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PAPER

Mobile Health Technology Adoption and Biomedical Innovation Performance: The Role of Entrepreneurial Orientation among Healthcare Professionals

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ABSTRACT

This study looks at how mobile health system quality (SQ) and perceived usefulness (PU) affect professionals' attitudes toward using mobile health technologies. It also explores how these factors relate to entrepreneurial orientation (EO) and perceived biomedical innovation performance (PBIP) in biomedical engineering settings. The research used a quantitative cross-sectional approach, gathering data from 260 biomedical and healthcare technology professionals in Indonesia. Partial least squares-structural equation modelling (PLS-SEM) was used to analyse both direct and mediating relationships among the main variables. The results showed that both mobile health system quality and PU had a positive link to attitude toward using mobile health systems. Attitude toward using was also positively linked to EO, which in turn was strongly related to PBIP. Attitude toward using also played an important role in connecting technology perceptions with EO. This study highlights how reliable, user-focused mobile health systems can encourage innovative professional behaviour in biomedical and healthcare technology fields. The results advance digital health and biomedical engineering research by linking perceptions of technology, entrepreneurial orientation, and perceived innovation performance.

KEYWORDS

mobile health, system quality, perceived usefulness (PU), entrepreneurial orientation (EO), biomedical innovation performance

1 INTRODUCTION

Healthcare systems are undergoing rapid transformation driven by digital innovation [1]. Mobile health systems facilitate remote patient monitoring, provide access to biomedical data [2], enhance clinical communication, and support coordinated care through technological integration [3]. These advancements enable healthcare

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professionals to manage care more efficiently and respond to patient needs more quickly. Although substantial investment has been made in digital healthcare infrastructure, critical questions remain about technology-related perceptions of innovation-driven professional behaviours within biomedical environments [4]. Previous research on mobile health (mHealth) has predominantly examined clinical effectiveness, adoption intentions, usability, security, privacy, and patient-centred outcomes [5].

Similarly, technology acceptance studies, particularly those grounded in the TAM, have demonstrated that perceived usefulness and users' attitudes are important predictors of technology acceptance and use [6]. However, fewer studies have examined whether positive perceptions of mHealth systems are associated with broader post-adoption behavioural outcomes, such as individual entrepreneurial orientation (EO) and perceived biomedical innovation performance (PBIP) among professionals working in biomedical and healthcare innovation environments [7].

As biomedical innovation increasingly relies on professionals' capacity to engage proactively with emerging technologies, identify opportunities for innovation, and integrate digital systems into healthcare solutions. In biomedical engineering environments, entrepreneurial orientation may influence how professionals experiment with new technologies, improve biomedical workflows, support healthcare innovation, and contribute to technology-enabled problem-solving [8]. However, existing literature rarely integrates technology acceptance perspectives with EO and innovation-related outcomes in biomedical contexts [9–10]. As a result, the relationship between mHealth technology perceptions, user attitudes, entrepreneurial behaviour, and PBIP remains insufficiently understood. In this study, entrepreneurial orientation is defined at the individual level and is based on how professionals rate their own innovativeness, proactiveness, and focus on opportunities. Biomedical innovation performance is also measured by how professionals assess their own contributions to activities like improving workflows, implementing technology, and developing healthcare solutions [26].

This study advances the biomedical engineering and digital health literature by extending the TAM beyond technology adoption to encompass innovation-related professional outcomes. It incorporates entrepreneurial orientation within the context of mobile health systems, a field that remains insufficiently examined in biomedical engineering research. Additionally, the study offers empirical evidence from Indonesia's emerging digital healthcare ecosystem. The primary objective is to investigate how perceived mobile health system quality and perceived usefulness (PU) affect attitudes toward use, EO, and PBIP among biomedical and healthcare technology professionals.

2 LITERATURE REVIEW

In healthcare and biomedical engineering contexts, system quality is particularly important because professionals often depend on mobile systems for timely access to patient-related information, remote monitoring data, clinical communication, and technology-supported decision-making [11]. Prior research on mobile healthcare systems suggests that technical reliability, interface quality, data availability, and system responsiveness are critical factors shaping users' evaluations of digital health technologies [12]. When professionals perceive a mobile health system as stable, efficient, and compatible with their work requirements, they are more likely to develop favourable attitudes toward using it in their daily professional activities [13].

This argument is consistent with technology acceptance research, which emphasises that users' positive beliefs about technology characteristics can influence their affective evaluations and willingness to engage with the system [14]. Therefore, in biomedical and healthcare innovation environments, high mobile health system quality is expected to strengthen professionals' attitude toward using mobile health technologies. Accordingly, the following hypothesis is proposed:

In the context of mobile health, PU reflects professionals' beliefs that mobile health systems can enhance clinical workflow efficiency, improve access to health-related information, support remote coordination, and facilitate biomedical or healthcare innovation activities [15]. Previous studies on mHealth and digital health adoption have consistently shown that users are more likely to develop favourable attitudes toward a technology when they perceive it as beneficial, practical, and relevant to their professional responsibilities [16]. For biomedical engineers, clinical researchers, healthcare managers, and technology professionals, mobile health systems may be perceived as useful when they support faster decision-making, reduce operational barriers, improve communication, or enable more effective management of biomedical data and healthcare services [17]. EO is especially relevant in biomedical engineering because innovation often requires professionals to challenge existing routines, integrate emerging technologies, and explore novel approaches to healthcare delivery and biomedical problem-solving [18].

Since biomedical innovation often requires proactive problem-solving and a willingness to explore uncertain technological opportunities, individual EO is expected to be positively related to PBIP [19]. Mobile health system quality may enhance EO indirectly by creating positive user attitudes, while PU may similarly promote EO [20]. Figure 1 shows the conceptual framework model.

H1: Mobile health system quality has a positive effect on attitude toward using mobile health technologies.
H2: Perceived usefulness has a positive effect on attitude toward using mobile health technologies.
H3: Attitude toward using mobile health technologies has a positive effect on individual entrepreneurial orientation.
H4: Individual entrepreneurial orientation has a positive effect on perceived biomedical innovation performance.
H5: Attitude toward using mediates the relationship between mobile health system quality and individual entrepreneurial orientation.

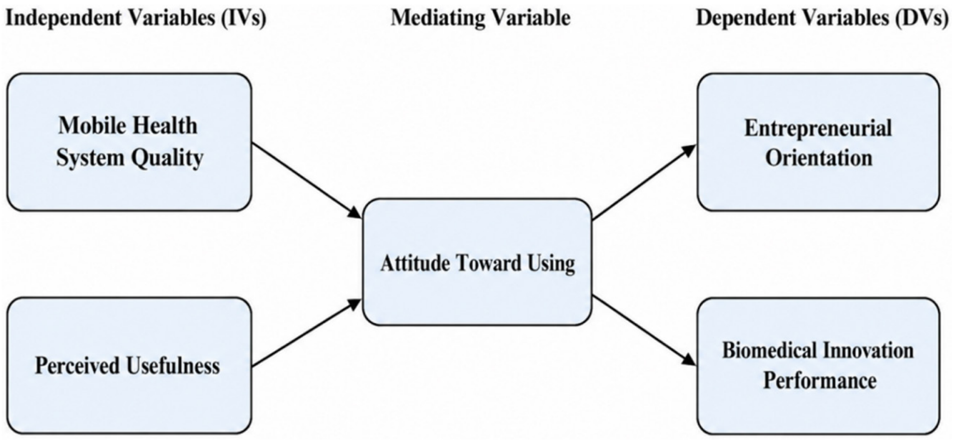

Fig. 1. Research model

3 METHODOLOGY

This study used a quantitative cross-sectional design to explore how mobile health system quality, user perceptions, and entrepreneurial orientation (EO) relate to biomedical innovation performance in Indonesia. Data collection was conducted using a structured electronic questionnaire distributed between March and April 2026. In total, 350 questionnaires were disseminated via professional networks and organisational contacts, yielding 260 valid responses after incomplete submissions were excluded. Purposive sampling was employed to recruit 260 participants from hospitals, biomedical device companies, and healthcare technology organisations throughout Indonesia. Eligible participants comprised biomedical engineers, clinical researchers, healthcare managers, and healthcare technology professionals with experience in the use or management of mobile health systems.

3.1 Variables and measurement

The independent variables included Mobile Health System Quality (SQ) and Perceived Usefulness. Mobile Health System quality was measured using six items adapted from Jen and Chao [21], assessing participants' perceptions of system reliability, responsiveness, and user interface. Perceived Usefulness was assessed using five items adapted from Davis [22], capturing the degree to which users believe that employing the mobile health system would enhance their job performance and innovation-related tasks.

The mediating variable, Attitude Toward Using, was measured with five items adapted from Davis [22], reflecting participants' overall affective evaluation of adopting and utilising mobile health technologies in their professional activities. The dependent variables consisted of Entrepreneurial Orientation and Biomedical Innovation Performance. Entrepreneurial Orientation was measured using six items adapted from Covin and Slevin [23], emphasising dimensions such as innovativeness, proactiveness, and risk-taking in professional decision-making. Biomedical innovation performance was assessed using five items adapted from Güner and Köse [24], focusing on participants' ability to translate entrepreneurial behaviours and mobile system utilisation into measurable innovation outcomes in biomedical engineering.

3.2 Data analysis

We analysed the data using partial least squares structural equation modelling (PLS-SEM). The process had two main steps: first, we assessed the measurement model, and then we evaluated the structural model. For the measurement model, we checked internal consistency reliability, convergent validity, and discriminant validity for all constructs. In the structural model, we looked at the significance of direct and mediating relationships using path coefficients, the coefficient of determination (R^2), and bootstrapping with 5,000 resamples.

4 FINDINGS AND DISCUSSION

4.1 Descriptive statistics

Descriptive statistics analysis shown in Table 1 indicated that mobile Health System Quality (SQ) reported the highest mean score ($M = 4.32$, $SD = 0.67$), followed by Perceived Usefulness (PU) (M = 4.11, SD = 0.72), indicating generally positive perceptions toward mobile health systems among biomedical and healthcare technology professionals. Attitude Toward Using (ATU) (M = 4.08, SD = 0.69), EO (M = 3.95, SD = 0.75), and Perceived Biomedical Innovation Performance (PBIP) (M = 4.05, SD = 0.70) also demonstrated relatively high mean scores, suggesting favourable attitudes toward mobile health adoption and innovation-related professional activities.

Table 1. Descriptive statistics

Variable	Mean	SD	Min	Max
Mobile Health System Quality (SQ)	4.32	0.67	2.5	5
Perceived Usefulness (PU)	4.11	0.72	2.2	5
Attitude Toward Using (ATU)	4.08	0.69	2.4	5
Entrepreneurial Orientation (EO)	3.95	0.75	2.0	5
Perceived Biomedical Innovation Performance (PBIP)	4.05	0.7	2.6	5

Figure 2 indicates positive perceptions of mobile health systems and favourable innovation-orientated attitudes among the respondents.

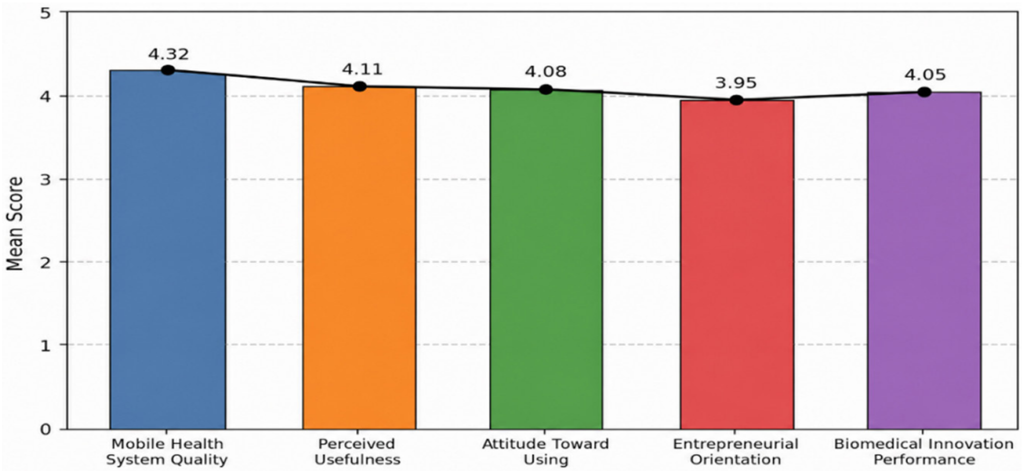

Fig. 2. Descriptive statistics of study variables

4.2 Correlation matrix

A correlation analysis in Table 2 revealed that all study variables were positively and significantly associated at the 0.01 significance level. Mobile Health System Quality (SQ) exhibited moderate positive correlations with Perceived Usefulness (PU) (r = 0.61) and Attitude Toward Using (ATU) (r = 0.55), indicating that higher perceptions of system quality are associated with more favourable evaluations of mobile health technologies. Additionally, Attitude Toward Using was positively correlated with Entrepreneurial Orientation (EO) (r = 0.52) and Perceived Biomedical Innovation Performance (PBIP) (r = 0.54), demonstrating associations between positive technology attitudes and innovation-orientated professional behaviours.

Table 2. Correlation matrix

Variable	SQ	PU	ATU	EO	BIP
SQ	1				
PU	0.61**	1			
ATU	0.55**	0.59**	1		
EO	0.43**	0.47**	0.52**	1	
PBIP	0.48**	0.50**	0.54**	0.60**	1

Note: ** $p < 0.01$.

The results in Table 3 show that common method bias was not a major issue in this study. Harman's single-factor test found that the first factor accounted for 36% of the total variance, which is below the recommended 50%. The full co-linearity variance inflation factor (VIF) was 1.53, well below the critical value of 3.3, suggesting no serious common method bias. Low marker-variable correlations and small differences in marker-variable correlations on latent factors, differences in factor loadings, and the strength of the measurement design help address concerns about common method variance.

Table 3. Common method bias diagnostics

Test	Value	Threshold/Interpretation
Harman's Single-Factor Test (variance explained by first factor)	36%	<50% indicates CMV is not severe
Full Collinearity VIF (highest among constructs)	1.53	<3.3 indicates CMV unlikely
Marker Variable Correlation (unrelated construct)	r = 0.05	Low correlation indicates minimal CMV
Common Latent Factor (CLF)	Average factor loading difference < 0.02	Supports low CMV

4.3 Measurement model

Table 4 shows that all constructs had good internal consistency reliability and convergent validity. Both Cronbach's alpha and composite reliability exceeded the recommended 0.70 threshold, indicating the constructs were reliable. Also, all Average Variance Extracted (AVE) values were higher than 0.50, confirming that the study constructs had adequate convergent validity.

Table 4. Measurement model assessment

Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Mobile Health System Quality (SQ)	0.88	0.91	0.63
Perceived Usefulness (PU)	0.85	0.89	0.61
Attitude Toward Using (ATU)	0.86	0.9	0.62
Entrepreneurial Orientation (EO)	0.87	0.91	0.64
Biomedical Innovation Performance (BIP)	0.84	0.88	0.6

Figure 3 presents the measurement model employed in this study, utilising Partial Least Squares Structural Equation Modelling (PLS-SEM). The latent constructs comprise Mobile Health System Quality (SQ), Perceived Usefulness (PU), Attitude Toward Using (ATU), Entrepreneurial Orientation (EO), and Perceived Biomedical Innovation Performance (PBIP).

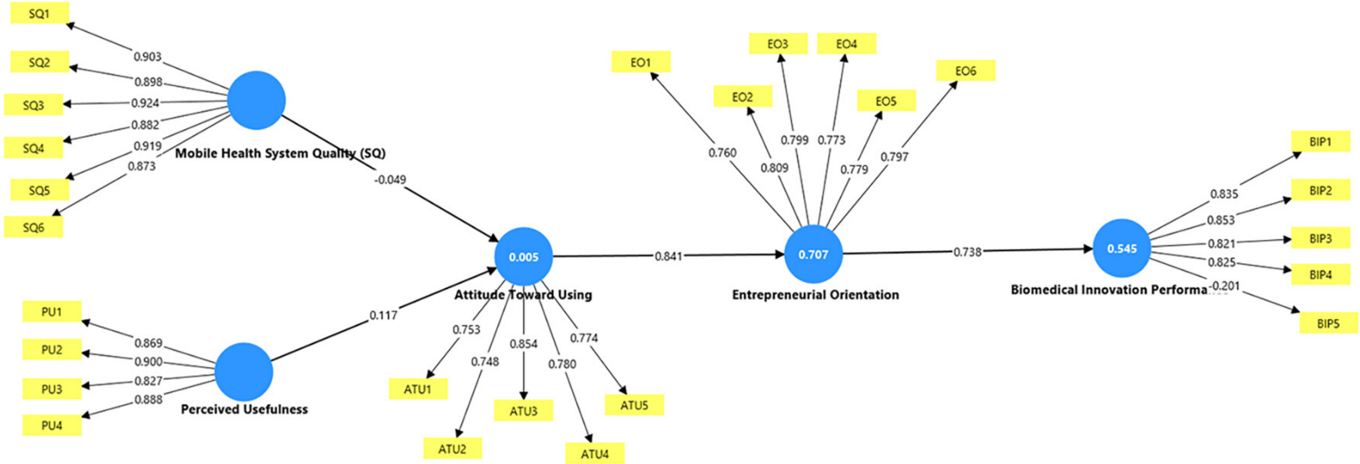

Fig. 3. Measurement model

Table 5 presents the Heterotrait-Monotrait (HTMT) ratios used to assess construct discrimination. All HTMT values are below the recommended threshold of 0.85, indicating that each construct is empirically distinct. Although the constructs are correlated, they represent distinct theoretical concepts, thereby supporting the measurement model's discriminant validity.

Table 5. Discriminant validity (HTMT)

Construct	SQ	PU	ATU	EO	BIP
SQ	1				
PU	0.65	1			
ATU	0.58	0.62	1		
EO	0.45	0.49	0.53	1	
BIP	0.5	0.52	0.55	0.6	1

Table 6 indicates that the diagonal values of the Fornell-Larcker criterion represent the square root of the Average Variance Extracted (AVE), while the off-diagonal values represent the correlations between constructs. All values exceed the lower bound of 0.70. For each construct, the correlation values are lower than the square root of AVE, demonstrating that each construct shares more variance with its own indicators than with other constructs.

Table 6. Discriminant validity (Fornell-Larcker Criterion)

Construct	SQ	PU	ATU	EO	BIP
SQ	0.79				
PU	0.61	0.78			
ATU	0.56	0.59	0.79		
EO	0.44	0.48	0.51	0.8	
BIP	0.49	0.51	0.54	0.59	0.77

4.4 Structural model

The structural model results in Table 7 demonstrated that Mobile Health System Quality (SQ) and Perceived Usefulness (PU) were positively associated with Attitude Toward Using (ATU), with both relationships reaching statistical significance ($p < 0.001$). These findings indicate that professionals' perceptions of system reliability, responsiveness, and usefulness are linked to more favourable attitudes toward mobile health technologies. Furthermore, Attitude Toward Using (ATU) was positively associated with Entrepreneurial Orientation (EO), and EO was positively associated with Perceived Biomedical Innovation Performance (PBIP).

The mediation analysis showed that Attitude Toward Using (ATU) played a significant role in linking Mobile Health System Quality (SQ) and Entrepreneurial Orientation (EO), as well as Perceived Usefulness (PU) and Entrepreneurial Orientation (EO). The R^2 values showed that the model explained 55% of the variance in ATU, 42% in EO, and 36% in Perceived Biomedical Innovation Performance (PBIP).

Table 7. Structural model: Direct and indirect effects

Hypothesis	Path	β (Path Coefficient)	t-Value	p-Value	Effect Type	R^2 of Endogenous Variable	f^2 Effect Size	Significance
H1	SQ → ATU	0.45	7.12	<0.001	Direct	0.55	0.12	Significant
H2	PU → ATU	0.48	7.85	<0.001	Direct	0.55	0.14	Significant
H3	ATU → EO	0.52	8.24	<0.001	Direct	0.42	0.18	Significant
H4	EO → BIP	0.6	9.1	<0.001	Direct	0.36	0.22	Significant
H5	SQ → ATU → EO	0.23	5.02	<0.001	Indirect	0.42	0.05	Significant
H6	PU → ATU → EO	0.25	5.4	<0.001	Indirect	0.42	0.06	Significant

5 DISCUSSION

This study found that Mobile Health System Quality (SQ) and Perceived Usefulness (PU) are both positively linked to Attitude Toward Using (ATU) mobile health technologies among biomedical and healthcare technology professionals. These findings support the TAM, which posits that users are more likely to have positive attitudes toward technologies they perceive as reliable, functional, and helpful for their work [25]. In biomedical engineering settings, digital systems help with remote monitoring, clinical communication, workflow management, and healthcare coordination. When professionals view these systems as high-quality and useful, they are more likely to adopt the technology.

The study found that a positive attitude toward mobile health systems is associated with greater EO. This means that professionals who view these systems favourably are more likely to try new solutions, use emerging technologies, and actively solve problems with technology. In biomedical engineering and healthcare innovation, these attitudes can encourage behaviours that support the adoption of new technologies, improve workflows, and drive digital transformation. The results also show that positive attitudes toward mobile health technologies may help connect how people see technology with their willingness to act entrepreneurially.

Entrepreneurial Orientation was also found to have a strong positive link with PBIP. This result supports earlier studies showing that being innovative, proactive, and opportunity-focused helps drive innovation-related outcomes [27]. In biomedical and healthcare technology fields, professionals with a stronger EO may be more likely to help with technology integration, process improvements, and innovation-focused work. Since this study used a cross-sectional, self-reported approach, the results should be interpreted as showing associations, not direct causes. Overall, these findings show that positive views of technology and innovation-orientated attitudes are important for supporting digital health and biomedical innovation.

6 CONCLUSION AND FUTURE WORK

This study explored how SQ, PU, ATU, EO, and PIBP are connected in Indonesia's biomedical engineering and healthcare technology fields. The results showed that people with positive views of mobile health systems were more likely to have a favourable attitude toward technology. This, in turn, led to a stronger entrepreneurial orientation and a higher perceived performance in biomedical innovation. The study builds on the TAM research by connecting technology perceptions with innovation-focused professional behaviour in biomedical settings. Although the study offers valuable insights, its cross-sectional, self-reported design limits its generalisability. Subsequent research should utilise longitudinal or multi-source methodologies to assess causal relationships and include objective indicators of biomedical innovation. Additionally, future investigations could compare various professional groups and explore factors such as digital literacy, organisational support, and healthcare technology readiness within biomedical innovation ecosystems.

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