



Research article

How nurses' technology readiness drives innovative work behavior in AI-enabled healthcare: The roles of AI self-efficacy, trust, and digital literacy

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Abstract: *Aim:* This study aimed to examine how nurses' technology readiness influences innovative work behavior in AI-enabled healthcare environments, focusing on the sequential mediating roles of AI self-efficacy and trust in AI, and the moderating role of digital literacy. *Design:* A cross-sectional, theory-driven quantitative design was employed to test a moderated serial mediation model among staff nurses working in AI-enabled hospital settings. *Methods:* Data were collected from nurses working in hospitals in Saudi Arabia utilizing AI-enabled clinical decision support systems across key departments, including intensive care units, emergency departments, radiology, general wards, and telehealth units. Established validated scales were used to measure nurses' technology readiness, AI self-efficacy, trust in AI, digital literacy, and innovative work behavior. Data were analyzed using advanced multivariate techniques to test direct, moderating, and serial mediation effects. *Results:* The findings revealed that nurses' technology readiness significantly and positively affects innovative work behavior. Technology readiness also positively influences AI self-efficacy, which in turn enhances trust in AI. Trust in AI was found to positively predict innovative work behavior. Digital literacy significantly moderates the relationship between technology readiness and AI self-efficacy, strengthening this relationship when digital literacy is high. Furthermore, AI self-efficacy and trust in AI sequentially mediate the relationship between technology readiness and innovative work behavior. *Conclusion:* The study concludes that nurses' innovative behavior in AI-enabled healthcare is shaped by a sequential psychological process driven

by technology readiness, AI self-efficacy, and trust in AI, and strengthened by digital literacy. This highlights the importance of integrating psychological and competency-based factors in understanding innovation in digital healthcare environments. *Implications for the profession and/or patient care:* The findings suggest that healthcare organizations should enhance nurses' technology readiness, strengthen AI self-efficacy through targeted training, build trust in AI systems through transparency and involvement, and invest in digital literacy development. These interventions are essential for fostering innovation among nurses, improving clinical decision-making, and enhancing the quality and efficiency of patient care in AI-enabled healthcare systems. *Impact:* This study advances nursing and healthcare informatics research by providing a comprehensive explanatory model of how individual readiness and digital competencies translate into innovative work behavior in AI-driven clinical environments. It offers actionable insights for healthcare leaders aiming to successfully integrate AI technologies into nursing practice while promoting innovation and patient-centered care.

Keywords: nurses' technology readiness; artificial intelligence; AI self-efficacy; trust in AI; innovative work behavior; digital literacy; cross-sectional study

1. Introduction

The rapid integration of artificial intelligence (AI) into healthcare systems is transforming clinical practice, particularly within hospital environments where AI-enabled clinical decision support systems (CDSS) are increasingly embedded in routine patient care. These systems—ranging from predictive monitoring tools to intelligent triage algorithms—require nurses to interpret complex data outputs and incorporate them into clinical decision-making processes. As frontline healthcare providers, nurses play a pivotal role in ensuring the effective utilization of such technologies, making their readiness to engage with AI a critical determinant of healthcare innovation and quality [1,2].

Technology readiness, defined as an individual's propensity to embrace and use new technologies [3], has been widely recognized as a key factor influencing technology adoption in healthcare settings. In nursing contexts, prior research demonstrates that technology readiness significantly shapes nurses' acceptance of electronic medical records and other digital systems [4,5]. More recent evidence suggests that technology readiness extends beyond mere adoption to influence behavioral and attitudinal outcomes, including reciprocity behaviors and engagement with digital innovations [6]. However, despite these advances, limited attention has been given to how nurses' technology readiness translates into innovative work behavior (IWB)—a critical competency in modern healthcare systems characterized by continuous technological change.

Innovative work behavior in nursing refers to the generation, promotion, and implementation of novel ideas that improve patient care and organizational performance [7]. It is increasingly viewed as essential for healthcare organizations striving to adapt to complex and technology-driven environments. Prior studies have linked leadership styles, organizational culture, and psychological factors to nurses' IWB [8–10]. However, the mechanisms through which technology-related factors—particularly in AI-enabled contexts—stimulate innovative behavior among nurses remain underexplored.

Emerging research highlights the importance of AI self-efficacy, defined as individuals' confidence in their ability to effectively use AI technologies, in shaping nurses' engagement with AI

systems. Studies indicate that higher levels of AI self-efficacy are associated with positive attitudes, improved learning engagement, and stronger behavioral intentions toward AI use [11–13]. In parallel, trust in AI has been identified as a critical factor influencing the successful integration of AI into clinical workflows. Nurses' trust in AI systems affects their willingness to rely on AI-generated recommendations and mitigates concerns related to uncertainty and algorithmic decision-making [14,15]. Systematic evidence further confirms that trust is a central determinant of healthcare professionals' adoption and sustained use of AI-based CDSS [2].

Importantly, recent studies suggest that AI self-efficacy and trust are not independent constructs but are dynamically linked. Higher self-efficacy enhances individuals' ability to understand and evaluate AI outputs, thereby fostering greater trust in these systems [16,17]. This indicates a potential sequential mechanism through which nurses' technological predispositions may translate into meaningful behavioral outcomes, such as innovative work behavior. Yet, empirical research examining this serial mediation pathway within real-world clinical settings remains scarce.

Another critical but often overlooked factor is digital literacy, which encompasses the knowledge and competencies required to effectively use digital technologies in healthcare environments. Digital literacy has been shown to function as a key job resource, enhancing work engagement and reducing burnout among nurses [18]. Moreover, it plays a crucial role in shaping self-efficacy and technology-related learning outcomes [19]. Despite its importance, digital literacy levels among nurses remain heterogeneous across roles and settings [20,21], potentially influencing how technology readiness translates into confidence and competence in AI use. This suggests that digital literacy may act as a boundary condition, strengthening or weakening the relationship between technology readiness and AI self-efficacy.

Against this backdrop, the present study seeks to advance nursing and healthcare informatics literature by developing and testing a comprehensive model that explains how nurses' technology readiness drives innovative work behavior in AI-enabled healthcare environments. Specifically, this study proposes that technology readiness influences innovative work behavior through a sequential mediation mechanism involving AI self-efficacy and trust in AI, while digital literacy moderates the relationship between technology readiness and AI self-efficacy. In other words, this study aims to:

- Develop and empirically test a comprehensive model explaining how nurses' technology readiness influences innovative work behavior in AI-enabled healthcare environments.
- Examine the sequential mediating role of AI self-efficacy and trust in AI in the relationship between nurses' technology readiness and innovative work behavior.
- Investigate the moderating role of digital literacy on the relationship between technology readiness and AI self-efficacy among nurses.

Focusing on staff nurses working in hospitals that have adopted AI-enabled CDSS across critical departments—such as intensive care units, emergency departments, radiology units, and telehealth services—this study provides a contextually rich examination of AI integration in clinical practice. By addressing the interplay between technological readiness, psychological mechanisms, and digital competencies, this research contributes to a deeper understanding of how nurses can be empowered to innovate in increasingly digitalized healthcare systems.

The present study advances research on AI-enabled nursing by moving beyond the examination of individual technology acceptance factors toward an integrated understanding of nurses' preparedness for engaging with AI in clinical practice. Although previous studies have examined technology readiness, AI self-efficacy, trust in AI, and digital literacy as separate determinants of technology-related attitudes and behaviors, these dimensions represent conceptually distinct yet

complementary aspects of nurses' capacity to engage with AI-enabled healthcare. Technology readiness captures a general orientation toward technological change, whereas AI self-efficacy reflects nurses' perceived capability to use AI effectively. Trust in AI addresses the extent to which nurses are willing to rely on AI-generated information, while digital literacy reflects the knowledge and skills necessary to understand, evaluate, and interact with digital technologies. Integrating these dimensions, therefore, provides a more comprehensive theoretical perspective on AI readiness than approaches that focus on any single factor in isolation. More importantly, the framework shifts the theoretical emphasis from AI as a technological innovation to the nurse as an active participant in AI-enabled clinical transformation. In doing so, the study highlights that effective AI integration in nursing depends not only on technological availability but also on nurses' technological orientation, perceived competence, trust, and digital capabilities. This integrated perspective extends existing AI-enabled nursing research by offering a multidimensional explanation of the human factors underlying nurses' preparedness to engage with AI-supported clinical decision-making.

2. Background and hypotheses development

The ongoing digital transformation of healthcare has intensified the need to understand how nurses adapt to and leverage emerging technologies, particularly AI. While prior research has largely focused on technology adoption and acceptance, there is a growing recognition that successful digital transformation in healthcare requires nurses not only to use technology but also to translate it into innovative practices that enhance patient care. In this context, technology readiness represents a foundational individual characteristic that shapes how nurses perceive, approach, and utilize AI-enabled systems in their daily work [1,3].

2.1. Theoretical foundation: Social cognitive theory

The theoretical foundation of this study is primarily informed by Bandura's Social Cognitive Theory (SCT), which explains behavior as the outcome of reciprocal interactions among personal factors, cognitive processes, and environmental influences. From an SCT perspective, individuals' behavioral responses to technological change are shaped not only by the characteristics of the technology but also by their personal beliefs about their capabilities and their evaluations of the environment in which the technology is used. This perspective provides a useful overarching logic for explaining how nurses' technology readiness may develop into innovative work behavior in AI-enabled healthcare environments. In the present study, technology readiness represents an individual predisposition toward embracing and engaging with technology, providing the personal foundation for subsequent technology-related cognitive evaluations. AI self-efficacy represents a more specific cognitive appraisal of nurses' capability to effectively use and interact with AI systems. Nurses who are more psychologically ready to engage with technology are more likely to develop confidence in their ability to use AI effectively, thereby strengthening their AI self-efficacy.

Within this theoretical sequence, trust in AI represents an important evaluative mechanism through which nurses assess the reliability, dependability, and usefulness of AI systems when applying them in clinical practice. Higher AI self-efficacy may enable nurses to better understand and evaluate AI outputs, reducing uncertainty and facilitating greater trust in AI. In turn, greater trust may encourage nurses to move beyond routine technology use and engage in innovative work behavior, including generating, promoting, and implementing new ideas and practices. Thus, the

proposed framework conceptualizes technology readiness as the initial personal predisposition, AI self-efficacy as a cognitive capability appraisal, trust in AI as an evaluative psychological mechanism, and innovative work behavior as the resulting behavioral outcome. This SCT-based perspective therefore provides a coherent theoretical explanation for the proposed sequential pathway from technology readiness through AI self-efficacy and trust in AI to innovative work behavior, while also allowing digital literacy to function as a boundary condition that determines the extent to which technological readiness is translated into AI-related self-efficacy.

2.2. Technology readiness and innovative work behavior

Technology readiness reflects an individual's inclination to embrace new technologies and has been empirically linked to technology acceptance in nursing, including electronic medical records and digital health systems [4,5]. Beyond adoption, technology readiness may foster proactive and exploratory behaviors, encouraging nurses to experiment with new tools and develop improved care practices. Such behaviors align closely with innovative work behavior (IWB), which involves idea generation, promotion, and implementation within the workplace [7].

In nursing settings, IWB has been associated with improved care quality, adaptability, and organizational performance [8,9]. Although leadership and organizational factors have been extensively studied as antecedents of IWB [9], the role of individual technological predispositions remains underexplored. Drawing on Social Cognitive Theory, nurses with higher technology readiness are more likely to engage proactively with AI functionalities, experiment with technology-enabled workflows, and develop confidence in their ability to use AI effectively. These technology-oriented cognitions and behaviors can, in turn, encourage nurses to generate, promote, and implement novel solutions, thereby enhancing their innovative work behavior. Therefore, the following hypothesis is formulated:

H1: Nurses' technology readiness has a positive effect on nurse innovative work behavior.

2.3. Technology readiness and AI self-efficacy

A key mechanism through which technology readiness may influence behavior is self-efficacy, particularly in the context of AI. AI self-efficacy refers to nurses' confidence in their ability to effectively interact with and utilize AI systems. Prior studies have shown that self-efficacy plays a central role in shaping technology-related attitudes and behaviors among nurses and nursing students [11,12].

Technology readiness provides the psychological foundation for developing such confidence. Individuals who are more open to and optimistic about technology are more likely to engage with AI systems, acquire relevant skills, and build confidence in their capabilities. Empirical evidence supports the link between technology-related readiness and self-efficacy in digital contexts [13,17]. Accordingly, nurses with higher technology readiness are expected to demonstrate stronger AI self-efficacy. Therefore, the following hypothesis is formulated:

H2: Nurses' technology readiness has a positive effect on AI self-efficacy.

2.4. The moderating role of digital literacy

While technology readiness reflects a general predisposition, the extent to which it translates into AI self-efficacy may depend on nurses' digital literacy. Digital literacy encompasses the skills

and competencies required to effectively use digital tools and interpret digital information in healthcare settings [21]. It has been identified as a critical resource that enhances nurses' work engagement and professional performance [18].

Importantly, digital literacy enables nurses to better understand AI functionalities, interpret outputs, and navigate digital systems, thereby strengthening the impact of technology readiness on self-efficacy. Conversely, limited digital literacy may constrain nurses' ability to translate their readiness into actual competence and confidence. Prior research highlights substantial variability in digital literacy levels among nurses, which can influence technology-related outcomes [20,22].

Thus, digital literacy is expected to act as a moderator, amplifying the positive relationship between technology readiness and AI self-efficacy when it is high. Therefore, the following hypothesis is formulated:

H3: Digital literacy moderates the relationship between nurses' technology readiness and AI self-efficacy, such that the relationship is stronger when digital literacy is high.

2.5. AI self-efficacy and trust in AI

Trust in AI has emerged as a critical factor influencing healthcare professionals' reliance on AI-based systems. In clinical contexts, trust determines whether nurses accept, interpret, and act upon AI-generated recommendations [2]. However, trust does not develop in isolation; it is shaped by individuals' confidence in their ability to understand and use AI technologies.

Nurses with higher AI self-efficacy are more likely to comprehend AI outputs, evaluate their relevance, and integrate them into clinical decision-making, thereby fostering trust. Empirical studies support this relationship, indicating that competence and self-efficacy reduce uncertainty and enhance trust in AI systems [14,15,23]. Additionally, research on AI-related competencies suggests that self-efficacy plays a pivotal role in shaping positive attitudes and trust toward AI technologies [16]. Therefore, the following hypothesis is formulated:

H4: AI self-efficacy has a positive effect on trust in AI.

2.6. Trust in AI and innovative work behavior

Trust in AI is not only essential for technology adoption but also for leveraging AI to drive innovation in clinical practice. When nurses trust AI systems, they are more likely to rely on AI-generated insights, experiment with new approaches, and integrate AI into care processes, thereby fostering innovative work behavior.

Conversely, low levels of trust may lead to resistance, underutilization of AI tools, and missed opportunities for innovation. Empirical evidence suggests that trust plays a mediating role in shaping technology-related outcomes and behavioral intentions in healthcare settings [2,14,24]. Therefore, trust in AI is expected to directly enhance nurses' innovative work behavior. Thus, the following hypothesis is formulated:

H5: Trust in AI has a positive effect on nurse innovative work behavior.

2.7. Sequential mediation of AI self-efficacy and trust in AI

Building on the Social Cognitive Theory and preceding arguments, this study proposes a sequential mediation mechanism linking technology readiness to innovative work behavior through

AI self-efficacy and trust in AI. From this perspective, technology readiness provides the initial personal predisposition toward technological engagement, which facilitates the development of AI self-efficacy. Greater confidence in using AI subsequently enables nurses to evaluate and engage with AI systems more positively, fostering trust in AI. This trust then facilitates the effective use of AI technologies in clinical practice and encourages nurses to generate, promote, and implement innovative ideas. This sequential pathway is supported by emerging research emphasizing the interconnected roles of self-efficacy and trust in shaping AI-related outcomes [13,14,25,26]. However, empirical examination of this mechanism within nursing practice remains limited, particularly in real-world AI-enabled clinical environments. Therefore, the following hypothesis is formulated:

H6: AI self-efficacy and trust in AI sequentially mediate the relationship between nurses' technology readiness and nurse innovative work behavior.

Figure 1 below presents the theoretical framework of the study.

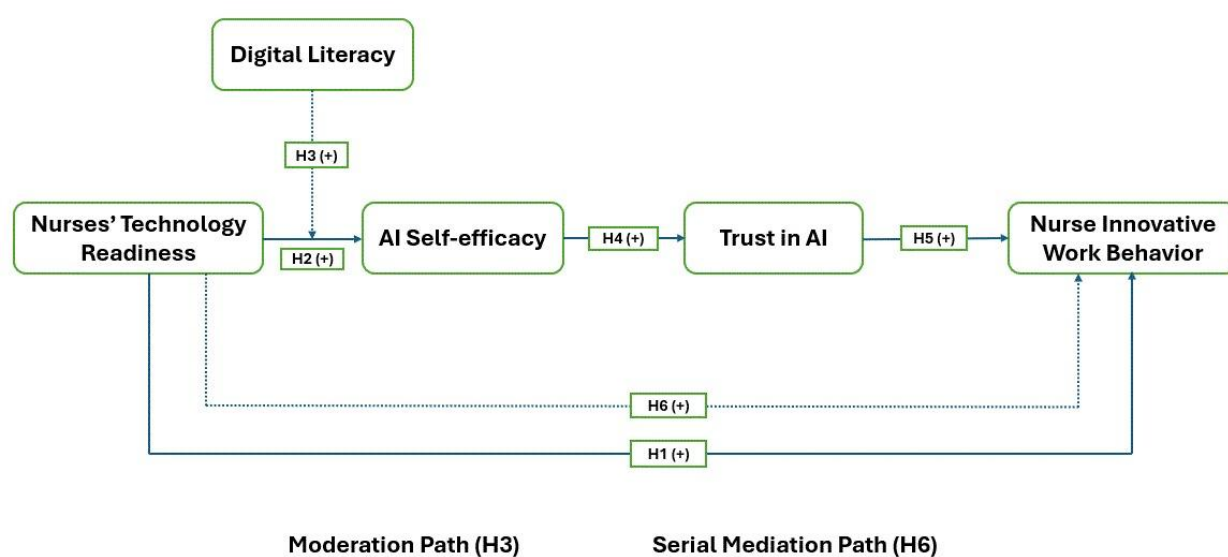


Figure 1. Theoretical framework.

3. Subjects and method

3.1. Research design

This study adopted a non-experimental, cross-sectional, descriptive-correlational design with a prospective data collection approach.

3.2. Setting

This study focuses on staff nurses working in hospitals in Saudi Arabia that have adopted AI-enabled clinical decision support systems (CDSS) as an integral part of routine patient care. Within these digitally advanced healthcare environments, nurses regularly engage with AI-driven technologies—such as predictive monitoring systems, intelligent triage tools, and decision-support algorithms—which require them to interpret outputs and incorporate them into clinical judgments. This context is particularly suitable for examining how nurses' technology readiness translates into

innovative work behavior through the sequential mechanisms of AI self-efficacy and trust in AI. Emphasizing frontline nurses is critical, as they are the primary users of AI in day-to-day clinical operations, and their level of digital literacy significantly influences how effectively they convert technological readiness into confidence and trust in AI systems.

3.3. Subjects

A stratified random sampling technique was employed to select 390 nurses from different departments within hospitals in Saudi Arabia that have implemented AI-enabled clinical decision support systems (CDSS) as part of routine patient care. Stratification was based on the proportion of nurses in each department to ensure a representative distribution aligned with the hospital workforce structure. Participating hospitals were selected based on documented implementation of AI-enabled CDSS, and nurses were randomly selected from departmental staff lists proportionate to department size. Data were gathered from nurses working in key units where AI technologies are extensively used, including intensive care units (ICU), emergency departments (ED), radiology and diagnostic units, medical–surgical wards, and telehealth or remote monitoring units. This approach ensured adequate exposure to AI systems while enhancing the generalizability of the study findings across clinical settings. A total of 450 nurses were approached for participation in the study. Of these, 390 nurses completed and returned the questionnaire, resulting in a response rate of 86.7%. Only fully completed questionnaires were included in the final analysis.

Participants were eligible for inclusion in this study if they were registered staff nurses currently working in hospitals in Saudi Arabia that have implemented AI-enabled clinical decision support systems (CDSS) as part of routine patient care. Only nurses who were directly involved in clinical practice and had regular exposure to AI-driven technologies—such as predictive monitoring systems, intelligent triage tools, and decision-support algorithms—were included, ensuring meaningful engagement with the study constructs. In addition, nurses were required to have at least six months of work experience in their current hospital to ensure adequate familiarity with organizational systems and AI applications. Participants also needed to demonstrate basic digital engagement in clinical practice, including the use of electronic health records or AI-supported systems, in order to meaningfully reflect the constructs of technology readiness, AI self-efficacy, trust in AI, digital literacy, and innovative work behavior. Finally, participation was voluntary, and only those who provided informed consent were included in the study.

A power analysis was performed using the Epi Info statistical software to determine the appropriate sample size. The calculation was based on a 95% confidence level (Z value) and a 0.05 margin of error (d proportion). This method ensured that the study was adequately powered to identify significant relationships among the variables while reducing the risks of both Type I and Type II errors.

3.4. Data collection tools

Part I comprised a researcher-developed demographic section designed to capture participants' background characteristics, including age, marital status, educational attainment, department, and years of professional experience.

Data were collected using a structured pen-and-paper questionnaire administered to the selected nurses within their respective departments. Participants were given adequate time to complete the

survey to ensure thoughtful and accurate responses. The questionnaire consisted of five main measurement scales:

- Nurses' technology readiness refers to the extent to which nurses are psychologically and behaviorally prepared to adopt and use new technologies in clinical practice. It was measured using a 16-item scale adapted from Parasuraman and Colby [27]. Responses were recorded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The overall score was obtained by summing all item responses, with higher scores indicating greater levels of technology readiness (Cronbach's $\alpha = 0.956$).
- Nurse innovative work behavior refers to nurses' intentional efforts to generate, promote, and implement new ideas, processes, or solutions in their work environment to improve healthcare delivery. It was assessed using a 10-item scale adapted from Masood and Afsar [10]. Participants responded on a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree), and the final score was computed as the mean of all items (Cronbach's $\alpha = 0.894$).
- AI self-efficacy reflects nurses' confidence in their ability to effectively use and interact with artificial intelligence-based systems in clinical decision-making and practice. It was measured using a 4-item scale adapted from Kwak et al. [12], with responses rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Cronbach's $\alpha = 0.853$).
- Trust in AI refers to nurses' belief in the reliability, accuracy, and dependability of artificial intelligence systems in supporting clinical decisions and patient care. It was evaluated using an 8-item scale developed by Liu et al. [14]. Each item was rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) (Cronbach's $\alpha = 0.892$).
- Digital literacy denotes nurses' ability to effectively locate, evaluate, utilize, and communicate information using digital technologies in healthcare settings. It was assessed using a 6-item scale adapted from Chung et al. [18], with responses recorded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Cronbach's $\alpha = 0.899$).

3.5. Data collection

All instruments used in this study were translated into Arabic following the back-translation technique to ensure linguistic accuracy and conceptual equivalence.

Data were collected using a pen-and-paper questionnaire. Research assistants, who were not members of the nursing staff, were specifically trained in the standardized procedures for survey administration. Nurses were approached during their scheduled shifts and invited to participate in the study. Participation was entirely voluntary, and informed consent was obtained prior to distributing the questionnaires.

After consent was provided, the research assistants distributed the paper-based surveys and clearly explained the study purpose, while emphasizing anonymity and assuring participants that their responses would not affect their job roles, evaluations, or shift assignments. Nurses were given approximately 15–20 minutes to complete the questionnaire during their working hours, either in designated break rooms or other quiet areas away from clinical duties.

Upon completion, participants were instructed to place their questionnaires in sealed envelopes and deposit them into a secure collection box. This box was stored in a locked location accessible only to the research team, ensuring confidentiality and preventing unauthorized access.

To further protect privacy, no identifying personal information was collected, and participants were explicitly instructed not to include their names on any survey materials. All responses were handled with strict confidentiality and analyzed in aggregate form only.

Data collection was conducted across all shifts (morning, afternoon, and night) to ensure representation of nurses working at different times, thereby reducing potential shift-related bias and enhancing the representativeness of the sample.

3.6. Data analysis

Descriptive statistics, including means and standard deviations, were computed to summarize the data. Missing values were addressed using multiple imputation to reduce potential bias and improve data accuracy. Data analysis was carried out using partial least squares structural equation modeling (PLS-SEM) with SmartPLS, alongside SPSS for preliminary and supplementary analyses.

PLS-SEM was employed to evaluate a framework predicting nurses' AI-related outcomes. It excels in models with multiple latent variables and emphasizes the explained variance of endogenous constructs, making it preferable to covariance-based SEM (CB-SEM) for emerging AI applications in nursing. The sample size provided sufficient statistical power for investigating the proposed relationships. PLS-SEM is robust for complex models and is effective with data not adhering to multivariate normality. Additionally, confirmatory factor analysis assessed the five-factor measurement model, yielding good fit indicators that affirmed the validity and reliability of the instruments used.

To ensure data quality, non-response bias was assessed by comparing early and late respondents using an independent samples t-test. The results revealed no statistically significant differences between the two groups ($p > 0.05$), indicating that non-response bias was unlikely to affect the findings.

Furthermore, common method bias (CMB) was examined to determine whether variance attributable to the measurement method could have influenced the results. The analysis showed that no single factor accounted for more than 50% of the total variance, suggesting that common method bias did not pose a significant threat to the validity of the study outcomes. In addition to Harman's single-factor test, the full collinearity variance inflation factor (VIF) approach was employed. The full collinearity VIF values ranged from 1.21 to 2.87, with all values remaining below the recommended threshold of 3.3.

3.7. Ethical considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and received approval from the Deanship of Scientific Research Ethical Committee at King Faisal University. Prior to data collection, verbal (oral) informed consent was obtained from all participating nurses. Although written consent is typically preferred, oral consent was adopted in this study due to practical and logistical constraints within busy clinical environments, where minimizing disruption to patient care and nursing duties was essential. This approach was reviewed and approved by the ethics committee and the participating hospitals.

The purpose and objectives of the study were clearly explained to all participants before data collection. Nurses were fully informed about the voluntary nature of their participation, their right to refuse or withdraw at any time without penalty or obligation, and the absence of any impact on their employment or clinical duties. Confidentiality and anonymity were strictly maintained throughout the study. No identifying information was collected, and all responses were treated as anonymous. Participants were assured that their data would be used solely for research purposes and analyzed only in aggregated form to prevent identification of individuals. Participation was entirely voluntary, and all contributors were protected by ethical safeguards ensuring privacy, confidentiality, and the right to withdraw at any stage without providing any justification.

4. Results

4.1. Participants' profile

Table 1 shows the demographic profile of the 390 participants. Most respondents are aged 25–35 years (43.6%) and are married (56.4%). The majority hold a Bachelor of nursing science degree (43.6%), with most having 1–10 years of experience. Regarding the work setting, participants are mainly distributed in emergency departments (28.2%) and medical–surgical units (25.6%), followed by ICUs, radiology units, and telehealth services.

Table 1. Demographic characteristics of the sample ($n = 390$).

Items	Category	Frequency	Percent (%)
Age	18–25	60	15.4
	25–35	170	43.6
	35–45	110	28.2
	>45	50	12.8
Marital status	Single	140	35.9
	Married	220	56.4
	Divorced	20	5.1
	Widow	10	2.6
Educational level	Nursing school diploma	80	20.5
	Technical nursing degree	100	25.6
	Bachelor of nursing science	170	43.6
	Postgraduate nursing	40	10.3
Experience	1–5 years	150	38.5
	5–10 years	140	35.9
	>10 years	100	25.6
Working unit	Intensive care units (ICU)	90	23.1
	Emergency department (ED)	110	28.2
	Radiology and diagnostic units	60	15.4
	Medical–surgical units	100	25.6
	Telehealth/remote monitoring units	30	7.7

4.2. Descriptive statistics

Table 2 presents the descriptive statistics of the study constructs. Overall, the mean values indicate moderate to relatively high levels across all variables. AI self-efficacy records the highest mean ($M = 3.82$, $SD = 0.64$), falling within the high range, followed by nurses' technology readiness ($M = 3.64$, $SD = 0.77$). Digital literacy ($M = 3.56$, $SD = 0.84$), trust in AI ($M = 3.55$, $SD = 0.80$), and nurse innovative work behavior ($M = 3.36$, $SD = 0.84$) all fall within the moderate range. Overall, the results suggest that respondents demonstrate fairly positive perceptions toward AI-related competencies and readiness, with some variation across constructs.

Table 2. Descriptive statistics.

Construct	Mean*	SD
AI self-efficacy (AISE)	3.82	0.64
Digital literacy (DL)	3.56	0.84
Nurse innovative work behavior (NIWB)	3.36	0.84
Nurses' technology readiness (NTR)	3.64	0.77
Trust in AI (TAI)	3.55	0.8

Note: *Low: 1.00–2.33; moderate: 2.34–3.67; high: 3.68–5.00.

4.3. Measurement model

Table 3 reports the reliability and convergent validity results of the measurement model. All constructs demonstrate strong internal consistency, with Cronbach's alpha values ranging from 0.853 to 0.956, exceeding the recommended threshold of 0.70. Similarly, composite reliability values (0.855–0.960) confirm satisfactory construct reliability. Regarding convergent validity, all average variance extracted (AVE) values are above the acceptable level of 0.50, ranging from 0.517 to 0.694, indicating that the constructs adequately explain their respective indicators. Overall, the results confirm that the measurement model is both reliable and valid.

Table 3. Reliability and convergent validity.

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
AI self-efficacy	0.853	0.855	0.694
Digital literacy	0.899	0.924	0.659
Nurse innovative work behavior	0.894	0.913	0.517
Nurses' technology readiness	0.956	0.960	0.603
Trust in AI	0.892	0.902	0.572

Table 4 presents the discriminant validity assessment using both the Fornell–Larcker criterion and HTMT ratios. For the Fornell–Larcker results, the square roots of AVE (diagonal values) are higher than the inter-construct correlations, confirming adequate discriminant validity among all constructs. Similarly, the HTMT values are all below the recommended threshold of 0.85 (and well

below 0.90), further supporting strong discriminant validity. Overall, both criteria indicate that the constructs are distinct and measure different underlying concepts without significant overlap.

Table 4. Discriminant validity.

Fornell–Larcker					
	AI self- efficacy	Digital literacy	Nurse innovative work behavior	Nurses’ technology readiness	Trust in AI
AI self-efficacy	0.833				
Digital literacy	0.271	0.812			
Nurse innovative work behavior	0.566	0.122	0.719		
Nurses’ technology readiness	0.635	0.183	0.589	0.777	
Trust in AI	0.692	0.201	0.595	0.510	0.756
HTMT					
	AI self- efficacy	Digital literacy	Nurse innovative work behavior	Nurses’ technology readiness	Trust in AI
AI self-efficacy					
Digital literacy	0.286				
Nurse innovative work behavior	0.618	0.225			
Nurses’ technology readiness	0.696	0.199	0.614		
Trust in AI	0.785	0.215	0.629	0.543	

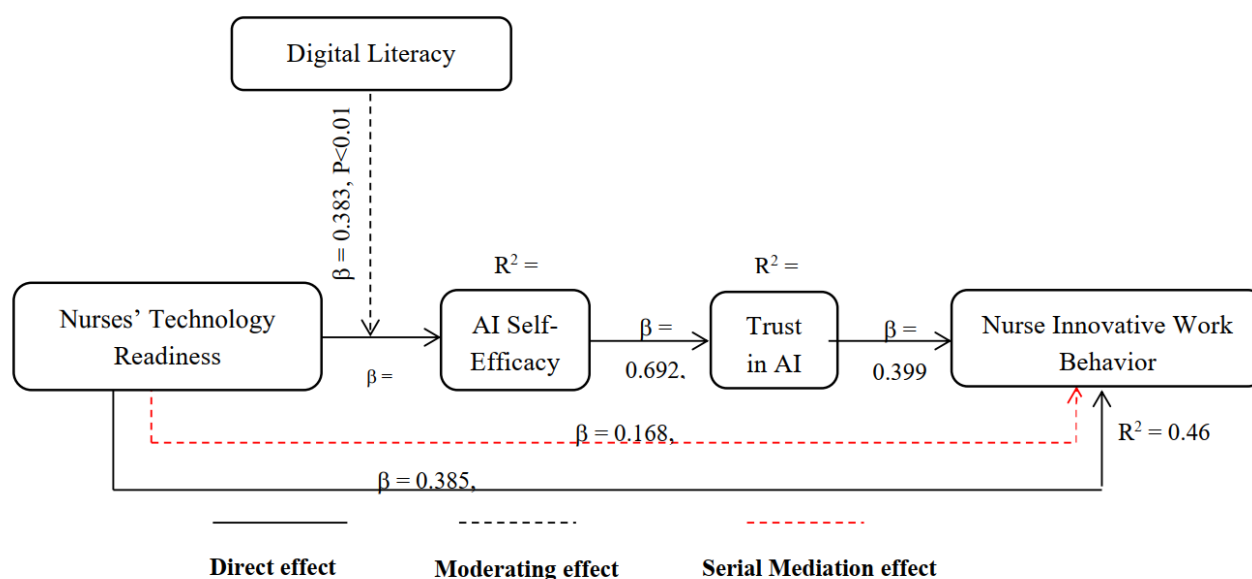
4.4. Path coefficients results

Table 5 and Figure 2 present the results of the structural model analysis, including direct, moderating, and serial mediation effects. The findings indicate that all hypothesized relationships are statistically significant and supported. For the direct effects, AI self-efficacy significantly influences trust in AI ($\beta = 0.692$, $t = 5.458$), while nurses’ technology readiness positively affects both AI self-efficacy ($\beta = 0.608$, $t = 8.188$) and nurse innovative work behavior ($\beta = 0.385$, $t = 3.800$). Additionally, trust in AI has a significant positive effect on nurse innovative work behavior ($\beta = 0.399$, $t = 4.174$).

Regarding the moderating effect, digital literacy strengthens the relationship between nurses’ technology readiness and AI self-efficacy ($\beta = 0.383$, $t = 4.098$). Finally, the serial mediation pathway from nurses’ technology readiness through AI self-efficacy and trust in AI to nurse innovative work behavior is also significant ($\beta = 0.168$, $t = 3.531$), confirming the proposed indirect mechanism. Overall, all hypotheses are empirically supported.

Table 5. Path coefficients and *t*-values.

Relationship	Beta (β)	<i>t</i> -value	<i>p</i> -value	Decision
Direct effect				
AI self-efficacy -> trust in AI	0.692	5.458	0.000	Supported
Nurses' technology readiness -> AI self-efficacy	0.608	8.188	0.000	Supported
Nurses' technology readiness -> nurse innovative work behavior	0.385	3.800	0.000	Supported
Trust in AI -> nurse innovative work behavior	0.399	4.174	0.000	Supported
Moderating effect				
Digital literacy $\times$ nurses' technology readiness -> AI self-efficacy	0.383	4.098	0.000	Supported
Serial mediation effect				
Nurses' technology readiness -> AI self-efficacy -> trust in AI -> nurse innovative work behavior	0.168	3.531	0.000	Supported

**Figure 2.** The final model of the study.

The R^2 values were 0.54 for AI self-efficacy, 0.48 for trust in AI, and 0.46 for nurses' innovative work behavior. Thus, the proposed model explains 54%, 48%, and 46% of the variance in AI self-efficacy, trust in AI, and nurses' innovative work behavior, respectively.

5. Discussion of findings

The present study provides a comprehensive examination of how nurses' technology readiness translates into innovative work behavior within AI-enabled healthcare environments. By integrating

AI self-efficacy, trust in AI, and digital literacy into a unified framework, the findings offer important theoretical and practical insights for nursing and healthcare informatics literature.

First, the results demonstrate that nurses' technology readiness has a direct and positive effect on innovative work behavior, highlighting the critical role of individual technological predispositions in fostering innovation in clinical settings. This finding extends prior research, which has largely focused on technology acceptance [1,4], by showing that technology readiness also drives higher-order outcomes such as idea generation and implementation. In line with innovation-oriented studies in nursing [7,8], nurses who are more open to and comfortable with technology are more likely to experiment with AI tools, explore new care approaches, and contribute to process improvements. This underscores the importance of cultivating a technologically receptive nursing workforce to support innovation in increasingly digital healthcare systems.

Second, the study confirms that technology readiness positively influences AI self-efficacy, reinforcing the notion that individuals' predispositions toward technology shape their confidence in using advanced digital systems. This finding aligns with previous studies emphasizing the role of self-efficacy in technology-related behaviors among nurses [11,12]. Nurses with higher readiness are more likely to engage with AI applications, develop relevant competencies, and feel confident in their ability to use these tools effectively. This highlights AI self-efficacy as a key psychological mechanism through which technological readiness translates into meaningful behavioral outcomes.

Third, the findings reveal that digital literacy significantly moderates the relationship between technology readiness and AI self-efficacy, such that the relationship is stronger at higher levels of digital literacy. This result provides important nuance by demonstrating that readiness alone is insufficient; it must be complemented by adequate digital skills to fully translate into confidence. Consistent with prior research [18,21], digital literacy acts as a critical enabling resource that is associated with nurses' ability to understand and utilize AI systems. The observed moderating effect also reflects existing disparities in digital competencies among nurses [20], suggesting that investments in digital literacy development are essential for maximizing the benefits of technology readiness.

Fourth, the study finds that AI self-efficacy positively influences trust in AI, supporting the argument that confidence in using AI systems fosters greater trust in their outputs and recommendations. This finding is consistent with emerging evidence indicating that competence reduces uncertainty and enhances trust in AI technologies [14,15]. Nurses who feel capable of interpreting AI outputs are more likely to rely on them in clinical decision-making, thereby strengthening their trust in AI-enabled systems. This result highlights the interdependent relationship between cognitive confidence and affective trust in shaping nurses' interactions with AI.

Fifth, the results indicate that trust in AI has a positive effect on nurses' innovative work behavior, emphasizing the importance of trust as a driver of meaningful technology utilization. When nurses trust AI systems, they are more willing to integrate AI-generated insights into their workflows, experiment with new approaches, and implement innovative solutions in patient care. This finding aligns with prior research underscoring the central role of trust in technology adoption and usage [2] and extends it by demonstrating its impact on innovation-related outcomes. Conversely, a lack of trust may hinder the effective use of AI and limit its potential to drive innovation in healthcare settings.

Finally, the study provides strong support for the proposed sequential mediation mechanism, whereby AI self-efficacy and trust in AI jointly mediate the relationship between technology readiness and innovative work behavior. This finding offers a more nuanced understanding of how

technological predispositions translate into behavioral outcomes, highlighting a stepwise process in which readiness enhances self-efficacy, which in turn fosters trust, ultimately leading to innovation. This sequential pathway is consistent with recent research emphasizing the interconnected roles of self-efficacy and trust in AI-related contexts [13,14], while extending the literature by empirically validating this mechanism among practicing nurses in real-world clinical environments.

6. Practical implications and recommendations

The findings of this study offer several important practical implications for healthcare managers, nursing leaders, policymakers, and educators seeking to enhance innovation in AI-enabled healthcare environments. By demonstrating that nurses' technology readiness translates into innovative work behavior through AI self-efficacy and trust in AI, and that digital literacy strengthens these relationships, the study highlights multiple actionable entry points for intervention.

6.1. *Enhancing nurses' technology readiness as a strategic priority*

Healthcare organizations should actively foster a culture that promotes positive attitudes toward emerging technologies. Since technology readiness directly influences both AI self-efficacy and innovative work behavior, hospitals should invest in initiatives that reduce resistance to technology and enhance optimism toward digital transformation. This can be achieved through structured orientation programs, early exposure to AI-enabled systems, and continuous communication emphasizing the benefits of AI in improving patient care quality and reducing workload. Leadership support is particularly important in shaping nurses' openness to technological change and reducing uncertainty associated with AI adoption.

6.2. *Building AI self-efficacy through targeted training programs*

The results highlight AI self-efficacy as a key psychological mechanism linking technology readiness to trust and innovation. Therefore, nursing administrators should implement targeted training programs designed to strengthen nurses' confidence in using AI systems. These programs should go beyond technical instruction and include hands-on simulation-based learning, case-based scenarios, and supervised practice using AI-enabled clinical decision support systems. By enhancing mastery experiences, nurses are more likely to develop confidence in interpreting AI outputs and integrating them into clinical decision-making processes.

6.3. *Strengthening trust in AI through transparency and human–AI collaboration*

Given the significant role of trust in shaping innovative work behavior, healthcare organizations must prioritize strategies that enhance nurses' trust in AI systems. This includes ensuring transparency in how AI algorithms generate recommendations, providing clear explanations of AI decision logic, and involving nurses in the evaluation and refinement of AI tools. Establishing human–AI collaboration models, where AI serves as a supportive decision-making partner rather than a replacement for clinical judgment, can further strengthen trust and acceptance among nurses.

6.4. Investing in digital literacy development as a foundational competency

The moderating role of digital literacy underscores its importance as a critical enabling factor in AI-driven healthcare environments. Hospitals and nursing schools should prioritize continuous digital literacy development programs tailored to different competency levels. These programs should include training in data interpretation, digital workflow management, and AI system navigation. Regular digital skills assessments can help identify gaps and guide personalized learning interventions. Strengthening digital literacy will ensure that nurses are better equipped to translate their technology readiness into practical AI-related competencies and confidence.

6.5. Integrating AI competencies into nursing education and professional development

Nursing education institutions should integrate AI literacy, digital literacy, and innovation-focused competencies into undergraduate and postgraduate curricula. Simulation-based AI training, interdisciplinary learning modules, and exposure to real-world clinical AI applications can prepare future nurses for technologically advanced healthcare environments. For practicing nurses, continuous professional development programs should be established to ensure ongoing skill enhancement in line with evolving AI technologies.

6.6. Supporting innovative work behavior through organizational culture and leadership

Finally, healthcare organizations should cultivate an innovation-supportive work environment that encourages experimentation, idea sharing, and continuous improvement. Leadership styles that promote psychological safety, inclusiveness, and empowerment can further stimulate nurses' innovative work behavior. Providing time, resources, and recognition for innovation-related activities will reinforce nurses' motivation to engage in creative problem-solving using AI technologies.

7. Limitations and future research directions

Despite the contributions of this study, certain limitations should be acknowledged. First, the study relied on self-reported measures collected from nurses, which may introduce common method bias, social desirability, or respondents' subjective perceptions. Although procedural and statistical approaches were employed to reduce and assess potential common method bias, self-reported data cannot completely eliminate the possibility of such effects. Future studies could therefore incorporate multiple data sources, such as supervisor-rated employee outcomes, objective organizational indicators, or temporally separated measurements, to strengthen the robustness of the findings. Second, the cross-sectional research design limits the ability to establish temporal precedence and definitive causal relationships among the examined variables. Although the hypothesized relationships were theoretically grounded and supported by the empirical findings, the observed associations should not be interpreted as conclusive evidence of causality. Future research could employ longitudinal, time-lagged, or experimental designs to examine how these relationships develop over time and to provide stronger evidence regarding causal direction. Third, the study was conducted within a single national healthcare context, which may constrain the generalizability of the

findings to healthcare systems with different institutional, cultural, technological, and organizational characteristics. Replication across different countries, healthcare systems, hospital types, and cultural settings would help determine whether the proposed relationships remain stable across contexts. Future comparative research could also examine whether national culture, healthcare infrastructure, organizational characteristics, or differences in AI adoption moderate the relationships identified in this study. Accordingly, the findings should be interpreted within the specific Egyptian healthcare context in which the data were collected rather than assumed to be universally generalizable.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Authors' contribution

Conceptualization, A.M.H., and H.A.K.; methodology, H.A.K.; software, H.A.K.; validation, A.M.H., H.A.K.; formal analysis, H.A.K.; investigation H.A.K.; resources, A.M.H.; data curation, H.A.K.; writing—original draft preparation, A.M.H., H.A.K.; writing—review and editing, A.M.H., H.A.K.; visualization, A.M.H., H.A.K.; supervision, A.M.H., H.A.K.; project administration, A.M.H., H.A.K.; funding acquisition, A.M.H.

Conflict of interest

The authors declare no conflict of interest.

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