

Perceptions and Beliefs of Healthcare Professionals towards Digital Healthcare Tools in Delhi-NCR, India: A Qualitative Interview Study

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ABSTRACT

Introduction: The integration of rapidly evolving digital tools and technologies in healthcare has revolutionised patient care by streamlining processes, improving efficiency and enhancing decision-making. However, their adoption in healthcare largely depends on the personal beliefs and experiences of Healthcare Professionals (HCPs).

Aim: To explore the perceptions and beliefs of HCPs regarding the use of Digital Healthcare Tools (DHTs) in the Indian context.

Materials and Methods: A qualitative exploratory study was conducted from June to August 2024 in various healthcare set-ups in Delhi-NCR, India. Data were collected using semistructured interviews with HCPs from different backgrounds. Participants were selected based on their proficiency in English and Hindi and their interest in digital tools and technologies. The responses were systematically analysed using a descriptive-interpretive thematic approach, mapped to the frameworks of the Technology Acceptance Model (TAM) and the Work System Model (WSM).

Results: Of the 25 study participants, 64% (N=16) were female, with a mean±SD age of 35.9±7.5 years and an average

professional experience of 10.5±3.4 years. The majority were engaged in direct patient care (doctors and physiotherapists, 36% each; total 72%) and used digital tools for less than 4 hours per day (80%). Digital tools were most frequently used for email and communication (100%), patient engagement and feedback (92%), and financial management (84%). They were less commonly used for teleconferencing (48%), education (40%), radiology and laboratory services (36%), and roster management (12%). Thematic analysis revealed six broad themes: impact and benefits, data security and privacy concerns, technical issues, training requirements, financial concerns, and future expectations, each with 3 to 7 subthemes. While all participants supported the transition to digital tools and digitalisation in Indian healthcare, they also expressed reservations about data breaches, privacy and security, technical skills, infrastructure and training needs, and data sharing.

Conclusion: Digital tools offer significant benefits for enhancing the quality of healthcare services. Despite technical and security challenges, the future of healthcare lies in the advancement of digital technologies. Continuous investment in technology and training is essential to harness the full potential of digital tools.

Keywords: Digital healthcare tools, Digital technologies, Electronic health records, Qualitative study, Semistructured interviews

INTRODUCTION

The potential of Digital Healthcare Tools and technologies (DHTs) to improve the delivery of healthcare interventions is enormous [1,2]. Digital tools for Healthcare Services (HCSs) encompass a wide range of technologies designed to enhance patient care, improve healthcare delivery and facilitate communication between HCPs and patients. They function as individual sources of data collection and, when integrated with Information and Communication Technologies (ICTs) and connected devices, help collect, process, store, transmit and manage data to improve clinical decision-making [3].

According to the World Health Organisation (WHO, 2018), "Digital health technologies have been used as an overarching term to include eHealth and mHealth (e.g., telemedicine, Electronic Health Records (EHR) and wearable sensors), as well as emerging areas such as the use of advanced computing sciences in big data and Artificial Intelligence (AI). Digital health technologies also include certain medical and assistive devices" [4].

Digital tools also cover a wide variety of software and platforms that support communication, productivity, collaboration, creativity, development, analytics, learning, security, social media management, and e-commerce. Examples include email clients, project management software, graphic design tools, integrated development environments, data visualisation applications, learning

platforms, antivirus programs, social media scheduling tools, and e-commerce platforms [5,6].

The WHO strongly recommends the use of DHTs in HCP education and training, emphasising that they should supplement rather than replace conventional educational initiatives. It further notes that incorporating digital channels can make health education more widely accessible and cost-effective [3]. The adoption of these solutions has accelerated significantly in recent years, driven by rapid technological advances and a growing recognition of their potential benefits—particularly during the COVID-19 pandemic, which necessitated remote care and telemedicine solutions to minimise virus exposure [5-7]. A study by the American Medical Association (AMA), for example, reported a dramatic rise in telemedicine use among physicians, increasing from 14% in 2016 to 80% in 2022, underscoring a major shift in perceptions and beliefs about DHTs within the healthcare community [5].

Despite these advances, the integration of DHTs into healthcare continues to generate debate. Concerns remain regarding data privacy, the effectiveness of digital interventions, and the digital divide affecting marginalised populations. Research suggests that although HCPs increasingly acknowledge the value of DHTs, barriers such as resistance to change, inadequate training and concerns about usability and trustworthiness still hinder broader

adoption [6,8,9]. Moreover, demographic factors—including age, gender, digital literacy and adoption behaviours—play a critical role in shaping perceptions and engagement levels [8,10].

Prominent theoretical frameworks, such as the Technology Acceptance Model (TAM) and Normalisation Process Theory (NPT), provide insights into the factors influencing the acceptance and integration of DHTs among both HCPs and patients. These models highlight the importance of perceived usefulness, ease of use and organisational support in shaping attitudes towards technology adoption [11,12]. Furthermore, the evolving landscape of digital health underscores the need for ongoing research to address ethical implications, ensure equitable access and develop effective strategies for engaging diverse populations in their healthcare journeys [13-15].

As DHTs continue to advance, understanding these dynamics is critical for fostering successful implementation and maximising potential benefits for patients and HCPs. However, addressing regulatory, security and interoperability challenges remains essential to fully harness the potential of Digital Information Technology (DIT) in healthcare. A recent study by Marwaha JS et al., documented different dimensions of decision-making involved in adopting and implementing digital health tools within healthcare systems [16]. Such frameworks can help healthcare organisations evaluate existing digital solutions and ensure the optimal utilisation of resources for long-term use in line with strategic objectives.

Considering these factors, adoption can only be successful if the perceptions of end-users are clearly understood and managed to improve uptake. A recent qualitative systematic review by Wosney M et al., reported that HCPs' experiences with digital health tools are shaped by multiple factors, including personal beliefs, encountered challenges and prior experiences with these technologies [6]. These act as moderator variables that influence adoption and perception challenges. Therefore, understanding the perceptions and beliefs of healthcare stakeholders about DHTs is crucial for several reasons. First, it informs the design and development of DHTs to better meet user needs and expectations. Second, it helps identify barriers to adoption and informs strategies to overcome them. Third, it provides insights into how DHTs can be effectively be integrated into healthcare practice to improve patient outcomes and experiences. Despite growing global evidence, limited literature is available in the Indian context [6].

The objective of this study was to explore the adoption of DHTs among HCPs, focusing on their perceptions and beliefs, identifying benefits and challenges and considering future developments to enhance the uptake of digital tools in healthcare.

MATERIALS AND METHODS

A qualitative exploratory study was conducted from June to August 2024 in various healthcare facilities across Delhi-NCR, India. Data were collected through semistructured interviews with HCPs, using a descriptive-interpretive approach. Interviews were conducted in clinics and hospitals across the region.

Ethical considerations: As this was an interview-based study, formal ethical approval was not obtained. However, the objectives and procedures of the study were explained to all participants, and explicit verbal consent was obtained before participation and recording of interviews. Participants were informed that their involvement was voluntary and that they could withdraw at any time. To ensure anonymity, all identifying details were removed, and participants were assigned unique codes. Only the principal investigator had access to the original codes. As an additional safeguard, transcripts were carefully reviewed to exclude any identifying information.

Inclusion criteria: The participant group included doctors, physiotherapists, lab technicians, pharmacists and administrative officers working in different healthcare organisations. Participants

from all age groups were eligible if they had sufficient English and Hindi communication skills and an interest in using DHTs to expand their client base and advance in their field.

Exclusion criteria: Individuals who reported not using internet-based technology, were not digitally inclined, or did not provide consent were excluded from the study.

Sample size: Convenience sampling was used for this study. HCPs were approached and invited to participate through personal contacts and referral channels. Enrollment was stopped when data saturation was reached, defined as the point at which no new or different themes, information, ideas, or patterns emerged during interviews with at least three consecutive participants.

Data collection instrument: A semistructured interview schedule was developed based on available literature and reviewed by one academic expert and one clinical expert to ensure accuracy and alignment with the study's aims. The schedule was designed to collect data on experiences and practices related to the use of DHTs in clinical care and practice. Questions were guided by the Technology Acceptance Model (TAM) (to explore perceptions and adoption of DHTs) and the Work System Model (WSM) [17] (to gain insights into people, process, and technology interactions within healthcare systems), following the methodology of Wosny M et al., 2024 [18].

Pilot study: A pilot study was conducted with a small sample to identify practical difficulties in implementing the interview process. Data from the pilot were not included in the analysis or results; rather, the purpose was to refine interview questions and procedures. Based on the findings, minor changes were made to the schedule and its implementation. The final semistructured interviews included 12 open-ended questions covering various aspects of digital tools used in healthcare services.

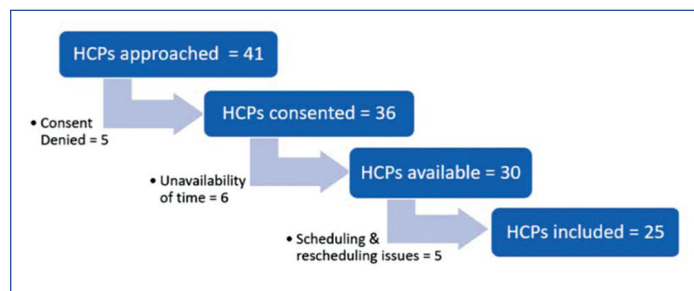
Data collection process: Each interview lasted approximately 15-20 minutes and continued until data saturation was reached [19]. All interviews were conducted in person, with prior scheduling and appointments. They were held in the participant's preferred setting (cafeteria, office, or duty room) and language (English or Hindi). Interviews began with an information and consent process, followed by personal introductions, socio-demographic questions, and questions related to the use of digital tools in healthcare service provision. All responses were recorded and subsequently transcribed for analysis.

Data analysis and mapping: The recorded interviews were manually transcribed by the interviewer, as many available transcription software tools could not accommodate the mix of Hindi and English responses. Two coders independently applied deductive and inductive approaches to develop codes for thematic analysis, following the method of Fereday J and Muir-Cochrane E (2006) [20]. Initial inter-coder reliability, computed using percentage agreement, was 72%, which was considered acceptable. Agreement was further improved through ongoing discussion until consensus was reached, either within the same code or by creating new themes, subthemes, or codes. During and after coding, all codes were defined to create a codebook with clear definitions and criteria, which were refined and re-coded as necessary. A consensus approach was also used for mapping themes and subthemes to the theoretical frameworks of TAM and WSM. This process was verified by a senior researcher with 10 years of experience in the field. Thematic analysis of interviews was carried out according to the guidelines of Braun V and Clarke V (2007) [21].

RESULTS

A total of 41 HCPs were approached for participation in this study. Of these, 25 HCPs participated, while the remaining 16 were excluded or dropped for the reasons cited in [Table/Fig-1]. Demographic details of the 25 participants are summarised in [Table/Fig-2].

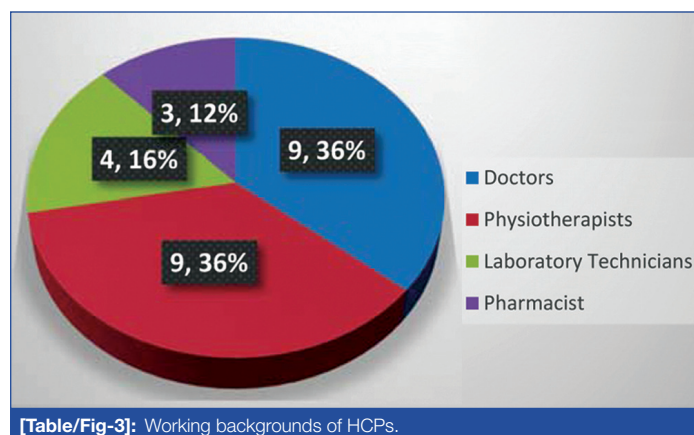
Among them, 36% (N=9) were male and 64% (N=16) were female. The mean (standard deviation) age of the HCPs was 35.9 ± 7.52 years, with an average professional experience of 10.5 ± 3.4 years. Participants represented 16 different organisations and four distinct work backgrounds or domains within hospital-based healthcare [Table/Fig-3]. The largest proportion of respondents belonged to medical science, including doctors and physiotherapists (36% each).



[Table/Fig-1]: Showing reasons for exclusion.

Description	Healthcare providers
Total number	25
Male, number (%)	9 (36)
Female, number (%)	16 (64)
Age, mean $\pm$ SD years	35.9 ± 7.52
Range in years	32-48
Experience, mean $\pm$ SD years	10.5 ± 3.42
Range	7-15

[Table/Fig-2]: Demographic characteristics of the participants included in the study.



[Table/Fig-3]: Working backgrounds of HCPs.

Study outcomes: The results of this study are based on a thematic analysis of the interview transcripts. Various factors and co-factors were identified, grouped, and classified according to the responses received. Participants highlighted several benefits of digital tool use for both HCPs and patients, concluding that digital tools should continue to be adopted in healthcare practice. However, despite these benefits, participants also raised concerns about challenges in using digital tools, which could act as barriers to their adoption.

Digital tool usage: Participants reported using more than 44 different software and hardware tools specifically in clinical practice to provide HCSs. These tools covered diverse areas, including:

- Communication tools (e.g., email, text messages, WhatsApp, video messages, and calls)
- Patient feedback/engagement tools (e.g., Google Reviews, Practo, mFine, 1mg, Lybrate)
- Financial management tools (e.g., insurance settlement portals, tax invoice generators, billing software, payment applications/portals)
- Clinical care tools (e.g., telemedicine, prescription-writing software, inventory management systems)

- Investigation/testing/reporting portals (e.g., smart sensors/devices, EHRs)
- Administrative management tools (e.g., attendance systems, appointment scheduling and reminder tools)

The most frequently used tools were related to communication (100%) and patient engagement (92%), as shown in [Table/Fig-4]. A majority of participants reported spending two to four hours per day using digital HCS tools, with detailed data provided in [Table/Fig-5].

Digital tools	Frequency reported, n (%)
E-mails and other communication related programs/tools	25 (100)
Patient feedback and engagement tools	23 (92)
Budgeting/financial management tools	21 (84)
Clinical prescription/patient information system	15 (60)
Calendar/appointment scheduler/reminder and related tools	15 (60)
Teleconferencing/tele-healthcare tools	12 (48)
Clinical education tools	10 (40)
Radiology and laboratory related information tools	9 (36)
Shift/duty management tools	3 (12)

[Table/Fig-4]: Details of digital healthcare service tool under use (n=25).

Self-reported (average) daily hours spent per day on digital healthcare service tools, n (%)	
1 to <2h	9 (36)
2 to <4h	11 (44)
4 to <6h	5 (20)
6h or more.	None reported

[Table/Fig-5]: Average time spent on digital healthcare service tool (n=25).

Participants also noted that while digital tools are easier for some patients to use, others face challenges that may limit their ability to benefit. Younger patients were generally more comfortable engaging with digital tools, whereas older adults often found them to be barriers. Factors such as age, personal preferences and trust influenced digital engagement, with some HCPs describing these differences as a “generation gap.”

Themes and subthemes developed: The responses were reviewed multiple times to categorise them into main themes and sub-themes, which were then mapped onto the TAM model and WSM. Each subtheme was operationally defined, and coding rules or criteria were developed to ensure clarity and avoid overlap. This process ensured that all interview responses could be classified under appropriate subthemes. Details of the themes, subthemes, coding, mapping with TAM and WSM frameworks, operational definitions, and coding rules are provided in [Table/Fig-6].

It is noteworthy that some themes—such as financial concerns and future expectations—could not be mapped to either TAM or WSM frameworks. Individual sample statements and their corresponding mapping to subthemes are presented in [Table/Fig-7].

Theme 1: Impact and Benefits of Digital Healthcare Tools

Digital tools have various impacts and benefits. One of the most common uses is virtual consultation applications, which enable patient care through digital platforms. Under this theme, the maximum number of related subthemes emerged. The subthemes reported in the interviews were linked to reduced paperwork, improved workflow and efficiency, time saving, better data maintenance and accessibility, user comfort and ease of use, reduced work stress, and greater flexibility and convenience.

Theme 2: Security and Privacy Concerns

The use of digital tools among HCPs has increased significantly in recent years, offering numerous benefits as summarised above.

Theme no.	Theme	Sub-theme		Code given	TAM component(s)	WSM component(s)	Coding criteria/rule
1	Impact and benefits of digital healthcare tools	1.1	Decrease in Paper work	Impact_Paperwork	Perceived Usefulness	Products & Services/ Outcomes	Use when participants express that the digital healthcare tools or technology decrease the requirement or volume or load of files, paperwork, etc.
		1.2	Improved work flow and efficiency	Impact_Workeffic	Perceived Usefulness	Tasks/Processes	Code when participants describe how the digital healthcare tools or technology helps to improve the structure, roles and reporting of the work or administrative duties, and/or emphasises the improvement of the efficiency of the work/ tasks related to patient care or any other daily tasks of a healthcare organisation.
		1.3	Time saving	Impact_Timesaving	Perceived Usefulness	Participants/ Processes	Apply when there's mention of reduced time taken for in the tasks/ processes/ communication between the users by use of digital healthcare tools or technology.
		1.4	Data maintenance and accessibility	Impact_Datamaint	Perceived Usefulness	Infrastructure/ Environment/ Participants	Use when participants discuss how digital healthcare tools or technology helps to ease/ reduce maintenance requirements or makes it quickly accessible to the end users.
		1.5	User comfort and ease of using	Impact_Userease	Perceived Ease of Use	Infrastructure/ Environment/ Participants	Code when participants express how digital healthcare tools or technology solutions makes it easy to use the services and improve the comfort/ convenience of using the HCSs improving its use for more patients.
		1.6	Decrease work stress	Impact_Workstress	Perceived Usefulness	Participants/ Products & Services	Use when there is mention of lesser work stress with use of digital healthcare tools or technology solutions by reducing the time and cost or improving the efficiency and accessibility etc. making the users to track and manage their care from time to time independently.
		1.7	Greater flexibility and convenience	Impact_Flexibility	Perceived Usefulness	Participants/Tasks/ Environment	Apply when discussing how digital healthcare tools or technology makes it easier to work remotely, provide flexible care, or adjust to patient needs.
2	Security and Privacy Concerns	2.1	Data breach and cybersecurity risks	Securpriv_Breach	Perceived Ease of Use (negative)	Technology/ Information/ Environment	Code when participants express fear of digital data being, leaked or compromised by external threats or cyberattacks.
		2.2	Patient confidentiality, privacy and trust	Securpriv_Confid	Perceived Usefulness (negative)	Participants/ Information/ Products and Services	Use when participants mention patients' or professionals' concerns about the confidentiality of digital records.
		2.3	Data sharing to third parties	Securpriv_Datash	External Variables	Information/ Processes/ Environment	Code when participants mention vague concerns related to sharing of data with other parties and lack of security procedures, lack of transparency, or unauthorised secondary data use, etc.
		2.4	Weak data governance	Securpriv_Gover	External Variables	Strategy/ Information/ Infrastructure	Code when participants mention unclear responsibilities or institutional gaps in managing digital privacy as per the defined government policy/ regulatory requirements.
3	Technical concerns in adoption of Digital healthcare tools	3.1	System integration issues	Technical_Integr	Perceived Ease of Use (negative)	Technology/ Information/ Processes	Code when participants mention interoperability failures, duplication of work, or fragmented systems, decreasing the adoption of the digital healthcare tool.
		3.2	Infrastructure limitations	Technical_Infrast	Perceived Ease of Use (negative)	Infrastructure/ Environment	Use when lack of reliable internet, servers, hardware, or IT resources is a barrier.
		3.3	Device and platform limitations	Technical_Device	Perceived Ease of Use (negative)	Technology/ Participants/ Infrastructure	Code when participants mention barriers using certain platforms or when software only works on specific devices.
		3.4	Frequent updates and new learning curves	Technical_Learning	Perceived Ease of Use	Technology/ Participants/ Support Services	Code when participants feel overwhelmed by updates, version changes, interface redesigns, or issues with changes in software(s).
4	Training requirements on uses of Digital tools	4.1	Need for formal training environments.	Training_Need	Perceived Usefulness	Participants/Tasks/ Support Services	Code when the participants express their perceptions and views about the need for training of digital healthcare tools or technology.
		4.2	Peer-to-peer learning	Training_Peerlearn	External Variables	Participants/ Processes/ Environment	Use when knowledge transfer happens through mentorship or informal team-based learning.
		4.3	Long training times	Training_Time	Perceived Ease of Use (negative)	Participants/ Processes/Support Services	Code when participants report it requires long time, additional time or extra time to get trained on any new digital healthcare tools or technology at the start of implementation.
		4.4	Training not tailored to roles	Training_Roles	Perceived Usefulness	Participants/Tasks/ Support Services	Code when participants describe that the roles and trainings on the software doesn't match job needs.

5	Financial concerns	5.1	High initial investment costs	Financial_Investm	Perceived Ease of Use (negative, indirect impact on behavioural intention)	Infrastructure/ Technology	Code when participants discuss capital expenses needed to acquire or upgrade digital healthcare tools/ technological systems.
		5.2	Maintenance and operational expenses	Financial_Mainta	Perceived Usefulness (negative, indirect via perceived value)	Infrastructure/ Support Processes	Apply when cost of keeping digital healthcare tools/ technological systems operational is mentioned as a burden.
		5.3	Uncertainties related to reimbursement, funding challenges and Return on Investment (ROI)	Financial_Roi	Perceived Usefulness (Negatively, indirect via perceived value)	Environment/ Processes/ Outcomes/ Participants	Apply when participants describe inadequate insurance reimbursement or unclear billing procedures to ensure tool is cost-effective or beneficial over time.
6	Future expectations	6.1	Easy system integration	Future_Integration	Perceived Ease of Use	Technology/ Processes/ Infrastructure	Use when participants describe hopes for systems that "talk to each other" or reduce redundancy.
		6.2	Streamlined workflows and automation	Future_Workflows	Perceived Ease of Use	Tasks/Technology/ Support Services	Apply when participants anticipate less paperwork, faster data entry, and simplified communication improving efficiency.
		6.3	Scalable and resilient infrastructure	Future_Infrastr	Perceived Usefulness	Infrastructure/ Technology/ Strategy	Use when participants mention expectations of digital infrastructure being robust, secure, and sustainable.
		6.4	Enhanced data governance and security	Future_Datagov	External Variables	Information/ Environment/ Strategy	Apply when participants expect better privacy protocols, audit trails, and consent mechanisms.
		6.5	Replacing healthcare jobs	Future_Hcjobs	Perceived Usefulness (negative)	Tasks/Technology/ Processes/ Participants	Code when participants expect that the future digital healthcare tools will replace or take away the healthcare jobs.

[Table/Fig-6]: Themes and subthemes developed from the interview responses mapped with Technology Acceptance Model (TAM) model and Work System Model (WSM).

*Authors compilation.

Example no	Participant no.	Experience	Sample quotes (from semistructured interviews)	Subtheme mapped
Theme 1: Impact and benefits of for adoption of digital healthcare tools				
1	P2	11 y	"...it reduced the stress of paperwork and workflow."	1.1, 1.2, 1.6
2	P3	7 y	"These tools have a lot of benefit and using these tools in the modern era increases the workflow and efficiency"	1.2
3	P4	14 y	"These digital tools reduce the paperwork and yes it's a friendly way to the user one can modify and make the tasks easy using these tools".	1.1, 1.4, 1.5
4	P5	9 y	"Digital tools save time and healthcare providers can reach a large number of patients in a short period of time".	1.2, 1.3
5	P6	9 y	"Digital tools have a benefit as these make the efficiency of work easier and helps to maintain data easily".	1.2, 1.4
6	P7	12 y	"...people feel comfortable while using these digital tools and their work gets convenient by these tools. It reduces the stress of paperwork and file work".	1.1, 1.5
7	P10	13 y	"Using digital tools reduced file work, made the work easier in one click all work become easier".	1.1, 1.5, 1.6, 1.7
8	P15	10 y	"...using these digital tools is convenient. It reduces stress of file work and paperwork"	1.1, 1.7
9	P16	9 y	"These tools reduce file work and make paperwork easier and reduce work stress."	1.1, 1.5, 1.6
10	P17	13 y	"These tools are easy to use to understand and work becomes easier using these digital tools"	1.5, 1.7
11	P24	8 y	"Digital tools improved the workflow efficiency, and it also decreased the load of paperwork now in one click one can get access to all data"	1.1, 1.2, 1.6, 1.7
Theme 2: Security and privacy concerns for adoption of digital healthcare tools				
1	P13	10 y	"...using these tools has a lot of security and privacy concerns."	2.1, 2.2
2	P16	9 y	"There is no security in using these tools, data is shared to other sources"	2.1, 2.3
3	P17	13 y	"These tools are user friendly, and there is no threat for data leakage and no privacy issue"; although he also acknowledged that "Cybercrime is a major threat using digital tools. Nowadays there are many frauds occurring, data is leaked sometimes."	2.1, 2.2
4	P21	13 y	"Using the digital tools is easy and there is no security and privacy concerns regarding it"	2.1, 2.2
5	P23	11 y	"Using these tools has a risk of cyber security."	2.1
6	P24	8 y	"Data leak may happen using these digital tools and there is risk of data compromise"	2.1
7	P25	12 y	"These tools have an issue of data leakage"	2.1
8	P23	11 y	"We are still not clear about the duration till when the data is to be stored digitally."	2.4
Theme 3: Technical concerns in adoption of digital healthcare tools				
1	P8	15 y	"There are lot of technical issues while using different tools and therefore patients hesitate to use these tools. Online consultation is not easy"	3.1
2	P10	13 y	"...most frequent example of technical issues can be seen when patients use virtual consultations, as they have to switch between multiple windows and but they are able to handle it online. Therefore, many patients are ready to use these tools."	3.1
3	P11	7 y	"Yes... using online tools is easier for example virtual consultations but there are problems when one has to shift between devices like Mac to Android platforms. But it can be workable, various healthcare providers use this for the sake of patients and patients are themselves adapting it, using online consultation."	3.1, 3.3
4	P12	9 y	"Different systems have different software's and Yes these digital tools play an important role but at this time servers are not that user friendly."	3.1, 3.2

5	P25	12 y	"Digital tools and digitalisation process is time saving but the technical issues, frequent updates and errors or glitches have to be managed well."	3.3, 3.4
Theme 4: Training requirements for adoption of Electronic Health Records (Ehr) and other digital healthcare tools				
1	P10	13 y	"The requirement is not proper tools maybe it is that users don't know how to use them properly... in absence of proper technical guidance it takes as much as a period of 1 to 1.5 month for the training on these tools."	4.1, 4.3
2	P12	9 y	"...many times, training is from colleagues and friends... the training period requires a time of 1 month or more depending on person to person"	4.2, 4.3
3	P13	10 y	"...for fast learners training period takes minimum 2 to 4 weeks, maintaining HER has a crucial role for the record keeping but the training has to be more focused as per the role to be performed in healthcare but certainly it reduces paperwork"	4.3, 4.4
4	P18 & P20	8 y & 20 y	Stated that it takes one month for the training of an individual for using digital tools, EHR records are maintained as its very helpful and useful, virtual consultations are used twice a week many times a patient who can't visit the clinic used virtual consultation.	4.3
5	P21	13 y	"Yes...training period depends on person to person, HER plays an important for the maintaining of records but it should be more focused as per our role and less technical"	4.2, 4.4
Theme 5: Financial concerns for adoption of digital healthcare tools				
1	P6	9 y	"Budget has an important role and initial cost of any technology has to be planned"	5.1
2	P8	15 y	"Yes...the most important aspect for every work is budget hence it plays an important role in daily practice even for regular maintenance and running".	5.2
3	P13	10 y	"Budget considerations doesn't have any particular role in the daily use of digital tools, however it the initial investment which has to be planned more cautiously"	5.1
4	P17	13 y	"For a good and better future with these tools latest advancements are required and that is only possible with the good budgeting as money is required for every aspect of regular maintenance also"	5.1, 5.2
5	P22	9 y	"...budget is important in every aspect as various components require budget even for smallest aspect of software and internet connection etc.,"	5.1, 5.2
6	P24	9 y	"Budget plays an important role in healthcare field as the latest advancements in the technology are accessed by updating the software's which are paid"	5.2
7	P25	12 y	"Some high cost digital tools become a problem because of the high costs, loan requirements, returns gained and repayments etc.,"	5.1, 5.3
Theme 6: Future of digital healthcare tools				
1	P6	9 y	"...future the server should be faster and more compatible with latest technologies, the servers should be user friendly and secure"	6.3, 6.4
2	P9&P22	14 y & 9 y	Stated that the future expectations is getting a faster server and upgraded software that is easy to use	6.3
3	P13	10 y	"Future may hold more automation and taking healthcare jobs."	6.2, 6.5
4	P17	13 y	"...more and more tasks of the healthcare service will be done by technology in future."	6.2
5	P19	12 y	"...physical health and healthcare service both will integrate better with upcoming technologies"	6.1
6	P25	12 y	"In future one expects that the software should be user friendly and with latest technologies which will be better integrated and hence easy to use"	6.1

[Table/Fig-7]: Healthcare providers individual responses mapped to themes and sub-themes.

However, alongside these advantages come concerns regarding security and privacy that need to be carefully addressed. The subcomponents reported included data breaches and cybersecurity risks, patient confidentiality and trust concerns, data-sharing practices with third parties, and data governance policies across different organisations.

Theme 3: Technical Concerns in Adoption of Digital Healthcare Tools

Technical concerns in adopting DHTs were also raised. Participants noted that many of these factors depend on the patient's comfort level. They reported frequent technical issues, such as network problems and communication downtime during consultations. While some patients adapt to these challenges, others feel uncomfortable and believe that in-person consultations are a better option. The subthemes identified included system integration issues, infrastructure limitations, device and platform constraints, and frequent software/hardware updates requiring additional time to learn new skills.

Theme 4: Training Requirements on Uses of Digital Tools

The training period varies from person to person, depending on how efficiently they can adapt to digital tools. EHRs are particularly crucial for ensuring the security, availability, and accuracy of patient information. Subthemes that emerged included the need for formal training environments, increased peer-to-peer learning, longer learning times, and training sessions that often do not address role-specific requirements.

Theme 5: Financial Concerns

Almost 60% of the HCPs reported using digital tools for financial management and budgeting, although the expected usage was higher. These tools have improved the ease of planning services as well as operations. The financial issues identified from the interviews included high initial investment costs, ongoing maintenance and operational costs, uncertainty in reimbursement, funding challenges, and concerns about return on investment from a business perspective.

Theme 6: Future Expectations

Participants expressed future expectations for digital tools to further enhance healthcare service delivery. They envisioned integrating these tools into healthcare systems to make services more efficient and cost-effective for both HCPs and patients. Subthemes identified included easier system integration, streamlined workflows and automation, scalable and resilient infrastructure, enhanced data governance and security, and the possibility of DHTs eventually replacing certain healthcare jobs.

DISCUSSION

Technological innovations in healthcare have led to the development of numerous devices and digital tools in the clinical setting. The aim of the present study was to explore the adoption and experiences of DHTs by healthcare clinicians and practitioners in clinical care. To achieve this, semistructured interviews were conducted with healthcare professionals directly involved in patient care, as well as those engaged in planning and administering clinical care services.

The methodology of the study was guided by theoretical models that connected the frameworks of the TAM and WSM. This approach was used to better understand the adoption process and how it integrates with the daily responsibilities of HCPs and the requirements of healthcare organisations in delivering healthcare services (HCSs). A similar approach has been used in previous studies [15,16], as it helps bridge the theoretical and practical aspects of work process integration with digital technology adoption. Furthermore, a heterogeneous group of participants was included in the study to reflect a diversity of perspectives, encompassing both experienced and relatively new practitioners.

During the interviews, healthcare providers described a wide variety of digital health tools used in practice. They also reported the amount of time spent daily on digital tools over the past several weeks to months.

It is evident from this study that older digital tools and sources—such as search engines, websites, and online discussion forums—are often neglected in contemporary discussions of digital health, while newer technologies such as apps, wearable devices, and social media receive greater attention. Clinical decision support systems, telemedicine platforms, EHRs and e-pharmacy platforms are examples of technologies that enable HCPs to deliver more effective, individualised care while also enhancing patient outcomes.

Some areas of concern also emerged in this study, directly and indirectly influencing the adoption of DHTs in developing countries such as India. These concerns must be addressed if digital technologies are to fulfil their purpose of delivering efficient healthcare services in the Indian context by saving time, improving outcomes, and enhancing collaborative care in a cost-effective manner.

Impact, Benefits, and Factors Involved

Factors influencing the adoption of new technologies by clinicians in India are multifaceted [22,23]. The impact and benefits of DHTs are closely tied to personal experiences, which directly affect their adoption among HCPs [24]. Furthermore, the frequent introduction of new DHTs tends to disrupt the adoption process [25-27]. Reported benefits include improved accessibility, enhanced efficiency, and performance gains, ultimately leading to better patient care outcomes [25]. Other influential factors include digital literacy, organisational support, regulatory compliance, patient engagement, cultural and social influences, attitudes toward technology adoption, and concerns about job security, among others.

Barriers, Concerns, and Challenges Involved

The concerns and challenges in adopting DHTs include issues related to the introduction of disruptive technologies, the training required for HCPs, security and privacy of both consumer and HCP data, technical limitations and infrastructure and financial constraints. These issues, highlighted repeatedly in the literature, continue to represent major barriers to effective adoption [25,28-31].

Technical Concerns and Disruptive Technologies

The use of ICT in Healthcare Service (HCS) provision has long been a cherished goal, which was further accelerated by the COVID-19 pandemic [25,32,33]. However, technical concerns play a significant role in adoption. These include interoperability issues, system integration and compatibility challenges, as well as the need for ongoing technical support and maintenance [25,29-31].

In addition, disruptive technologies such as AI, blockchain, machine learning, virtual reality, the Internet of Medical Things, telemedicine and wearable devices are evolving rapidly and hold great potential to restructure the way HCPs work [25]. For example, AI can serve as a clinical prediction tool, screen

population data, predict outbreaks, mitigate risk factors, and guide effective resource allocation and cost savings—benefiting individuals, societies, and governments alike [34]. Moreover, AI has potential applications in enhancing HCP learning and development by providing personalised, adaptive, and effective learning experiences through generative AI, machine learning, and predictive analytics [35]. In the Indian context, AI can also help bridge skill gaps while fostering collaboration and knowledge sharing [36-38].

Organisational Challenges and Training Concerns

The successful adoption of digital tools is influenced by various organisational and environmental factors. Organisational barriers—such as staff resistance—have been shown to significantly impact the successful implementation of Electronic Medical Records (EMRs) [39,40]. Effective change management strategies are essential to address this resistance. Engaging leadership to champion EMR initiatives and involving staff in the planning process can improve acceptability and reduce pushback against digital tools.

Although the COVID-19 pandemic necessitated a rapid shift towards telehealth adoption, adequate training and sufficient time for integration remain crucial for success [25,28,29,32]. This requires comprehensive training, personalised support, and phased implementation to allow clinicians to become familiar with the technology. Monitoring progress and adapting implementation strategies as needed help ensure a smoother transition [32].

Ethical and Legal Concerns

Data security and privacy remain paramount concerns in the digital health landscape. Patients and providers alike express concerns about breaches of personal health information, which can undermine trust in digital health technologies [41]. In India, data privacy has historically been one of the most neglected aspects of healthcare data management [42]. Misconceptions regarding the security of digital systems compared with traditional paper records further complicate matters, contributing to skepticism and reluctance to adopt new technologies.

Additionally, the rapid evolution of cybersecurity threats demands continuous adaptation and robust protective measures to maintain data integrity and safeguard patient trust. Key regulatory frameworks in this area include the Health Data Management Policy 2020, and the Digital Personal Data Protection (DPDP) Act 2023.

Financial Concerns

A major obstacle identified in the implementation of EMRs in India is financial constraints. Approximately 44% of medical professionals cited lack of funding as a critical barrier to the adoption of EMR in previous studies [39]. Effective strategies such as prioritising budget planning, seeking government grants, and forming partnerships with private entities are necessary to overcome these financial hurdles [30,39,43,44]. Furthermore, India's healthcare infrastructure and reimbursement mechanisms for DHTs are still evolving [45,46]. Reimbursement mechanisms exist for telemedicine and digital health services (DHSs) [47]. However, challenges persist, including continuously evolving infrastructure limitations and ongoing data privacy concerns.

Government of India Initiatives

Government initiatives in India represent a strategic response to the evolving healthcare landscape [48,49], driven by both technological advancements and the urgent need for improved healthcare access, particularly during and after the COVID-19 pandemic. Among the most widely used DHTs are the Aarogya Setu app for contact tracing and screening [50] and the CoWIN app for vaccination scheduling and distribution [51].

Since the launch of the National Digital Health Mission on 15 August 2020 (now known as the Ayushman Bharat Digital Mission), the Indian government has introduced multiple initiatives aimed at integrating digital health technologies, enhancing service delivery, and improving patient engagement. Key programs include:

- Tele-MANAS [52] - telemedicine-based mental health support
- e-Sanjeevani [53] - a platform facilitating remote consultations and improving access in underserved communities
- Nikshay 2.0 Portal [54] - for tracking and managing tuberculosis (TB) cases

Despite persistent challenges such as inadequate infrastructure and low levels of digital literacy, these initiatives aim to bridge the urban-rural healthcare gap and support the achievement of Sustainable Development Goals (SDGs). The introduction of the Telemedicine Practice Guidelines in March 2020 [55] further legitimised telehealth practices in India [56]. Collaboration between public and private sectors remains crucial to foster innovation and ensure effective implementation across all sections of society [57].

Implications for Healthcare Administrators/Managers and Planners

The managerial implications of this study highlight the need for strategies that design and develop user-centred DHTs tailored to the needs and expectations of both patients and HCPs. Healthcare organisations should foster a culture of digital adoption by providing training and support to enhance digital literacy and ensure equitable access to DHTs.

In addition to promoting benefits and addressing challenges, healthcare organisations should implement robust measures to ensure data privacy and security, thereby protecting confidentiality and building trust. Regular assessment of the effectiveness of digital health tools, combined with systematic feedback collection, is essential to inform future development and implementation.

Role of Researchers

Researchers working in the field of DHTs must consider evidence-based practices, ethical standards and interdisciplinary collaboration. They should employ robust evaluation methodologies and actively engage with policymakers to promote effective, responsible and patient-centred solutions [49,58,59].

Future research

Future studies should focus on different subgroups of stakeholders involved—HCPs, planners and administrators and consumers of Healthcare Services (HCSs)—who interact with these tools on a daily basis. Longitudinal studies in this area, where DHT implementation is transforming healthcare practice, can improve the understanding of factors acting as barriers and facilitators. Further research should employ qualitative, quantitative and mixed-method approaches to validate and build upon the findings of the present study. This would help generate more robust data, which in turn could improve the acceptability and accelerate the adoption of DHTs to enhance patient care services. Additional areas of focus should include the acceptability and adoption of AI-powered diagnostics, personalised medicine, virtual reality therapy, wearable devices, telehealth, digital therapeutics, health data analytics, and cybersecurity, as well as addressing issues of health equity and access. Studies should also evaluate engagement and recruitment strategies, investigate integration challenges, assess effectiveness and safety, address local contexts and cultural adaptation, and rethink the process of informed consent while ensuring continuous ethical engagement with digital tools.

Finally, the potential impact of Healthcare 5.0 on replacing parts of the healthcare workforce is a growing concern that warrants investigation within the Indian healthcare context, involving not only HCPs but also other key stakeholders.

Limitation(s)

The present interview-based study has several strengths but also some limitations. While the study attempted to include HCPs from diverse backgrounds and organisations to provide a comprehensive overview of the topic, the use of convenience sampling may have introduced selection bias. Additionally, the study findings are based on researchers' interpretations of participants' responses during semistructured interviews, without structured observations to validate the perceptions and views expressed. The insights explored are also tool-specific, which may limit the scope and generalisability of the findings. Lastly, since the study was conducted only in the Delhi-NCR region, its findings may not be generalisable to other states in India or to healthcare systems in other countries.

CONCLUSION(S)

The use of digital tools in HCSs has transformed the way individuals access and receive medical care. Healthcare professionals' perceptions and beliefs about DHTs play a crucial role in their adoption, effective utilisation and in achieving the long-anticipated benefits in clinical care. Understanding these perceptions and beliefs is essential for developing tailored digital health solutions in the Indian context. Such solutions will help meet the needs and expectations of all stakeholders, ultimately enhancing the quality, accessibility and efficiency of Indian HCSs. Finally, the findings of the present study should inform and translate into practice and policy recommendations for better governance structures at the local, national, and international levels, in line with the dynamic advances in DHTs and related technologies.

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