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A SURVEY-BASED ANALYSIS OF HEALTHCARE PROFESSIONALS' PERSPECTIVES ON THE CLINICAL INTEGRATION OF AI-DRIVEN HEALTH APPLICATIONS IN PAKISTAN

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Abstract

Objective: *To assess healthcare professionals' awareness and usage of AI-driven health applications, explore their perceptions of benefits and limitations, and identify barriers and facilitators to clinical adoption in Pakistan.*

Methods: *A cross-sectional survey was conducted among 350 healthcare professionals, medical students, and AI conference attendees from POF Hospital and WMC in Pakistan, selected via purposive sampling. Data were collected using a standardized questionnaire based on the Technology Acceptance Model (TAM), assessing demographics, AI usage, perceived usefulness, ease of use, and barriers/facilitators. Descriptive and inferential statistics were analyzed using SPSS.*

Results: *Most participants were aged 31–40 (58.9%), female (71.4%), and held undergraduate degrees (81.1%), with 57% from medicine and 31.1% from nursing. AI usage was moderate, with 58.3% of medical professionals and 63.3% of nurses reporting adoption. Perceived usefulness scored 3.64 (SD = 1.25), ease of use 3.05 (SD = 1.01), and technology familiarity 2.61 (SD = 0.74), indicating basic to intermediate digital literacy. Major barriers included data security concerns (86.0%), time constraints (33.7%), and lack of training (30.0%), while facilitators were accessibility (65.1%), trust in apps (60.3%), and reliability (55.7%).*

Conclusion: *Pakistani healthcare professionals show moderate AI adoption with positive perceptions of its usefulness but face significant barriers like data security concerns and limited training. Enhancing digital literacy, strengthening data privacy frameworks, and integrating AI education into medical curricula are critical to advancing AI-driven health integration in Pakistan..*

INTRODUCTION

The integration of artificial intelligence (AI)-Driven Health applications into clinical practice has the potential to transform healthcare delivery by enhancing diagnostic accuracy, personalizing treatment, and streamlining administrative processes. AI-Driven Health applications, encompassing diagnostic algorithms, predictive analytics, and virtual health assistants, are reshaping clinical practice by enabling real-time decision-making and personalized care(1) . Mobile devices and mobile applications facilitate access to clinical evidence at the point-of-care.(2) Globally, approximately 60% of healthcare

professionals utilize AI tools for clinical decision-making, diagnostics, and patient monitoring, with the digital health market valued at USD 332.5 billion in 2022 (World Health Organization, 2023). In Pakistan, the adoption of AI-based health applications is increasing, particularly post-COVID-19, with tools supporting telemedicine and diagnostic assistance gaining traction. However, a 2022 survey indicated that while 70% of Pakistani healthcare professionals were aware of AI applications, fewer than 30% integrated them into clinical practice, citing barriers such as inadequate training, unreliable infrastructure, and concerns about data privacy(3).Smartphones and related medical education apps are widely used by medical students and majority of the students felt that the use of smartphones would improve their educational experiences, be beneficial to medical faculty for teaching, and could be more effectively used in medical education.(4) Many health apps have a built-in feature to track the user's activity, including diet, exercise, etc. For example, users input their food intake and the app creates a log of what has been consumed on a particular day and provides the user with feedback, such as, their estimated weight loss or gain if they continue to eat in the same pattern over the next few days or how far they are from their goal weight. (5, 6) The number of mobile health applications on app stores that can be used for rehabilitation is increasing(7).

Several factors influence the clinical integration of AI-driven health applications. Awareness and knowledge of AI technologies are critical, with trained professionals more likely to adopt these tools(8). Perceived usefulness and ease of use, as outlined in the Technology Acceptance Model (TAM), significantly drive adoption, while trust in AI's reliability and transparency is essential to mitigate concerns about errors or algorithmic bias (9). Infrastructure, including internet access and hardware availability, is a key determinant in Pakistan, where connectivity varies (10). Ethical concerns, such as data security , data privacy and patient consent, along with organizational support and regulatory clarity, further shape adoption (11). These factors align with the study's focus on understanding healthcare professionals' perspectives in Pakistan's resource-constrained healthcare system. Apps related to the Physician Information, Institutional Apps, and Disease Specific Care Apps showed highest percent of usability problems.(12)

The present research develops and validates new scales for two specific variables, perceived usefulness and perceived ease of use, which are hypothesized to be fundamental determinants of user acceptance. (13)Global research highlights both the potential and challenges of AI-driven health applications.(14) Noted that AI enhances diagnostic accuracy and treatment planning through machine learning and intelligent imaging.(15) emphasized that AI-powered mobile apps promote patient-centric care by enabling remote consultations and health tracking, though ethical concerns like data privacy persist. (16) found that explainable AI (XAI) models improve clinicians' trust, but issues like confirmation bias remain. (17) reported that clinicians' acceptance of AI treatment suggestions depends on system transparency and their own experience.(8) identified trust, perceived utility, and data privacy as key drivers of AI adoption.(9) proposed a framework for responsible AI collaboration, emphasizing transparency and ethical use. In Pakistan, a study showed that medical students using mobile apps, including AI-driven tools, reported improved knowledge and skills, though adoption was limited by cost and infrastructure. These studies underscore the global relevance of AI in healthcare but lack specificity to Pakistan's unique challenges, such as limited resources and regulatory frameworks.

A significant research gap exists regarding healthcare professionals' perspectives on the clinical integration of AI-driven health applications in Pakistan. Most studies, focus on high-income countries with advanced technological infrastructure, which differs markedly from Pakistan's context (16) (9) While others noted high awareness of AI applications in Pakistan, routine clinical integration remains underexplored, particularly concerning trust, ethical concerns, and specialty-specific perspectives. Limited research addresses how medical students and AI conference attendees, as future adopters, perceive AI's role in low-resource settings. This study addresses these gaps by examining awareness, perceptions, barriers (infrastructure, training), and facilitators (trust, organizational support) of AI-driven health application integration among Pakistani healthcare personnel. Collaborative writing applications can also

support KT and KM during smaller disease outbreaks, but can also play a wider supportive role in the management of public health emergencies .(18)

The significance of this study lies in its potential to inform strategies for effective AI adoption in Pakistan's healthcare system. By identifying factors influencing healthcare professionals' trust and acceptance, the study will guide the development of user-centered AI tools that align with clinical workflows and ethical principles. The inclusion of medical students and AI conference attendees will provide insights into future-oriented AI solutions, such as AI-enhanced diagnostic tools tailored to Pakistan's needs. The findings will support policymakers and educators in integrating AI training into medical curricula, enhancing digital literacy. This research contributes context-specific evidence to the global AI healthcare literature, addressing an understudied low- and middle-income country context.

The objectives of this study were as fellow;

1. Assess healthcare professionals' awareness and usage of AI-Driven Health applications in clinical practice.
2. Explore their perceptions of the benefits and limitations of integrating AI health apps.
3. Identify barriers and facilitators to clinical adoption.

METHODOLOGY

This study utilized a cross-sectional survey design to collect quantitative data on AI- driven health application usage among healthcare students and professionals in Pakistan. The target population included healthcare professionals (medical professionals, nurses, medical lab technologists (MLT)) at POF Hospital, medical students at WMC, and AI conference attendees interested in AI-drive Health innovations. A purposive sampling technique selected 350 participants familiar with AI-driven Health technologies, ensuring relevance to the study's focus. Inclusion criteria encompassed healthcare workers and students with smartphone familiarity, while exclusion criteria eliminated non-healthcare staff, non-medical students, and those without smartphone access.

Data were collected using a standardized questionnaire adapted from prior AI-driven Health studies (18) and tailored to Pakistan's context (questions on internet access, trust). The questionnaire, aligned with the Technology Acceptance Model (TAM), assessed demographics (age, gender, field), app usage, perceived usefulness, ease of use, and barriers/facilitators.

Data collection combined online (Google Forms) and offline (paper-based questionnaires) modes to accommodate variable internet access in Pakistan. Data analysis was conducted using SPSS. Descriptive statistics (frequencies, percentages, means, standard deviations) summarized demographics, usage patterns, and perceptions. Inferential statistics included chi-square tests to examine usage and barriers across fields.

RESULTS

Table-1

Demographic Details of the participants (n = 350)

Variable	Category	f (%)
Age	21–30	145 (40.6%)
	31–40	202 (58.9%)
	>40	3 (0.6%)
Gender	Female	250 (71.4%)
	Male	100 (28.6%)
Education	Undergraduate	284 (81.1%)
	Graduate	66 (18.9%)
Field of Study	Medicine	200 (57.0%)

Variable	Category	f (%)
	Nursing	109 (31.1%)
	MLT	29 (8.3%)
	Other	13 (3.7%)

Table 1 presents the demographic characteristics of the 350 participants. Most participants were between 31 and 40 years old (58.9%), followed by those aged 21 to 30 (40.6%), with only a small portion over 40 years (0.6%). In terms of gender, most respondents were female (71.4%), while males accounted for 28.6% of the sample. Regarding education level, a large majority held undergraduate degrees (81.1%), while only 18.9% had graduate-level education. As for their field of study, 57% were from medicine, 31.1% from nursing, 8.3% were medical lab technologists (MLTs), and 3.7% represented other fields.

Table-2 2

Extent of AI-Driven Health Usage Among Healthcare Personnel (n = 350)

Field	Users, f (%)	Non-users, f (%)
Medicine	116 (58.3%)	78 (39.0%)
Nursing	69 (63.3%)	37 (33.9%)
Medical Lab Technologist (MLT)	17 (58.6%)	11 (37.9%)
Other (AI conference attendee)	6 (46.2%)	7 (53.8%)

Table 2 outlines the usage of AI-driven health tools among healthcare personnel (n = 350). Across all fields, a greater proportion of individuals reported being users rather than non-users. Among medical professionals, 58.3% reported using AI tools, compared to 39% who did not. Nursing professionals showed slightly higher adoption, with 63.3% being users. MLTs also showed comparable usage patterns (58.6% users), while those in the "other" category primarily AI conference attendees had the lowest user proportion (46.2%) and the highest non-user proportion (53.8%). Overall, this table suggests that AI integration is more prominent among core clinical roles like medicine and nursing than in peripheral or emerging fields.

Table-3

Descriptive Statistics for Perceived Usefulness, Ease of Use, and Technology Familiarity (n=350)

Variable	Category	f (%)	Mean (SD)
Perceived Usefulness			3.64 (1.25)
	Not important	10 (2.9%)	
	Slightly important	82 (23.4%)	
	Neutral	52 (14.9%)	
	Important	87 (24.9%)	
	Very important	119 (34.0%)	
Ease of Use			3.05 (1.01)
	Not comfortable	21 (6.0%)	
	Somewhat comfortable	98 (28.0%)	
	Neutral	81 (23.1%)	

Variable	Category	f (%)	Mean (SD)
	Comfortable	141 (40.5%)	
	Very comfortable	9 (2.6%)	
Technology Familiarity			2.61 (0.74)
	None	18 (5.1%)	
	Basic	137 (39.1%)	
	Intermediate	159 (45.4%)	
	Advanced	36 (10.3%)	

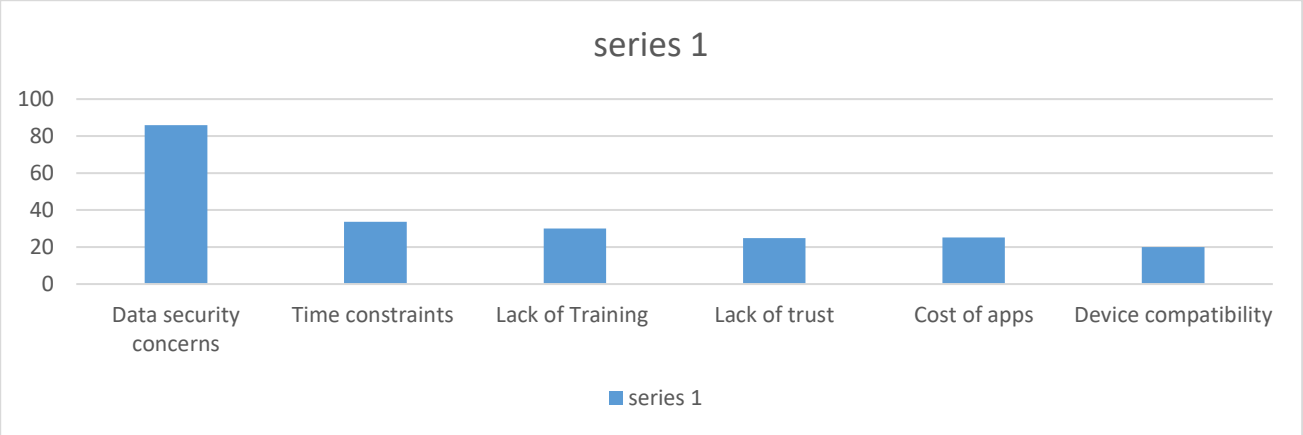
Table 3 presents descriptive statistics and frequency distributions for participants' perceptions of AI in healthcare. The average perceived usefulness of AI was moderately high at 3.64 (SD = 1.25). About one-third of respondents (34%) rated AI as very important, and 24.9% found it important, indicating generally favorable attitudes. Regarding ease of use, the mean score was 3.05 (SD = 1.01), reflecting a neutral to slightly positive perception. Most participants (40.5%) described AI as comfortable to use, while only 6% felt not comfortable. For technology familiarity, the mean score was 2.61 (SD = 0.74), indicating a basic to intermediate level. Nearly half (45.4%) identified their skill level as intermediate, and 39.1% as basic, suggesting a need for more advanced digital training.

Table 4
Barriers and Facilitators Affecting AI-Driven Health Integration (n= 350)

Category	Factor	f (%)
Barriers	Data Security Concerns	301 (86.0%)
	Time Constraints	118 (33.7%)
	Lack of Training	105 (30.0%)
	Lack of Trust	87 (24.9%)
	Cost of Apps	88 (25.1%)
	Device Compatibility	70 (20.0%)
Facilitators	Trust in Apps	211 (60.3%)
	Accessibility	228 (65.1%)
	Reliability	195 (55.7%)

Table 4 lists key barriers and facilitators influencing AI adoption in healthcare. The most reported barrier was concern over data security (86.0%), followed by time constraints (33.7%) and lack of training (30.0%). Other notable obstacles included cost of applications (25.1%), lack of trust (24.9%), and device compatibility issues (20.0%). On the facilitator side, the most frequently cited enabler was accessibility (65.1%), followed by trust in apps (60.3%) and reliability (55.7%). These findings indicate that while practical and technical concerns inhibit AI integration, trust, accessibility, and reliability serve as strong motivators for adoption.

Figure-1
AI-Driven Health Barriers



A Bar Chart showing percentages of AI-Driven Health barriers. The "series 1" graph shows barriers to AI-driven health on a 0-100 scale. Data security concerns score highest at 80, indicating it's the biggest obstacle, followed by time constraints and lack of training at 30 each. Lack of trust and cost of apps both score 20, while device compatibility is the least concern at 10. This suggests data security is the primary barrier, with training, trust, and cost also impacting AI adoption in healthcare, though to a lesser extent.

DISCUSSION

The findings of this study provide valuable insights into the perspectives of Pakistani healthcare professionals regarding the integration of AI-driven health applications into clinical practice. The results align with and expand upon existing literature while offering a context-specific understanding rooted in the challenges and opportunities present in Pakistan's healthcare system.

The demographic profile indicated a predominance of young to middle-aged professionals (21–40 years), with a majority being female and holding undergraduate degrees. The concentration of participants from medical and nursing fields is reflective of the professional distribution in tertiary healthcare facilities. This demographic spread may have influenced the adoption trends of AI applications, as younger professionals often display greater adaptability toward digital health innovations(8).

Usage trends from Table 2 reveal that while most healthcare professionals are adopting AI tools, particularly in core clinical fields like medicine (58.3%) and nursing (63.3%), there remains a significant minority who are not yet engaging with these technologies. This aligns with previous research in Pakistan, which found that although awareness of AI is growing, clinical integration remains relatively low (19). The higher usage rates among nursing staff suggest a recognition of AI's value in streamlining patient care and administrative tasks, consistent with global trends noted by Oyeniyi (2024), who highlighted AI's effectiveness in remote monitoring and health tracking.

Perceptions related to usefulness, ease of use, and technology familiarity (Table 3) further support the Technology Acceptance Model (TAM) framework, which posits that perceived usefulness and ease of use are primary drivers of technology adoption(13) . With a mean score of 3.64, perceived usefulness was rated positively, resonating with findings by (20) and(9), who emphasized AI's potential in diagnostic accuracy and decision support. Ease of use scored lower (3.05), indicating a neutral to slightly positive sentiment. This is consistent with (16, 21), who reported that usability concerns often hamper clinician engagement, especially when tools lack intuitive interfaces or adequate support systems.

Technology familiarity was reported at a basic to intermediate level, reflecting a digital literacy gap among healthcare professionals in Pakistan. Only 10.3% of respondents classified their skills as advanced, suggesting the urgent need for targeted training programs. Some researches similarly reported that while medical students using AI-based apps

showed improved learning outcomes, lack of advanced skills and infrastructure impeded consistent use.

Barriers to AI adoption identified in Table 4 mirror those found in other low- and middle-income countries (LMICs). Data security concerns were overwhelmingly reported (86.0%) as the top barrier, highlighting ethical and regulatory anxieties. This concern is echoed in the work of (11), who emphasized the role of ethical frameworks and data governance in building trust. Time constraints (33.7%) and lack of training (30.0%) were also prominent barriers, reinforcing findings from (8), who cited these factors as significant deterrents to AI adoption globally. Other barriers such as cost, trust, and device compatibility further underscore infrastructural and socio-economic limitations, as also noted by (3, 22).

Despite these challenges, facilitators such as accessibility (65.1%), trust in apps (60.3%), and reliability (55.7%) emerged as key drivers of AI integration. These findings align with the proposed framework for responsible AI collaboration by (9) who emphasized transparency and reliability as central to fostering trust in AI systems. The high rating of accessibility as a facilitator also reflects the growing penetration of smartphones and internet connectivity in urban Pakistan, enabling greater exposure to digital tools.

Comparatively, studies conducted in high-income countries(16); (17) demonstrate more advanced levels of integration and a stronger focus on ethical AI, transparency, and system interoperability. However, these contexts differ significantly from Pakistan, where limited resources, training, and infrastructure pose unique challenges. By incorporating perspectives from medical students and AI conference attendees, this study also broadens the scope to include future adopters of AI, which has been largely overlooked in previous research (23).

CONCLUSION

This study explored the perspectives of Pakistani healthcare professionals on the integration of AI-driven health applications. Findings show moderate adoption rates, with generally positive perceptions of AI's usefulness but neutral comfort levels regarding ease of use. Major barriers included data security concerns, lack of training, and time constraints, while facilitators such as trust, accessibility, and reliability supported adoption. To advance AI integration, efforts should focus on improving digital literacy, strengthening data privacy frameworks, and embedding AI education in medical curricula. With targeted support and infrastructure, AI can significantly enhance healthcare delivery in Pakistan. Future studies should further explore real-world implementation and specialty-specific challenges.

LIMITATIONS AND RECOMMENDATIONS OF THE STUDY

This study has several limitations that must be acknowledged. Firstly, the sample was limited to select institutions and cities, which may not accurately represent the broader population of healthcare professionals in Pakistan. This geographical and institutional limitation restricts the generalizability of the findings. Secondly, the data were self-reported, which can introduce response bias, particularly in areas such as technology usage and familiarity where participants might overestimate their competencies or engagement. Moreover, the cross-sectional design of the study captures only a single point in time and does not account for changes in attitudes or usage patterns over time. Another limitation is the selection of participants based on their prior exposure or interest in AI, which might have excluded those unfamiliar with the technology but who are essential stakeholders in AI adoption within the healthcare system.

Based on these limitations, several recommendations can be made for future research and practice. Broader studies involving diverse regions and healthcare settings across Pakistan would enhance the representativeness and applicability of the findings. Longitudinal studies are also needed to observe how perceptions and adoption behaviors evolve as AI technologies and healthcare infrastructure develop. There is a clear need for structured, hands-on training programs to enhance professionals' technological skills and confidence in using AI tools. Additionally, institutions and policymakers should work collaboratively to improve infrastructure, implement robust data security frameworks, and establish clear guidelines for AI integration. Finally, incorporating AI literacy into medical and allied health curricula would better

equip future professionals to work with emerging digital health technologies, ensuring a more prepared and accepting workforce.

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