Ayushman Bharat Digital Mission (ABDM): making of India's digital health story. CSI transactions on ICT, 11(1), 3-9.
22. Kumari, N., & Banerjee, M. (2025). Telemedicine: A New Horizon in Public Health Management. In Leveraging the Potential of AI in the Real World (pp. 1-20). CRC Press.
23. Fu, Z., Burger, H., Arjadi, R., & Bockting, C. L. (2020). Effectiveness of digital psychological interventions for mental health problems in low-income and middle-income countries: a systematic review and meta-analysis. The Lancet Psychiatry, 7(10), 851-864.
24. Dal Mas, F., Massaro, M., Rippa, P., & Secundo, G. (2023). The challenges of digital transformation in healthcare: An interdisciplinary literature review, framework, and future research agenda. Technovation, 123, 102716.
25. Gallegos-Rejas, V. M., Thomas, E. E., Kelly, J. T., & Smith, A. C. (2023). A multi-stakeholder approach is needed to reduce the digital divide and encourage equitable access to telehealth. Journal of telemedicine and telecare, 29(1), 73-78.
26. Saeed, S. A., & Masters, R. M. (2021). Disparities in health care and the digital divide. Current psychiatry reports, 23, 1-6.
27. Odonkor, A. A. (2023, February 28). Digital technologies improve healthcare in China. China Daily. https://global.chinadaily.com.cn/a/202302/28/WS63fdc134a31057c47ebb150c.html
28. Khaleej Times. (2020). UAE's Smart Health Strategy: Transforming healthcare in the UAE. Retrieved from https://www.khaleejtimes.com/
29. Rai, U., Upadhyay, A., & Singh, R. (2022). Telemedicine: A Future of Healthcare Sector in India. In Telemedicine: The Computer Transformation of Healthcare (pp. 351-372). Cham: Springer International Publishing.
30. Dada, S. A., & Adekola, A. D. (2024). Leveraging digital marketing for health behavior change: A model for engaging patients through pharmacies. International Journal of Science and Technology Research Archive, 7(2), 050-059.
31. Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. Annual review of public health, 42(2021), 159-173.
32. Farsi, D. (2021). Social media and health care, part I: literature review of social media use by health care providers. Journal of medical internet research, 23(4), e23205.
33. Sendra, A., Farré, J., & Vaagan, R. W. (2020). Seeking, sharing and co-creating: a systematic review of the relation between social support theory, social media use and chronic diseases. Social Theory & Health, 18(4), 317-339.
34. Bajpai, N., & Wadhwa, M. (2020). India's national digital health mission (No. 36). ICT India Working Paper.
35. National Health Authority. (n.d.-a). Ayushman Bharat Digital Mission. Retrieved from https://abdm.gov.in/
36. National Health Authority. (n.d.-b). Ayushman Bharat Health Account (ABHA). Retrieved from https://abha.abdm.gov.in/
37. Patel, S., Sreelal, B. S., Kalyani, S., Joy, S. G., Pravalika, T., Ramya, T., ... & Gandhi, A. P. (2024). Digital health literacy among the ageing population: A comparative cross-sectional study between rural and urban Telangana, India. Medical Journal Armed Forces India, 80(3), 313-319.
38. Ministry of Electronics & Information Technology. (n.d.). Digital India Programme. Retrieved from https://www.digitalindia.gov.in/
39. Bassi, A., John, O., Praveen, D., Maulik, P. K., Panda, R., & Jha, V. (2018). Current status and future directions of mHealth interventions for health system strengthening in India: Systematic review. JMIR mHealth and uHealth, 6(10), e11440.
40. Vasanthan, L., Natarajan, S. K., Babu, A., Kamath, M. S., & Kamalakannan, S. (2024). Digital health interventions for improving access to primary care in India: A scoping review. PLOS Global Public Health, 4(5), e0002645.
41. Mathias, E. G., Dhyani, V. S., Krishnan, J. B., Rani, U., Gudi, N., & Pattanshetty, S. (2023). Community-based health literacy interventions in India: A scoping review. Clinical Epidemiology and Global Health, 22, 101310.
42. Lahariya, C. (2018). 'Ayushman Bharat' program and universal health coverage in India. Indian Pediatrics, 55(6), 495-506.
43. Kamath, R., Banu, M., Shet, N., Jayapriya, V. R., Lakshmi Ramesh, V., Jahangir, S., ... & Kamath, S. (2025). Awareness of and Challenges in Utilizing the Ayushman Bharat Digital Mission for Healthcare Delivery: Qualitative Insights from University Students in Coastal Karnataka in India. In Healthcare (Vol. 13, No. 4, p. 382). MDPI.

44. Mishra, U. S., Yadav, S., & Joe, W. (2024). The Ayushman Bharat Digital Mission of India: An assessment. Health Systems & Reform, 10(2), 2392290.
45. Al Dahdah, M., & Mishra, R. K. (2023). Digital health for all: The turn to digitized healthcare in India. Social Science & Medicine, 319, 114968.
46. Fitzpatrick, P. J. (2023). Improving health literacy using the power of digital communications to achieve better health outcomes. Frontiers in Digital Health, 5, 1264780.
47. Fernando, M., Abell, B., McPhail, S. M., Tyack, Z., Tariq, A., & Naicker, S. (2024). Applying the NASSS Framework Across Implementation Stages to Facilitate CDSS Integration: Interview and Focus Group Study. JMIR Medical Informatics, 12(1), e60402.
48. McMurry, A. J., Gottlieb, D. I., Miller, T. A., Jones, J. R., Atreja, A., Crago, J., ... & Mandl, K. D. (2024). Cumulus: a federated electronic health record-based learning system powered by Fast Healthcare Interoperability Resources and artificial intelligence. Journal of the American Medical Informatics Association, 31(8), 1638-1647.
49. Braa, J., Sahay, S., & Monteiro, E. (2023). Design theory for societal digital transformation: the case of digital global health. arXiv preprint arXiv:2311.09173.
50. Stormacq, C., Wosinski, J., Boillat, E., & Van den Broucke, S. (2020). Effects of health literacy interventions on health-related outcomes in socioeconomically disadvantaged adults living in the community: a systematic review. JBI evidence synthesis, 18(7), 1389-1469.
51. Sheikh, A., Anderson, M., Albala, S., Casadei, B., Franklin, B. D., Richards, M., ... & Mossialos, E. (2021). Health information technology and digital innovation for national learning health and care systems. The Lancet Digital Health, 3(6), e383-e396.
52. Musen, M. A., Middleton, B., & Greenes, R. A. (2021). Clinical decision-support systems. In Biomedical informatics: computer applications in health care and biomedicine (pp. 795-840). Cham: Springer International Publishing.