Article DOI: https://doi.org/10.37284/eajhs.7.1.2331

East African Journal of Health and Science
eajhs.eanso.org
Volume 7 Issue 1, 2024
Print ISSN: 2707-3912 | Online ISSN: 2707-3920
Title DOI: https://doi.org/10.37284/2707-3920

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya

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Article DOI: https://doi.org/10.37284/eajhs.7.1.2331

Date Published: *23 October 2024*

Keywords: *mHealth, Kenya, Mobile phone, Internet, Technology Adoption.*

ABSTRACT

Background and Purpose*:* Kenya and other low-income countries face healthcare challenges such as affordability, access, and health worker shortages. Digital technologies have disrupted traditional service delivery in industries such as banking and retail. Significant changes have not yet affected healthcare. Technological advancements in healthcare may help to leapfrog barriers such as the cost of physical infrastructure. The study examined the influence of technical, social, and individual factors in adopting mHealth products in Embu, Kenya. **Methods:** A cross-sectional quantitative study using a structured close-ended questionnaire was conducted in Embu, Kenya, between August and December 2019. Correlation and regression analysis were used to determine the effect of the influential factors on adopting mHealth products. **Results:** 207 (75%) randomly selected respondents over 18 years completed the survey, with the largest group (39.4%) aged between 35-44 years and 43% holding a post-secondary school diploma. Correlation analysis showed that social factors positively and significantly correlate to mHealth products' adoption (r (207) = .793, P < .05), reflecting a generally favourable view towards using mobile phones for seeking healthcare. Similarly, technical factors showed a significant correlation with mHealth adoption (r (207) = .931, P < .05), supported by widespread smartphone ownership and access to high-speed internet. Individual factors, including perceptions of the time-saving benefits of seeking healthcare services using a mobile phone, also demonstrated a positive correlation with the adoption of mHealth (r (207) = .708, P < .05). **Conclusions:** Our study underscores the significant relationship of social, technical, and individual factors in adopting mHealth products. Digital health implementers should leverage increasing access to technical factors such as the Internet, smartphones, good mobile network coverage, and high utilization of social media to facilitate the positive adoption of mHealth. Our research provided insights from Embu; however, expansive studies encompassing rural and urban demographics are required to enhance generalizability.

Article DOI: https://doi.org/10.37284/eajhs.7.1.2331

APA CITATION

Kirengo, T. O. & Bellows, S. (2024). Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya. *East African Journal of Health and Science*, *7*(1), 516-527. https://doi.org/10.37284/eajhs.7.1.2331.

CHICAGO CITATION

Kirengo, Thomas Onyango and Scott Bellows. 2024. "Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya". *East African Journal of Health and Science* 7 (1), 516-527. https://doi.org/10.37284/eajhs.7.1.2331.

HARVARD CITATION

Kirengo, T. O. & Bellows, S. (2024) "Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya", *East African Journal of Health and Science*, 7(1), pp. 516-527. doi: 10.37284/eajhs.7.1.2331.

IEEE CITATION

T. O., Kirengo & S., Bellows, "Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya", *EAJHS*, vol. 7, no. 1, pp. 516-527, Oct. 2024.

MLA CITATION

Kirengo, Thomas Onyango & Scott Bellows. "Understanding the Factors Influencing Adoption of mHealth in Rural Patients: A Case of Embu, Kenya". *East African Journal of Health and Science*, Vol. 7, no. 1, Oct. 2024, pp. 516-527, doi:10.37284/eajhs.7.1.2331.

INTRODUCTION

Kenya faces various healthcare challenges: affordability, access, and health worker shortages, the ratio being only 15 health workers to 500 people [1]. According to the Kenya Demographic and Health Survey (KDHS), only 58% of women attend the recommended four antenatal care visits before childbirth. Only one in every three newborns receives postnatal care from a doctor, nurse, or midwife. Additionally, less than 60% of children with a respiratory or diarrheal illness had been taken to a health provider [2]. Digital technologies have disrupted traditional service delivery throughout industries such as banking, retail, and insurance in the third industrial revolution [3]. Despite this, significant changes have not affected healthcare. African countries may benefit from technological advancements in healthcare to leapfrog and overcome barriers to healthcare provision [4].

In 2005 eHealth was identified as a priority by the World Health Organization (WHO) as it is critical to achieving Universal Health Coverage (UHC) [5]. It was defined as the use of information and communication technologies (ICT) in support of health and health-related fields at the World Health Assembly (WHA) [6]. African leaders committed to supporting eHealth aimed at creating holistic applications of ICT to support and improve healthcare delivery, coordination, and integration amongst different healthcare providers at different levels in the system [4].

mHealth (also known as mobile health) is defined as the use of mobile devices for medical and public health practice [5]. Examples include short message service (SMS) appointment booking reminders, medical call centres, mobile patient monitoring devices such as smart watches, electronic health records, patient information on mobile devices, and mobile telehealth such as hospital or clinic apps. mHealth can increase access to health services for those in remote and underserved locations as mobile phones are currently the most widespread form of personal technology. Their use has increased remarkably in developing nations from 1.2 billion to 5.5 billion in 2015. [5]. Kenya's mobile and internet penetration is among the highest in Africa at 83% and 58% of the 44.35 million population [7]. Smartphones accounted for 1.8 Million of 3.1 Million devices sold in Kenya in 2015 [8]. However, access to healthcare has not considerably improved despite the increased mobile penetration [9].

Digital health initiatives in developing countries have been on the increase. A WHO survey indicated that 83% of member states had implemented at least one mHealth initiative in their country [10]. In 2011 Safaricom, the largest Mobile Service provider in Kenya launched a new service that allowed sick persons to seek

Article DOI: https://doi.org/10.37284/eajhs.7.1.2331

medical attention from doctors available on the phone. Despite addressing an apparent need, fair pricing, and an endorsement by the Kenya Medical Practitioners and Dentist Board (KMPDB), the product failed to gain traction [11]. A mobile phone system in Zanzibar that enabled mothers to contact their primary care provider led to increased attendance of antenatal clinic visits and reduced the prenatal mortality rate to 1.9% compared to a high of 3.6% but was still unable to achieve an impactful scale [12].

We identified a knowledge gap in understanding the key factors influencing the adoption of mHealth products currently available in the Kenyan market. The main aim of our study was to determine the influence of individual, technical, and social factors on users intention to adopt mhealth products in Embu.

THEORETICAL FRAMEWORK

The Technology Acceptance Model (TAM), the Extended/ Modified TAM, also referred to as TAM 2 model, and the Unified Theory of Acceptance and Use of Technology (UTAUT) are widely accepted theories to explain why individuals accept new information technology and systems [13]. They are based on principles of the theory of reasoned action and consider different vital and moderating factors that affect adoption [14, 15]. The key factors identified were: performance expectancy, effort expectancy, social influence, and facilitating conditions. The moderating factors were: age, gender, experience, and voluntariness [16].

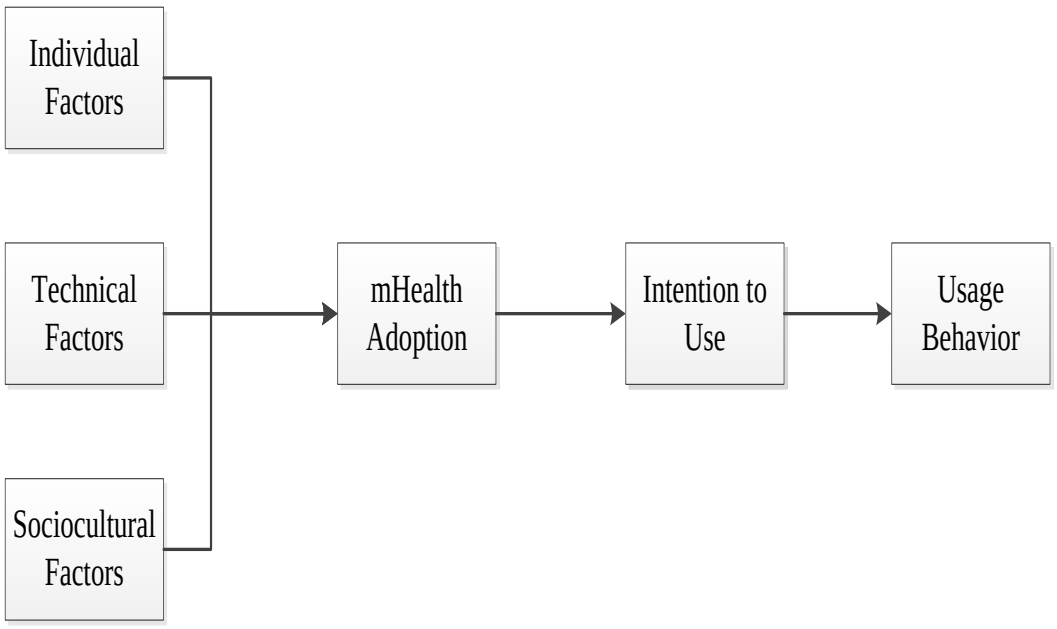
CONCEPTUAL FRAMEWORK

The social context of the population largely influences the diffusion of innovation [17]. Social factors like compliance, subjective norms, group norms, social network configuration, and identification (social image and self-image) have been conceptualized to influence innovation and technology adoption ([18].

Technical factors are those concerning technology, including infrastructure and the level of technological advancement, user needs and benefits, and the competitive landscape [19].

The study's conceptual approach to the factors influencing the adoption of mHealth is based on these theories.

Figure 1: Conceptual Framework



Article DOI: https://doi.org/10.37284/eajhs.7.1.2331

METHODOLOGY

We performed a cross-sectional quantitative study using a structured close-ended questionnaire administered to participants face to face. Data collection was carried out from August to December 2019 in Embu, Kenya. Questions were adapted from previous studies, reviewed, and reworded to fit the framework of the research. A 10-person pre-test was conducted to ensure the questions were clearly understood and properly structured. The Cronbach's Alpha test indicated that all the sections in the questionnaire possessed high-reliability standards ranging from 0.773 to 0.883 for the constructs under investigation. The Cronbach's Alpha value for the combined variables of the study was 0.866.

Two research assistants were recruited and trained to conduct the questionnaire survey. The principle investigator supervised the data collection and participated in 5% of the surveys. The questionnaire included an initial section for the respondents bio-data (Age, gender and level of education). It was then divided into 4 sections with questions regarding: Technical, social, and individual factors and behavioural intention, as described in the conceptual framework (**Figure 1**). Opinions were recorded using a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Verbal consent was received from each respondent at the start of the survey, and their confidentiality and anonymity were maintained. Respondents were additionally made aware of their right to withdraw their consent at any point during the questionnaire.

The study population consisted of any individual above 18 years in the Embu County Central Business District, with an estimated population of 144,347 [20]. Cochran formula (1977) was used to determine the sample size, 277 participants (margin of error(e)=5%, confidence level(z)=90%, sample proportion(p)=0.5), who were then selected using simple random sampling[21].

Data analysis was done using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. All the data was coded and verified at the point of data entry. Bivariate relationships between the observed variables were established, with the dependent variable being the intention to use mHealth products, while the independent variables were technical factors, social factors, and individual influences that affect the adoption of mHealth products.

Descriptive analysis used frequencies, percentages, means, and other central tendencies. Relationships between the dependent and independent variables were established by using correlations and regression analysis. Statistical significance was considered at a 95% confidence interval (CI).

Ethics were maintained throughout the study with supporting documentation from the Dean School of Graduate Studies, Research and Extension, United States International University (USIU), and the Kenya, National Commission for Science, Technology, and Innovation (NACOSTI).

RESULTS AND FINDINGS

A total of 207 (out of 277) respondents (93(46.3%) female, 108(53.7%) male) participated in the survey, with a response rate of 207(75%). **Table 1** shows that most of the respondents 80(39.4%) were between the ages of 35-44yrs. The majority of the respondents 89(43%) had a post-secondary school diploma, followed by those with a Post-secondary school certificate 58(28%).

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Table 1: Socio-demographic characteristics of study participants

Characteristics of study participants		All (N=207)	Percentage (%)
Gender	Male	108	53.7%
	Female	93	46.3%
	Missing	6	-
Age in years	18-24	8	3.9%
	25-34	26	12.8%
	35-44	80	39.4%
	45-54	60	29.6%
	55-64	27	13.3%
	>64	2	1.0%
	Missing	4	-
Education	Primary School	6	2.9%
	Secondary School	12	5.8%
	Post-secondary School Certificate	58	28.0%
	Post-secondary School Diploma	89	43.0%
	Undergraduate Degree	34	16.4%
	Master's Degree	8	3.9%

Descriptive Statistics

The respondents were required to give their opinions on a scale of 1 (strongly disagree) to 7 (strongly agree) on the social, technical, and individual affecting the adoption of mHealth products. An analysis was done to determine the frequency and percentage distribution of the responses. The study found that the majority of respondents either agree or strongly agree that people who are either important 160(77.3%), familiar 145(70%), or influence their behaviour 143(69.3%) think that they should use their mobile phone for healthcare. Own or have access to a smartphone 143(69.6%). Believe that seeking healthcare, using a mobile phone would be useful 178(85.9%). **Table 2** shows the descriptive statistics of responses to the factors affecting the adoption of mHealth.

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Table 2: Social, Technical, and Individual Factors affecting Adoption of mHealth Products

Factors	Questionnaire	Disagree Strongly	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Agree Strongly	N	Mean response	Std. Deviation
Social Factors	People who are important to me think that I should use mobile phone for healthcare	0%	0.5%	4.3%	3.9%	14.0%	48.8%	28.5%	207	5.92	0.826
	People who are familiar to me think that I should use mobile phone for healthcare	0%	1.9%	2.4%	6.3%	19.3%	56.5%	13.5%	207	5.67	0.852
	People who influence my behaviour think that I should use mobile phone for healthcare	0.5%	1.9%	3.9%	5.3%	18.8%	48.3%	21.3%	207	5.70	0.865
Technical Factors	Do you own or have access to a Smartphone	0.5%	2.9%	2.9%	7.7%	15.9%	43.5%	26.1%	206	0.847	0.847
	Do you have access to good mobile phone network service at home	1.4%	1.9%	2.9%	7.7%	16.4%	37.7%	31.9%	207	0.789	0.789
	Do you have access to good mobile phone network service at work	0%	6.8%	2.4%	5.8%	14.5%	43.0%	26.6%	205	0.858	0.858
	Do you have high speed internet available at home	0.5%	20.8%	9.2%	5.8%	15.5%	30.4%	16.4%	204	0.897	0.897
	Do you have high speed internet available at work	1.0%	25.1%	3.4%	5.8%	10.6%	30.4%	23.2%	206	0.892	0.892
	Do you use internet based apps for communication frequently eg.Whatsapp, email	0.5%	1.9%	2.4%	2.9%	11.6%	42.0%	38.6%	207	0.745	0.745
	Do you use social media frequently eg. Facebook, Instagram, Twitter	0%	1.9%	2.4%	2.9%	15.5%	39.6%	37.7%	207	0.752	0.752
Individual Factors	In seeking healthcare using mobile phone would improve my performance	0%	0.5%	1.0%	2.4%	10.1%	50.2%	34.3%	204	6.15	.835
	In seeking healthcare using mobile phone would save my time	0%	0.5%	1.9%	0.5%	15.5%	52.7%	28.5%	206	6.04	.846
	In seeking healthcare I would use mobile phone anywhere	0%	0.5%	1.4%	3.9%	10.6%	44.9%	38.6%	207	6.14	.916
	In seeking healthcare I would find using mobile phone useful	0%	0.5%	1.0%	2.9%	9.7%	50.2%	35.7%	207	6.15	.845

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Correlation & Regression analysis

Correlation analysis showed that social factors ($r(207) = .793$, $P < .05$), technical factors (r(207) = .931, $P < .05$) and individual factors (, $r(207) = .708$, $P < .05$) positively and significantly correlate to mHealth products' adoption, as shown in **Table 3**.

Table 3: Correlation between Social, Technical and Individual Factors and mHealth Products

Factors	Pearson Correlation	Sig. (2-tailed)
Social factors	.793**	.000
Technical factors	.931**	.000
Individual factors	.708**	.000
** Correlation is significant at the 0.01 level (2-tailed).		

Bivariate linear regression model findings, as shown in **Table 4**, revealed that the adoption of mHealth products among the residents of Embu town can be attributed to technical factors (R Square = 86.6%), social factors (R Square = 62.9%), and individual factors (R Square = 50.1%).

Table 4: Regression Model Summary for influential Factors and mHealth Products

Factors	R	R Square	Adjusted R Square	Std. Error of the Estimate
Social Factors	.793[a]	.629	.627	.452
Technical Factors	.931[a]	.866	.866	.271
Individual Factors	.708[a]	.501	.499	.524
a Predictors: (Constant), Social, Technical or Individual Factors b Dependent Variable: mHealth Products				

ANOVA analysis, **Table 5**, showed a statistically significant relationship linking social factors ($F(1, 205) = 347.445$, $P < .05$), technical factors ($F(1, 205) = 1329.264$, $P < .05$), individual factors ($F(1, 205) = 205.897$, $P < .05$) and adoption of mHealth products.

Table 5: Regression ANOVA for Influential Factors and mHealth Products

Factors	Model	Sum of Squares	df	Mean Square	F	Sig.
Social Factors	Regression	70.867	1	70.867	347.445	.000[b]
	Residual	41.813	205	.204		
Technical Factors	Regression	97.624	1	97.624	1329.264	.000[b]
	Residual	15.056	205	.073		
Individual Factors	Regression	56.463	1	56.463	205.897	.000[b]
	Residual	56.217	205	.274		
a. Dependent Variable: Adoption of mHealth products b. Predictors: (Constant), Social, Technical, or Individual factors						

The study findings, **Table 6**, indicate that social factors ($\beta = .616$, $t(207) = 18.640$, $P < .05$), technical factors ($\beta = .730$, $t(207) = 36.459$, $P < .05$), and individual factors ($\beta = .763$, $t(207) = 14.349$, $P < .05$) positively and significantly predicts adoption of mHealth products.

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Table 6: Regression Coefficients for Influential Factors and mHealth Products

Factors	Model	B*	Std. Error*	Beta**	t	Sig.	Relationship as equation
Social Factors	(Constant)	2.207	.193		11.436	.000	
	Social factors	.616	.033	.793	18.640	.000	Adoption of mHealth products = 2.207 + 0.616 Social Factors + ε
Technical factors	(Constant)	1.708	.113		15.161	.000	
	Technical factors	.730	.020	.931	36.459	.000	Adoption of mHealth products = 1.708 + 0.730 Technical Factors + ε
Individual factors	(Constant)	1.090	.327		3.330	.001	
	Individual factors	.763	.053	.708	14.349	.000	Adoption of mHealth products = 1.090 + 0.763 Individual Factors + ε

a. Dependent Variable: Adoption of mHealth Products
* Unstandardized Coefficient
** Standardized Coefficient

DISCUSSION:

Our study examined the factors influencing the adoption of mHealth products by people living in a rural town, Embu, in Kenya. Majority of the respondents were male 108(53.7%), aged between 35-54 years 140(69%), and had Post-secondary school education 147(71%). We found that social, technical, and individual factors positively and significantly correlated and predicted the adoption of mHealth products.

The study revealed that individuals perceive it as beneficial to seek healthcare services using mobile phones. They felt that using mobile phones enhances communication and helps improve efficiency, thus improving their performance and that seeking healthcare using mobile phones would save time. Hence, most people would seek healthcare using their mobile phones regardless of location if such an option was available.

Social Factors and Adoption of mHealth Products

Our study showed that social factors influence and predict technology adoption. Most of the study respondents' social connections showed a favourable view of using mobile phones to seek health care. Wyatt & Krauskopf (2012) found that many people already use smartphones when seeking health services, taking notes and memos, and looking up drugs, among other things [22]. New mHealth products need social influence to achieve awareness at a critical mass level that can influence spread [17]. Social factors have been found to have a stronger influence on technology adoption, especially in the early stages of new technology, when many users have little experience and knowledge of these technologies and their benefits and, therefore, rely on the views of others [23]. Although, our study did not examine the effect of social factors at different stages of technology adoption. Understanding and ensuring a positive social attitude exists towards the technological solutions being introduced is necessary. Care should be taken when selecting influential individuals to associate with mHealth technologies, as this might impact successful adoption.

The language used in mHealth products should be considered, and translation into the local dialect

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may improve the use of these technologies. Slobin et al. found that the adoption of mHealth products and other innovations is affected by language barriers [24]. Active planning is needed to predict and break social barriers when introducing mHealth products.

Technical Factors and Adoption of mHealth Products

We found that most participants owned or had access to smartphones, good mobile phone networks, and high-speed internet services at their homesteads and work. They frequently used internet-based applications and social media sites and could potentially adopt and use mHealth products to access and utilize health services. This was interesting as some studies suggest that Kenya still faces numerous challenges, such as low technology uptake, particularly in rural areas, due to poor policies, infrastructure, and high poverty levels [25]. However, in the past few decades, Kenya and other African countries have rapidly increased mobile phone penetration, connectivity, and coverage [25, 26]. Oteri et al. (2015) found that Kenya has rapidly increased network coverage, fuelled mainly by telecom industry competition [26, 27]. Additionally, Lorenz & Buhtz (2017) showed that new technologies such as 3G and 4G have enabled mobile Internet access [18].

The interconnectedness of technology and social influence should also be considered. Our findings confirm that the utilization of online social networks such as Facebook is widespread. Most African social media users only access the internet using mobile devices such as smartphones [26].

Individual Factors and Adoption of mHealth Products

Similarly, our analysis also found that individual factors predict the adoption of mHealth Products. People have varied views about different technologies depending on their perceptions and attitudes [25]. Perceived benefits such as time savings, ease of use, and fears like negative beliefs and product shortcomings affect the adoption of technology [13, 28-30]. For example, health practitioners who believe technology might replace them at work are liable to develop a negative attitude towards mHealth products [16]. Adequate support and training on how to use mHealth technologies can help users develop the right attitude and become part of the implementation process (19). A human-centred design approach is needed in the development of mHealth products. High empathy and focus on solutions for actual user problems are key. In addition, end users should be engaged early to use a product as they will be the probable catalyst to its wider adoption through their social connections.

Limitations

Our study encountered some limitations. We had a 207(75%) response rate from our target sample size and a predominance of respondents over the age of 34 years, which could have introduced bias. Moreover, the study was confined to a single geographical area in Kenya, limiting the generalizability of our results. While recognized as influential, other factors, such as the perceived ease of use of mHealth technologies, were outside our research scope. The cross-sectional design of our study precludes the establishment of causality. The questionnaire survey was conducted in English and was not translated into the local language. A qualitative design might be useful to get an in-depth view of the respondent's opinions. Future research should explore these areas to validate our results in diverse settings.

CONCLUSION:

Our study emphasises the importance of social, technical, and individual factors in adopting mHealth products. The findings highlight that increasing access to technical resources, such as the Internet, smartphones, and good mobile network coverage, coupled with high social media usage, can significantly facilitate the adoption of mHealth technologies. To enhance adoption rates, digital

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health implementers must focus on user-centred design and ensure that mHealth products are accessible and valuable to users.

Our research suggests that broader studies encompassing both rural and urban settings are necessary to improve the applicability of the findings. Additionally, the role of healthcare practitioners as key influencers in adopting healthcare technology warrants further investigation, which could provide critical insights for more effective implementation of eHealth solutions.

Summary Points:

What was already known on the topic?

- Digital technologies have the potential to address healthcare affordability, access, and health worker shortages in low-income countries like Kenya.
- The widespread adoption of mobile phones in developing nations offers a platform for mHealth initiatives to increase access to health services.
- Social, technical, and individual factors influence the adoption of new technologies, as outlined by theories like the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

What this study added to the body of knowledge?

- This study provided empirical evidence that social, technical, and individual factors significantly influence the adoption of mHealth products in a rural Kenyan setting.
- The study demonstrated a generally favourable view towards using mobile phones to seek healthcare.
- The research highlighted the increasing access to the Internet, smartphones, and social media that can be leveraged in driving the adoption of mHealth technologies.

Conflict of Interest:

The author(s) declare that they have no conflicts of interest.

Acknowledgements:

Ryan Nyotu Gitau, AfyaPress Africa Limited, Kenya,

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LIST OF ABBREVIATIONS AND ACRONYMS

BI-Behavioural intentions
ICT-Information Communication Technology
IF-Individual Factors
GOK-Government of Kenya
GSMA-Groupe Spécial Mobile Association
HIS-Health Information Systems
KMPDB-Kenya Medical Practitioners and Dentist Board
KDHS-Kenya Demographic and Health Survey
mHealth- Mobile Health
PDAs-Personal digital assistants
SDG-Sustainable Developmental Goal
SF-Social Factors
SIM - Subscriber Identity Module
SMS-Short Message Service
SN- Subjective norm
SPSS - Statistical Package for Social Sciences
USSD - Unstructured Supplementary Service Data
TAM-Technology Acceptance Model
TF-Technical Factors
TRA - Theory of Reasoned Action
UHC-Universal Health Coverage
UN-United nations
UTAUT- Unified Theory of Acceptance and Use of Technology
WHO-World Health Organization

