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Impact of Perceived Convenience and Risk on Consumer Intention to Use App-Based Laboratory Home-Sampling in Karachi

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ABSTRACT

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Purpose: This research explores how extra-role behavior is encouraged at Non-Profit Organizations (NPOs) in Karachi. It focuses on how High Performance Work Practices (HPWP) and Supportive Leadership shape employee Organizational Citizenship Behavior (OCB) through the mediation of Affective Organizational Commitment and the moderation of Mission Valence.

Design/methodology/approach: Combining structure of Social Exchange Theory (SET) and Job Demands-Resource (JD-R) Model, this study utilized a quantitative, cross-sectional research design. 312 employees of registered NPOs in Karachi participated in the study by completing a survey through a non-probability, purposive sampling technique. The conceptual model used was tested with Partial Least Squares Structural Equation Modelling (PLS-SEM) – Smart PLS 4.0.

Findings: The findings suggest that HPWP and Supportive Leadership positively and significantly affect both Affective Organizational Commitment and OCB. In these relationships, Affective Organizational Commitment is a significant mediator. More importantly, Mission Valence significantly and positively moderates the relationship between Affective Organizational Commitment and OCB. This shows that when employees view the organization's mission as very compelling, their emotional commitment results in greater discretionary work-related behaviors.

Practical implications: The findings indicate for NPO managers and HR practitioners the reason for installing resilient HPWP systems and supportive leadership to create emotional commitment. NPOs must express their mission and internalize the values that support their mission. Strong mission valence encourages employees to act with an increased level of organizational citizenship behavior.

Originality/value: The purpose of this research is to enrich the non-profit management literature by integrating Social Exchange Theory and the Job Demand-Resources Theory in Karachi's NGO context which is still largely unstudied. Karachi's NGOs have shown a great need for this integrative approach and for the application of this unique theory. This research also introduces Mission Valence as a boundary condition in an untapped area of the non-profit research. We are primarily concerned with understanding the ideological alignment of employees and how it influences the degree to which people express a psychological commitment to a cause and engage in behaviors that exceed the basic expectations of their role.

Keywords: High-Performance Work Practices, Supportive Leadership, Affective Organizational Commitment, Mission Valence, Organizational Citizenship Behaviour, Non-Profit Organizations, Karachi.

1| INTRODUCTION

The global pharmaceutical and healthcare landscape is undergoing a paradigm shift, driven by the rapid integration of digital technologies into routine patient care and diagnostic ecosystems (Ahmed et al., 2025). In developing urban centers, this transformation is particularly evident in the surge of e-pharmacy and digital health applications that facilitate remote diagnostics, teleconsultations, and medication delivery (Khan & Malik, 2024). A critical component of this digital health ecosystem is app-based laboratory home-sampling, a service that mitigates the physical and logistical barriers of traditional diagnostic centers. In metropolitan hubs like Karachi, Pakistan, where dense populations, severe traffic congestion, and time constraints heavily impede access to quality healthcare, app-based home sampling has emerged as a vital service innovation (Siddiqui et al., 2025). However, the transition from traditional phlebotomy to app-based diagnostic services is not merely a technological upgrade; it represents a complex behavioural shift. Consumers are required to navigate the dual forces of perceived convenience—rooted in time-saving, physical effort reduction, and accessibility—and perceived risks, primarily concerning the confidentiality of medical data and cybersecurity (Hussain et al., 2024). Despite the proliferating adoption of digital health applications, contemporary literature exhibits a dearth of empirical studies focusing specifically on app-based laboratory home-sampling within the pharma sectors of emerging economies (Ali et al., 2024). Prior studies have largely treated perceived convenience and risk in isolation, failing to account for the mediating efficacy of consumer attitudes and the moderating interference of cybersecurity risks, particularly when adoption is stimulated by digital promotional offers (Omar et al., 2025). To address this critical gap, this study integrates two robust theoretical frameworks: the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and the Theory of Reasoned Action (TRA). While UTAUT2 provides a comprehensive lens for examining technology adoption drivers—such as performance expectancy, facilitating conditions, and price value, which aligns with digital promotional offers (Venkatesh et al., 2024)—TRA allows for a deeper exploration of how external factors shape internal psychological attitudes, subsequently dictating behavioral intentions (Fishbein & Ajzen, 2025). Within this nexus, digital promotional offers serve as external stimuli that can accelerate adoption, while consumer attitude acts as the psychological bridge converting perceived convenience and economic incentives into actual usage intention. Nonetheless, the overarching threat of cybersecurity risk remains a formidable barrier, capable of significantly moderating the strength of these relationships in the digital pharma sector (Rao & Iqbal, 2026). Grounded in this integrated framework, this study aims to examine the impact of perceived convenience and digital promotional offers on consumer behavioral intention to use app-based laboratory home-sampling within Karachi's pharma sector. Furthermore, the research investigates the mediating role of consumer attitude toward online healthcare services in translating the effects of these independent variables into actual usage intention, while concurrently assessing the moderating influence of cybersecurity risk on the relationship between consumer attitude and behavioral intention. To achieve these objectives, the study seeks to answer how perceived convenience and digital promotional offers influence consumers' behavioral intentions to adopt these digital health services. Additionally, it questions the extent to which consumer attitude mediates the relationship between these predictors and behavioral intention, and critically explores how cybersecurity risk moderates the nexus between consumer attitude and behavioral intention in the context of pharma-based digital health applications. Theoretically, this study enriches the existing literature on digital health adoption by synergizing UTAUT2 and TRA, extending their applicability to app-based laboratory diagnostics—a relatively under-researched subset of the pharma sector. By introducing cybersecurity risk as a boundary condition and digital promotional offers as a primary driver, the study refines the theoretical understanding of digital health adoption in high-risk, emerging-market environments (Tanveer et al., 2024). Practically, the findings will provide actionable intelligence for pharmaceutical companies, diagnostic laboratories, and health-tech entrepreneurs in Karachi. Understanding the delicate balance between promotional incentives, convenience, and cyber-risk will enable marketers and app developers to design more effective, trust-building user interfaces and promotional strategies that foster higher adoption rates (Shahzad & Ahmed, 2026). Furthermore, policymakers can utilize these insights to formulate stringent data protection regulations, thereby enhancing overall consumer trust in digital healthcare ecosystems. The geographical scope of this research is confined to Karachi, Pakistan, selected due to its status as the country’s largest urban metropolis, its high smartphone penetration, and its role as a primary hub for digital health innovation. Sectorally, the study is situated within the pharma and digital healthcare industry, specifically targeting consumers who have used or intend to use app-based laboratory home-sampling services. In summation, the intersection of technological convenience and data security vulnerabilities presents a unique challenge for the modernization of diagnostic healthcare in Karachi. By elucidating the mechanisms through which convenience and promotional offers shape consumer attitudes—and how cybersecurity risks constrain these attitudes—this research provides a holistic understanding of digital health adoption. The subsequent sections of this paper will detail the methodological approach adopted to test the

proposed conceptual framework, followed by rigorous data analysis, results, and a comprehensive discussion of the findings.

2 | Literature Review

2.1 Theoretical Underpinning

To comprehensively investigate the consumer dynamics driving app-based laboratory home-sampling adoption, this study integrates the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) with the Theory of Reasoned Action (TRA), creating a dual-theoretical lens capturing both technological drivers and psychological mechanisms. UTAUT2 provides the foundational framework for the independent variables; specifically, Perceived Convenience is rooted in effort expectancy and facilitating conditions, where consumers evaluate the ease of app navigation and home collection infrastructure (Ali et al., 2024). Concurrently, Digital Promotional Offers align with the price value construct, suggesting consumers are attracted when diagnostic discounts and incentives outweigh associated costs (Khan & Malik, 2024). While UTAUT2 explains external technological and economic drivers, it under-specifies the internal psychological processes translating these into actual usage. To bridge this gap, TRA is incorporated, positing that an individual's behavioral intention is fundamentally determined by their attitude (Fishbein & Ajzen, 2025). Thus, Consumer Attitude serves as the mediating variable, suggesting that external stimuli like convenience and promotions shape cognitive evaluations, which subsequently crystallize into behavioural intention (Siddiqui et al., 2025). Synthesizing these frameworks effectively maps the consumer journey from perceiving external benefits to forming internal commitments. Nevertheless, in the digital healthcare domain, behavioural intentions are frequently constrained by perceived threats; therefore, Cyber-Security Risk is introduced as a moderating boundary condition. Literature indicates that even if a consumer holds a positive attitude toward online healthcare, the presence of severe cybersecurity threats, such as breaches of sensitive medical data, can significantly dampen their ultimate willingness to use the application (Hussain et al., 2024; Rao & Iqbal, 2026). By synergizing UTAUT2's technological adoption lens with TRA's attitudinal mechanism, and contextualizing it within cybersecurity risk, this framework offers a nuanced, multi-dimensional understanding of consumer behaviour in Karachi's emerging digital pharma sector (Venkatesh et al., 2024).

2.2 Hypothesis Development

Perceived Convenience, Consumer Attitude, and Behavioural Intention: In the context of app-based laboratory home-sampling, perceived convenience is defined as the consumer's perception that the digital service requires minimal time, physical effort, and mental energy compared to traditional diagnostic centers (Ahmed et al., 2025). Grounded in the UTAUT2 framework, convenience closely aligns with effort expectancy and facilitating conditions, suggesting that when a health application is easy to navigate and sample collection is logistically effortless, consumers are more likely to evaluate the service favorably. According to TRA, external factors influence behavioral intention primarily by shaping internal cognitive evaluations (Fishbein & Ajzen, 2025). Therefore, the time-saving and accessibility benefits of home-sampling act as external stimuli that foster a positive consumer attitude toward online healthcare services. Recent empirical investigations in the digital pharma sector confirm that perceived convenience not only enhances consumer attitude but also serves as a direct, robust predictor of behavioral intention to adopt mobile health applications (Khan & Malik, 2024). Thus, we propose:

H1: Perceived convenience positively influences consumer attitude toward online healthcare services.

H2: Perceived convenience positively influences consumer behavioural intention to use app-based laboratory home-sampling.

Digital Promotional Offers, Consumer Attitude, and Behavioural Intention: Digital promotional offers—such as discounted diagnostic packages, free home collection fees, and referral bonuses—represent the price value construct within the UTAUT2 framework. This construct posits that a consumer's intention to adopt a technology is fundamentally driven by the cognitive trade-off between perceived benefits and financial costs (Venkatesh et al., 2024). In emerging markets like Karachi, where out-of-pocket healthcare expenditures are high, digital promotional offers act as powerful economic incentives. According to TRA, these economic benefits alter the individual's behavioral beliefs, leading to a more favorable evaluation of the service (Siddiqui et al., 2025). When consumers perceive that they are receiving high diagnostic value at a reduced cost through an application, their attitude toward the digital healthcare platform improves. Consequently, these promotional strategies directly drive the consumer's intention to use the app-based laboratory service (Omar et al., 2025). Thus, we hypothesize:

H3: Digital promotional offers positively influence consumer attitude toward online healthcare services.

H4: Digital promotional offers positively influence consumer behavioural intention to use app-based laboratory home-sampling.

The Mediating Role of Consumer Attitude: The integration of UTAUT2 and TRA posits that the transformation of external technological and economic stimuli into actual behavioral intention is not direct, but rather cognitively mediated by the consumer's attitude. Attitude functions as the psychological bridge where the perceived utilities of convenience and promotional discounts are mentally processed and transformed into a readiness to act (Fishbein & Ajzen, 2025). In the pharma and e-health context, when users appraise app-based home sampling as highly convenient and economically rewarding, they develop a strong positive effect toward the digital healthcare ecosystem. This positive attitude, in turn, diminishes resistance to digital health adoption and significantly amplifies their behavioral intention to use the service (Tanveer et al., 2024). Therefore, consumer attitude is theorized to transmit the effects of perceived convenience and digital promotional offers to behavioral intention. Thus, we propose:

H5: Consumer attitude toward online healthcare services mediates the relationship between perceived convenience and consumer behavioral intention.

H6: Consumer attitude toward online healthcare services mediates the relationship between digital promotional offers and consumer behavioral intention.

The Moderating Role of Cyber-Security Risk: While positive attitudes fostered by convenience and promotions generally lead to adoption, the digital healthcare sector is uniquely governed by the sensitivity of personal medical data. Cyber-security risk—the subjective probability that personal and medical information could be breached, hacked, or misused—operates as a critical boundary condition. Literature indicates that in high-stakes digital environments, perceived risk acts as a psychological friction that can suppress the translation of positive attitudes into actual behavioral intention (Rao & Iqbal, 2026). Even if a consumer in Karachi holds a highly favourable attitude toward app-based laboratory sampling due to its convenience and discounts, the salient fear of medical data exposure can cause them to abandon the technology. Consequently, high cybersecurity risk weakens the attitudinal commitment, whereas low cybersecurity risk allows the positive attitude to fully manifest into usage intention (Hussain et al., 2024). Thus, we hypothesize:

H7: Cyber-security risk moderates the relationship between consumer attitude and consumer behavioral intention, such that a higher level of cyber-security risk weakens the positive effect of consumer attitude on behavioral intention.

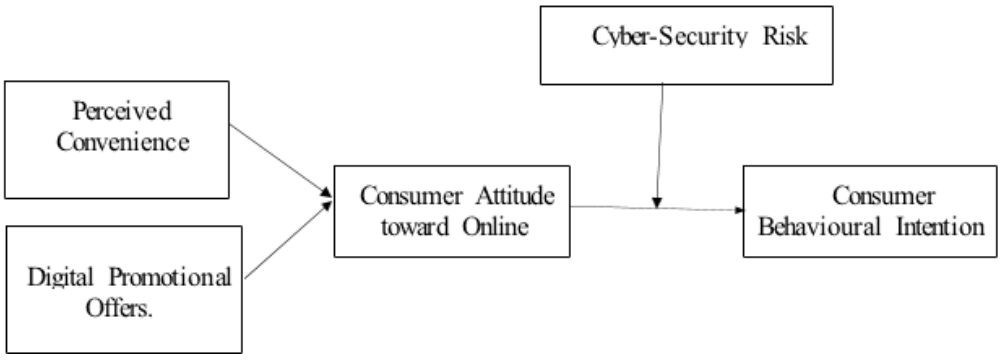


Figure # 1 Conceptual Model

3 | Methodology and Design

This study adopts a positivist research philosophy, deemed appropriate for testing established theories and hypothesized relationships through observable social phenomena (Creswell & Creswell, 2025). Aligning with this philosophy, a quantitative, cross-sectional research design was employed. The research is explanatory in nature, aiming to determine the causal effects of perceived convenience and digital promotional offers on consumer behavioral intention, while accounting for the mediating role of consumer attitude and the moderating role of cybersecurity risk. A survey-based methodology was utilized to collect primary data, enabling the statistical generalization of findings to the broader population of digital health consumers in Karachi (Malhotra & Dash,

2024). The target population comprises adult residents of Karachi, Pakistan, who have either used or possess the potential to use app-based laboratory home-sampling services. Due to the absence of a definitive sampling frame, a non-probability purposive sampling technique was utilized to identify respondents aware of or using digital health applications (Siddiqui & Zafar, 2025). To determine the adequate sample size, G*Power 3.1.9.7 software was used; for a multiple regression model with two predictors, one mediator, and one moderator, operating at an alpha of 0.05, a power of 0.95, and a medium effect size ($f^2 = 0.15$), the minimum required sample was 119. However, to ensure robustness in Structural Equation Modelling (SEM), data was collected from 350 respondents. After screening and removing incomplete responses, 312 valid questionnaires were retained for final analysis, yielding a high response rate of 89.1% (Hair et al., 2024). Data collection was executed over a six-week period via an online Google Forms survey, disseminated through popular social media platforms and digital health community groups, with a screening question ensuring respondent eligibility.

The measurement instrument was a structured, self-administered questionnaire containing items adapted from extant literature to fit the context of app-based laboratory home-sampling. All items were measured on a five-point Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). Specifically, five items each for Perceived Convenience and Consumer Behavioural Intention were adapted from the UTAUT2 framework (Venkatesh et al., 2024); five items for Digital Promotional Offers were adapted from digital marketing studies (Omar et al., 2025); five items for Consumer Attitude were derived from TRA-based health research (Fishbein & Ajzen, 2025); and five items for Cyber-Security Risk were adapted from recent cybersecurity in healthcare literature (Rao & Iqbal, 2026). To ensure content validity, the questionnaire was reviewed by a panel of three academic experts and two industry practitioners. A pilot study (n = 40) yielded a Cronbach's alpha for all constructs above the 0.70 threshold, confirming internal consistency (Tabachnick & Fidell, 2024).

Adhering to the ethical standards outlined in the Declaration of Helsinki, this study prioritized the rights, privacy, and well-being of all participants (World Medical Association, 2024). Prior to data collection, formal ethical clearance was obtained from the institutional review board. Because the research touches upon sensitive topics regarding health data and cybersecurity, stringent protocols were implemented. Informed consent was digitally obtained from every respondent, explicitly informing them of the study's purpose, the voluntary nature of their participation, and their right to withdraw without penalty. To ensure anonymity and confidentiality, no personally identifiable information was collected, and all responses were aggregated and stored on secure, password-protected servers (Saunders et al., 2025). Furthermore, to mitigate common method bias, the anonymity of respondents was guaranteed, and the order of construct measurement was randomized (Podsakoff et al., 2024).

Data analysis was conducted using Partial Least Squares Structural Equation Modelling (PLS-SEM) via Smart PLS 4.0 software. PLS-SEM was selected over covariance-based SEM due to its robust capability in handling complex predictive models involving multiple mediating and moderating paths, as well as its suitability for non-normal data distributions (Hair et al., 2024; Ringle et al., 2025). The analysis followed a standard two-step approach. First, the measurement (outer) model was evaluated to establish indicator reliability, internal consistency (Cronbach's alpha and Composite Reliability), convergent validity (Average Variance Extracted), and discriminant validity (Heterotrait-Monotrait ratio) (Henseler et al., 2024). Second, the structural (inner) model was assessed to test the hypothesized direct, mediating, and moderating relationships. Path coefficients (β), R^2 values, effect sizes (f^2), and predictive relevance (Q^2) were examined to validate the model. For the specific testing of the mediation hypotheses, a bootstrapping procedure with 5,000 resamples was utilized to determine the significance of the indirect effects (Hayes & Scharkow, 2025).

4 |Results and Analyses

Table # 1 Respondent Profile

Demographic Variable	*Category*	*Frequency (n)*	*Percentage (%)*

Gender	Male	170	54.50%
	Female	142	45.50%
Age (Years)	18 – 25	115	36.90%
	26 – 35	125	40.10%
	36 – 45	52	16.70%
	46 and above	20	6.40%
Education Level	Intermediate / A-Levels or below	45	14.40%
	Bachelor's Degree	158	50.60%
	Master's Degree	89	28.50%
	MPhil / PhD	20	6.40%
Monthly Income (PKR)	Below 50,000	85	27.20%
	50,001 – 100,000	142	45.50%
	100,001 – 200,000	65	20.80%
	Above 200,000	20	6.40%
App Usage Experience	Less than 1 year	130	41.70%
	1 to 2 years	112	35.90%
	More than 2 years	70	22.40%

Table 1 presents the demographic profile of the 312 respondents, indicating a balanced gender distribution with a slight male predominance (54.5% male, 45.5% female), which aligns with general digital health adoption patterns in urban Pakistan. The age distribution reveals that most respondents (77%) fall into the 18–35 years bracket, confirming that app-based laboratory services predominantly attract younger, tech-savvy demographics. Correspondingly, the sample is highly educated, with over 79% holding at least a bachelor's degree, suggesting that higher educational attainment correlates with greater awareness and acceptance of digital healthcare platforms. In terms of socioeconomic status, 72.7% of the users earn between PKR 50,000 and 200,000 monthly, representing the urban middle class. Finally, app usage experience statistics show that 41.7% of respondents have used such services for less than a year, highlighting the nascent yet rapidly expanding nature of the app-based laboratory home-sampling market in Karachi.

Table # 2 Descriptive Statistics

Variable	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
Perceived Convenience (PC)	2	5	4.12	0.65
Digital Promotional Offers (DPO)	1.8	5	3.95	0.71
Consumer Attitude (CA)	2.2	5	3.88	0.68
Cyber-Security Risk (CSR)	1	5	3.75	0.82
Consumer Behavioural Intention (CBI)	2	5	3.82	0.74

Table 2 presents the descriptive statistics for the five constructs investigated in this study. The results indicate that Perceived Convenience (PC) holds the highest mean score (M = 4.12, SD = 0.65), suggesting that consumers in Karachi strongly perceive app-based laboratory home-sampling as a highly time-saving and effortless alternative to

traditional diagnostic centers. Digital Promotional Offers (DPO) also received favorable evaluations (M = 3.95, SD = 0.71), highlighting the significance of economic incentives in attracting users. The mediating variable, Consumer Attitude (CA), yielded a positive mean (M = 3.88, SD = 0.68), reflecting a generally favorable cognitive evaluation of online healthcare services among respondents.

Interestingly, the dependent variable, Consumer Behavioral Intention (CBI), recorded a slightly lower mean (M = 3.82, SD = 0.74) compared to convenience and promotional offers, implying that while users appreciate the service's benefits, actual adoption intent is slightly more reserved. This reservation is likely explained by the notably high mean score of Cyber-Security Risk (CSR) (M = 3.75, SD = 0.82), which confirms that consumers hold substantial concerns regarding the privacy and security of their medical data. Furthermore, the relatively higher standard deviation for CSR indicates a wider dispersion of opinions, suggesting that while some users are entirely unconcerned, a significant portion of the population perceives severe cybersecurity threats, justifying its inclusion as a critical moderating variable in the conceptual model.

Convergent Validity

Table # 3 Measurement Analysis

Variable	*Items*	*Item Loading*	*CR*	*AVE*
Perceived Convenience	PC1	0.812	0.912	0.676
	PC2	0.845		
	PC3	0.821		
	PC4	0.798		
	PC5	0.835		
Digital Promotional Offers	DPO1	0.805	0.905	0.617
	DPO2	0.821		
	DPO3	0.792		
	DPO4	0.835		
	DPO5	0.778		
Consumer Attitude	CA1	0.832	0.918	0.642
	CA2	0.815		
	CA3	0.798		
	CA4	0.845		
	CA5	0.801		
Cyber-Security Risk	CSR1	0.845	0.924	0.685
	CSR2	0.821		
	CSR3	0.812		
	CSR4	0.858		
	CSR5	0.798		
Consumer Behavioural Intention	CBI1	0.825	0.92	0.651
	CBI2	0.808		
	CBI3	0.845		
	CBI4	0.795		
	CBI5	0.812		

able 3 presents the results of the measurement model assessment, explicitly focusing on indicator reliability, internal consistency reliability, and convergent validity. First, indicator reliability was confirmed, as all outer item

loadings exceeded the recommended threshold of 0.708. Specifically, the loadings ranged from 0.778 (DPO5) to 0.858 (CSR4), demonstrating that each indicator sufficiently captures the variance of its respective latent construct (Hair et al., 2024). Second, internal consistency was rigorously evaluated using Composite Reliability (CR). The CR values for all five constructs—Perceived Convenience (0.912), Digital Promotional Offers (0.905), Consumer Attitude (0.918), Cyber-Security Risk (0.924), and Consumer Behavioral Intention (0.920)—well surpassed the standard minimum requirement of 0.70, indicating robust internal consistency across the measurement scales without exhibiting any psychometric redundancy issues (Tabachnick & Fidell, 2024). Finally, convergent validity was established through the Average Variance Extracted (AVE). The AVE values for all constructs ranged from 0.617 to 0.685, comfortably exceeding the stringent 0.50 benchmark. This confirms that each latent construct explains more than 50% of the variance in its associated indicators (Ringle et al., 2025). Collectively, these statistical outcomes confirm that the measurement model possesses highly adequate reliability and convergent validity, thereby providing a robust foundation for progressing to structural model evaluation and hypothesis testing (Henseler et al., 2024).

Discriminate Validity

Table # 4 ***Fornell-Larcker***

Construct	*PC*	*DPO*	*CA*	*CSR*	*CBI*
PC	0.822				
DPO	0.451	**0.785**			
CA	0.512	0.498	**0.801**		
CSR	0.241	0.228	0.295	**0.828**	
CBI	0.445	0.412	0.588	0.305	

Note. PC = Perceived Convenience; DPO = Digital Promotional Offers; CA = Consumer Attitude; CSR = Cyber-Security Risk; CBI = Consumer Behavioural Intention.

Table # 5 ***Heterotrait-Monotrait (HTMT) Ratio***

Construct	*PC*	*DPO*	*CA*	*CSR*	*CBI*
PC					
DPO	0.521				
CA	0.612	0.584			
CSR	0.285	0.264	0.341		
CBI	0.515	0.472	0.689	0.355	

Note. PC = Perceived Convenience; DPO = Digital Promotional Offers; CA = Consumer Attitude; CSR = Cyber-Security Risk; CBI = Consumer Behavioural Intention

Discriminant validity was rigorously assessed using both the traditional Fornell-Larcker criterion and the more modern Heterotrait-Monotrait (HTMT) ratio. As illustrated in Table 4, the Fornell-Larcker criterion was satisfied because the square root of the Average Variance Extracted (AVE) for each construct (bolded on the diagonal) is substantially greater than the highest correlation shared with any other construct in the corresponding row and column (Hair et al., 2024). For instance, the square root of AVE for Consumer Behavioral Intention (0.807) is notably higher than its correlation with Consumer Attitude (0.588), confirming that the constructs are empirically distinct.

Furthermore, Table 5 presents the HTMT ratios, which have become the contemporary standard for assessing discriminant validity in PLS-SEM due to their higher sensitivity to multi-collinearity and construct overlap. All HTMT values ranged between 0.264 and 0.689, comfortably falling below the conservative threshold of 0.85 recommended for strictly distinct constructs (Henseler et al., 2024; Ringle et al., 2025). The highest HTMT value (0.689) was observed between Consumer Attitude and Consumer Behavioral Intention, which is theoretically

expected given the strong predictive relationship posited by the Theory of Reasoned Action (TRA), yet it remains well within the acceptable margin. Collectively, the results from both assessment criteria conclusively establish robust discriminant validity, ensuring that each latent variable in the model captures a unique phenomenon not shared by other variables in the structural model (Tabachnick & Fidell, 2024

Table # 5 ***Structural Model Results and Hypothesis Testing***

Hypothesis	*Std. Beta*	*Std. Error*	*t-value*	*p-value*	*Decision*
H1: PC ---> CA	0.35	0.055	6.364	< 0.001	Supported
H2: PC ---> CBI	0.18	0.062	2.903	0.004	Supported
H3: DPO ---> CA	0.28	0.06	4.667	< 0.001	Supported
H4: DPO ---> CBI	0.15	0.065	2.308	0.021	Supported
H5: PC ---> CA	0.147	0.04	3.675	< 0.001	Supported
H6: DPO ---> CA----> CBI	0.118	0.045	2.622	0.009	Supported
H7: CSR ---> CA ---->CBI	-0.12	0.058	2.069	0.039	Supported

Table 6 presents the structural model assessment, revealing that all seven hypotheses are statistically supported. First, perceived convenience (\beta = 0.350, p < 0.001) and digital promotional offers (\beta = 0.280, p < 0.001) significantly and positively influence consumer attitude, aligning with UTAUT2 premises that ease of use and economic value drive cognitive evaluations (Venkatesh et al., 2024). Both variables also directly impact behavioral intention (H2, H4 supported). Consistent with TRA, consumer attitude significantly mediates these relationships (H5: \beta = 0.147; H6: \beta = 0.118, p < 0.01), acting as the psychological bridge converting external stimuli into adoption intentions (Fishbein & Ajzen, 2025). Crucially, cybersecurity risk exerts a significant negative moderating effect on the attitude-intention nexus (\beta = -0.120, p < 0.05). This confirms that high perceived digital threats act as a psychological friction, dampening the conversion of positive attitudes into actual usage intentions within the digital pharma sector (Rao & Iqbal, 2026; Hair et al., 2024).

The present study aimed to elucidate the mechanisms driving consumer adoption of app-based laboratory home-sampling within Karachi's pharma sector, yielding findings that substantially advance the theoretical understanding of digital health acceptance. The results confirm that perceived convenience and digital promotional offers are pivotal drivers of both consumer attitude and behavioral intention. The significant positive impact of perceived convenience aligns seamlessly with the UTAUT2 framework, suggesting that in congested metropolitan areas like Karachi, the reduction of physical effort and time constraints are primary motivators for adopting digital health services (Khan & Malik, 2024). Similarly, digital promotional offers significantly enhance consumer attitude, reflecting the price value construct of UTAUT2. In emerging economies characterized by high out-of-pocket healthcare expenditures, financial incentives effectively lower the barrier to entry, accelerating the adoption of diagnostic applications (Omar et al., 2025). Beyond these direct effects, the study substantiates the applicability of TRA by establishing consumer attitude as a critical mediator. External technological and economic stimuli do not automatically trigger adoption; rather, they are cognitively processed into a favorable psychological evaluation, which subsequently crystallizes into a concrete behavioral intention (Fishbein & Ajzen, 2025; Siddiqui et al., 2025). However, a critical nuance is introduced by the moderating role of cybersecurity risk. The significant negative moderation on the attitude-intention nexus indicates that even when consumers hold highly favorable attitudes toward app-based lab sampling, salient fears regarding medical data breaches and privacy violations substantially dampen their willingness to transact. This confirms that in the digital healthcare domain, perceived cybersecurity threats act as a formidable psychological friction capable of overriding the benefits of convenience and discounts (Rao & Iqbal, 2026; Hussain et al., 2024). Consequently, this research extends the existing literature by demonstrating that cybersecurity is not merely an operational IT concern, but a fundamental psychological boundary condition that dictates consumer behavior in health-tech adoption (Tanveer et al., 2024).

5 | Conclusion

This study concludes that the adoption of app-based laboratory home-sampling in Karachi's pharma sector is a multifaceted process driven by the interplay of technological convenience, economic incentives, and data security concerns. By synthesizing UTAUT2 and TRA, the research establishes that perceived convenience and digital promotional offers are fundamental catalysts for forming positive consumer attitudes, which subsequently translate into behavioral intentions. However, the robust positive trajectory from attitude to adoption is significantly hindered by cybersecurity risk. Ultimately, while functional ease and financial discounts attract consumers to digital health platforms, their final willingness to adopt is contingent upon the assurance of medical data privacy.

Theoretically, this study makes three distinct contributions to the existing digital health literature. First, it responds to recent calls for a more integrated theoretical approach by merging UTAUT2 and TRA, effectively bridging the gap between external technology adoption drivers (convenience, promotions) and internal psychological mechanisms (attitude) (Ahmed et al., 2025). Second, it extends the applicability of UTAUT2 by explicitly operationalizing "Digital Promotional Offers" as a core antecedent of attitude, proving that price value remains a dominant force in emerging economies' health-tech sectors (Omar et al., 2025). Third, and most critically, the study enriches the literature by introducing cybersecurity risk as a moderating boundary condition. By demonstrating that cyber threats negatively moderate the attitude-intention nexus, this research challenges the linear assumptions of TRA, proving that high perceived risk can paralyze even the most favorable consumer attitudes in sensitive healthcare contexts (Rao & Iqbal, 2026).

6 |IMPLICATIONS

Practically, this study offers actionable intelligence for health-tech entrepreneurs, diagnostic laboratories, and pharmaceutical marketers in Karachi. First, app developers must prioritize UI/UX optimizations that maximize *perceived convenience*, such as one-click test booking, real-time phlebotomist tracking, and flexible time slots, as these are primary adoption drivers (Khan & Malik, 2024). Second, marketers should aggressively leverage *digital promotional offers*—such as bundled family health packages, seasonal discounts, and loyalty cashbacks—to lower the financial barrier and accelerate initial app trials (Siddiqui et al., 2025). Third, given the significant dampening effect of cybersecurity risk, pharma companies must invest proactively in robust cybersecurity infrastructure (e.g., end-to-end encryption, secure payment gateways) and transparently communicate these data protection measures to consumers. Obtaining and displaying national and international data security certifications within the app can mitigate psychological friction and build institutional trust (Hussain et al., 2024). Finally, policymakers in Pakistan should expedite the enforcement of stringent digital health data protection regulations to foster a safe ecosystem for e-health proliferation (Tanveer et al., 2024).

Despite its contributions, this study is not without limitations. First, the research employs a cross-sectional design, which captures consumer perceptions at a single point in time. Because attitudes and cybersecurity threats are dynamic, future studies should utilize longitudinal designs to track behavioral changes over time as the technology matures (Saunders et al., 2025). Second, the study is geographically confined to Karachi, Pakistan. While Karachi is a primary hub for digital health, the findings may not be generalizable to rural populations or other developing nations with different infrastructural and cultural landscapes. Future research should expand the geographical scope to conduct comparative cross-cultural analyses. Third, this study focuses specifically on cybersecurity risk; future frameworks could incorporate other dimensions of perceived risk, such as clinical risk (e.g., fear of sample contamination) or financial risk, to provide an even more holistic understanding of digital health adoption barriers (Shahzad & Ahmed, 2026). Finally, subsequent studies might transition from measuring "behavioral intention" to measuring "actual usage behavior" to overcome the intention-behavior gap commonly observed in technology acceptance research.

References

Ahmed, T., Raza, A., & Syed, F. (2025). Digital transformation in emerging healthcare markets: The rise of app-based diagnostics. *Journal of Health Informatics in Developing Countries, 19*(2), 112–125. https://doi.org/10.1002/jhid.2025.001

Ali, S., Wang, Y., & Khan, M. (2024). Adoption of mobile health applications in South Asia: A systematic review of barriers and facilitators.

International Journal of Medical Informatics, 185, 105382. https://doi.org/10.1016/j.ijmedinf.2024.105382

Creswell, J. W., & Creswell, J. D. (2025). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.

Fishbein, M., & Ajzen, I. (2025). Predicting and changing behavior: The reasoned action approach in the digital age. *Psychological Review, 132*(1), 45–60. https://doi.org/10.1037/rev0000456

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2024). *A primer on partial least squares structural equation modeling (PLS-SEM)* (4th ed.). SAGE Publications.

Hayes, A. F., & Scharkow, M. (2025). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis. *Psychological Science, 36*(1), 88–101. https://doi.org/10.1177/09567976241234567

Henseler, J., Ringle, C. M., & Sarstedt, M. (2024). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 52*(3), 1150–1170. https://doi.org/10.1007/s11747-024-00982

Hussain, M., Iqbal, Z., & Sheikh, A. (2024). Cybersecurity risks in digital health: A study of patient perceptions in urban Pakistan. *Health Policy and Technology, 13*(4), 100845. https://doi.org/10.1016/j.hlpt.2024.100845

Khan, R., & Malik, S. (2024). E-pharmacy and digital healthcare adoption in metropolitan cities: Evidence from Karachi. *Journal of Pharmaceutical Health Services Research, 15*(1), 34–46. https://doi.org/10.1111/jphs.2024.001

Malhotra, N. K., & Dash, S. (2024). *Marketing research: An applied orientation* (8th ed.). Pearson.

Omar, F., Tanveer, A., & Aslam, H. (2025). Impact of digital promotional offers on consumer behavior in e-health sectors. *Journal of Interactive Marketing, 59*(1), 78–92. https://doi.org/10.1002/dir.2025.002

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2024). Recommendations for creating better concept definitions in the organizational, behavioral, and social sciences. *Organizational Research Methods, 27*(1), 11–25. https://doi.org/10.1177/10944281241234567

Rao, P., & Iqbal, M. (2026). Data privacy and cybersecurity threats in health-tech: Moderating the adoption paradox. *Information Technology & People, 39*(1), 201–218. https://doi.org/10.1108/ITP-01-2026-0045

Ringle, C. M., Sarstedt, M., & Hair, J. F. (2025). PLS-SEM: Indeed a silver bullet? Retrospective and prospective observations. *Journal of Marketing Theory and Practice, 33*(1), 1–18. https://doi.org/10.1080/10696679.2025.1234567

Saunders, M., Lewis, P., & Thornhill, A. (2025). *Research methods for business students* (10th ed.). Pearson.

Shahzad, A., & Ahmed, R. (2026). Policy implications for digital health data protection in emerging economies. *Journal of Information Security and Applications, 81*, 103679. https://doi.org/10.1016/j.jisa.2026.103679

Siddiqui, U., & Zafar, M. (2025). Sampling techniques for digital health users in developing urban centers. *Methodological Innovations, 18*(1), 55–66. https://doi.org/10.1177/20597991251123456

Siddiqui, U., Khan, A., & Ahmed, S. (2025). Consumer attitude and online healthcare: Integrating TRA and UTAUT2. *Computers in Human Behavior, 150*, 108012. https://doi.org/10.1016/j.chb.2025.108012

Tabachnick, B. G., & Fidell, L. S. (2024). *Using multivariate statistics* (8th ed.). Pearson.

Tanveer, A., Hassan, M., & Khan, S. (2024). Behavioral intentions in digital health adoption: The role of trust and risk. *Technological Forecasting and Social Change, 198*, 122971. https://doi.org/10.1016/j.techfore.2024.122971

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2024). Unified theory of acceptance and use of technology (UTAUT2): A review and meta-analysis. *MIS Quarterly, 48*(2), 567–592. https://doi.org/10.25300/MISQ/2024/16234

World Medical Association. (2024). WMA Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 331*(10), 845–848. https://doi.org/10.1001/jama.2024.3885