
Evaluating the role of perceived usefulness in user adoption of mobile immunisation notification system in Uganda

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Abstract: The study sought to evaluate the role of perceived usefulness in user adoption of mobile immunisation-notification system in Uganda. Descriptive survey design was employed and structured questionnaires were administered to 51 healthcare professionals and mothers from Gulu referral and Gulu independent hospitals in Northern Uganda using purposive sampling technique. Regression analysis was performed to evaluate the impact of the identified antecedents on the intention to adopt IMUNOT through perceived usefulness based on technology acceptance model. The findings showed e-health knowledge, accessibility, support, content and trust as the antecedents of perceived usefulness with 87.8% of variance. The findings suggest the importance of perceived usefulness in the mobile Immunisation-notification system adoption. The study provides behavioural and infrastructural strategies for stakeholders on how to foster perceived usefulness in the system adoption. However, more variables may be evaluated to improve the analytical capability of the model.

Keywords: perceived usefulness; immunisation; notification; adoption and mobile e-health; Uganda.

Reference to this paper should be made as follows: Abandu, J. and Kivunike, F.N. (2017) 'Evaluating the role of perceived usefulness in user adoption of mobile immunisation notification system in Uganda', *Int. J. Telemedicine and Clinical Practices*, Vol. 2, No. 2, pp.154–167.

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1 Introduction

In Uganda, maternal-child health carries 20% of the total disease burden and most of which are caused by the poor mobilisation of mothers (Namazzi et al., 2015; Union, 2015; Bonny, 2010). The high mortality of mothers and children has become a world-wide concern and hence need to provide accessible information to the public through e-health (WHO, 2014; Nurmatov et al., 2014). Mobile e-health uses mobile communication devices such as cell phones and smartphones to exchange health information and support public health (Barton, 2012). Cell phones and smartphones have become trust worthy in terms of user management and advanced security features (Chandra et al., 2010). The use of mobile e-health ranges from communication between individuals and health systems to health monitoring by the systems. The communication between the individuals and the health systems involves the use of call centres; appointment reminders and treatment compliance. In Uganda, the use of village health teams (VHTs) and health cards are the prevalent methods for disseminating information to the mothers despite the availability of mobile phones (UBOS, 2014; Bazos et al., 2015). These traditional methods are limited by delays; poor facilitation and insensitive attitudes of the staff (MOH, 2012; Bazos et al., 2015). Information and communication technology (ICT) is only used between Ministry of Health and health offices of the districts (MOH, 2012). For example, mTRAC is used for monitoring medicine supply through sending SMS with real-time data to map stocks; mobileVRS facilitates the birth registration of children (MOH, 2013). Health monitoring and surveillance provides for health checks through real-time data for disease clustering (Brinkel et al., 2014). It is envisaged that timely notification of mothers through mobile phones is likely to improve their participation and understanding of the value of vaccination. It is believed that a system perceived useful may be highly accepted by the target users (Davis et al., 1989; Venkatesh et al., 2003; Ghobakhloo et al., 2012).

Based on the above facts and technology acceptance model (TAM); the study sought to evaluate the role of perceived usefulness in the user intention to adopt mobile immunisation notification (IMUNOT) system in Uganda. The purpose of the study was achieved through evaluating each of the antecedents of perceived usefulness in relation to their impact on the intention to adopt IMUNOT. Adoption refers to the individual's intentional use of a technology for the tasks it is designed to support (Yarbrough and Smith, 2007). It is envisaged that the IMUNOT system if adopted will notify and remind mothers of the immunisation schedules. The research involved health workers and mothers from Gulu referral and Gulu independent hospitals in Northern Uganda as the main consumers of the new system. Northern Uganda is still recovering from the post conflict effects caused by the twenty years of the Lord's Resistance Army (LRA) revolt

coupled with the high infant mortality rate (Atri and Cusimano, 2013; Mugenyi et al., 2009). The mothers in Northern Uganda face the challenge of inaccessible information from the distant health facilities; in addition to food shortage that keeps them busy in the farms as their main source of survival (Atri and Cusimano, 2013). Based on these reasons, Northern Uganda provides a favourable context for testing the research problem. The IMUNOT system if adopted can help to remind the mothers of the dates of immunisation via the short messaging services (SMS) sent through their mobile phones.

Table 1 Summary of e-health implementation factors

<i>Categories</i>	<i>Constructs</i>	<i>Source</i>
Contextual	ICT skills	Hage et al. (2013), Woodward et al. (2014), Schwitzgebel (2006) and Anwar et al. (2011)
	E-health knowledge	Hage et al. (2013) and Singh and Muthuswamy (2013)
	Perceived usefulness	Davis (1989) and Venkatesh et al. (2003)
	Perceived ease of use	Davis (1989) and Venkatesh et al. (2003)
	Trust	Asianzu and Maiga (2012), Masrek (2012), Luo et al. (2010) and McGinn et al. (2011)
	Attitude	Davis (1989), Venkatesh et al. (2003) and Hage et al. (2013)
Process	Awareness	Woodward et al. (2014) and Hage et al. (2013)
	Support	Enz (2012), Silow-Carroll et al. (2012), Hage et al. (2013) and Denis et al. (2001)
	Knowledge sharing	Huang and Liu (2004), Nguyen et al. (2012) and Adebayo et al. (2013)
	Accessibility	Phichitchaisopa and Naenna (2013) and Asianzu and Maiga (2012)
	Funding	Singh et al. (2013), McGinn et al. (2011) and Isabalija et al. (2011)
Content	Compatibility	Hage et al. (2013), Viitanen et al. (2011), Henry (2007) and Hill et al. (2007)

2 Literature review

2.1 Underlying theoretical model

The study was grounded on the popular TAM by Davis et al. (1989) and Venkatesh et al. (2003). TAM examines the acceptance of an information system through the review of the related work to maintain consistency in the study. TAM has strengthened the field of information systems by its research rigor and serves where the theories are scarce. TAM provides for further extensions and associates with the challenging models that explain the acceptance of an information system by the users. TAM describes the acceptance of a system based on perceived usefulness and perceived ease of use as an extension of the theory of reasoned action that explains why a user accepts or rejects a system (Ajzen and Fishbein, 1980). The perceived usefulness and perceived ease of use are the two dependent constructs of TAM that influence user satisfaction predicted to be a major

factor that influences the adoption of a system. Perceived usefulness shows the level of belief by a person that a particular use of a system will enhance the performance of his work and productivity. The productivity of the users increases with the increase in the speed of the work processes (Phichitchaisopa and Naenna, 2013). Perceived ease of use indicates the degree of spending little effort in using the system and it is associated with content and technical issues (McGinn et al., 2011). Perceived ease of use involves the ability of a technology to be used easily; facilitating ones service and ease of fixing errors (Phichitchaisopa and Naenna, 2013; McGinn et al., 2011). Behavioural intention to use demonstrates the attitude towards the use of the system. According to TAM, the behavioural intention to use a system is influenced by the perceived usefulness of the system and in turn affects the actual system usage. TAM claims perceived usefulness as a key factor to the system acceptance but it does not explain what constitutes the 'perceived usefulness' (Loria, 2010).

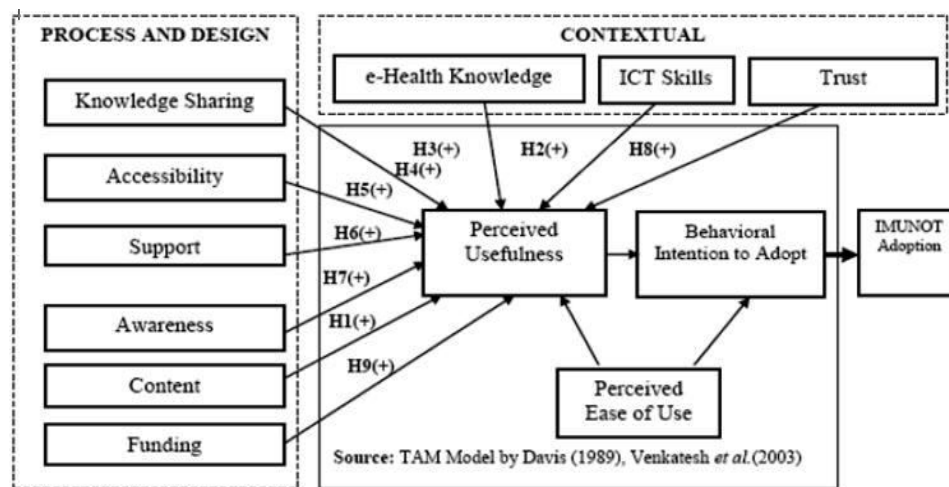
In the study, e-health factors were identified and then categorised into contextual, process and content factors. Contextual factors determine the characteristics of a population sample in terms of the skills; trust and attitude (Isabalija et al., 2011). The contextual variables include a need for e-health; isolation; digital divide and post-conflict effects. Users may resist a new system if they feel comfortable with the routine practice (Anwar et al., 2011). The persons who possess ICT skills are likely to accept a new system (Woodward et al., 2014). A need for e-health may arise through comparing the performances of the existing and new systems. If the previous system of supplying information is slow, it is likely that users may adopt the new system as an alternative. A system can easily be adopted if the information it provides is accessible without hindering the workflow (Hasan et al., 2013). Access to ICT infrastructure (computers, internet, training, user support, software and skilled personnel) is vital for the acceptance and use of a system. Access to a strong ICT infrastructure allows room for planning and healthcare interventions (Anwar et al., 2011). A strong ICT infrastructure requires adequate funding for the acquisition of hardware; software and meeting the costs of the business operations (Darkins et al., 2008). Process factors determine the ability of an organisation to promote the use of e-health through a set of strategies. The strategies may include: leadership; knowledge sharing; awareness; training; trust; funding and expertise. Content factors determine the design of a system in terms of the interoperability and compatibility of the system with other systems in one or more organisations (Hage et al., 2013; Viitanen et al., 2011). Other factors include perceived usefulness and ease of use as explained by TAM. Leadership is one of the critical factors that determine the success of e-health adoption (Silow-Carroll et al., 2012). A good leadership communicates to diverse groups in terms of collective learning; evaluation meetings and strong collaborations with different supporting partners (Hage et al., 2013). Knowledge sharing helps to exchange knowledge among people; friends; families; communities or organisations. Knowledge sharing requires a positive perception or attitude towards ICT adoption by the top management. Most people understand e-health as the use of ICT without focusing on the e-health inventions and hence need for awareness through training and sensitisation (Woodward et al., 2014). Training helps the users to get comfort of accepting the system (Singh and Muthuswamy 2013). Trust is a belief by users that the information provided can be misused or the information is insecure (Mohamad, 2012; Luo et al., 2010; McGinn et al., 2011). Information is insecure in terms of eaves dropping, password cracking and denial of services (Dishongh and McGrath, 2010). The technical capacity building of an organisation can be acquired through

expertise and skills. Lack of interoperability of a system to interface with other systems is an obstacle to user acceptance of the system (McGinn et al., 2011). Compatibility of a system influences the life style of users in their daily job responsibilities and beliefs which in turn impacts on the system adoption (Hill et al., 2007).

2.2 Research model and hypotheses

Figure 1 shows the proposed model derived from the extension of TAM to show the role of perceived usefulness in the adoption of IMUNOT as hypothesised in the relationships H1 (+) to H9 (+).

Figure 1 Mobile IMUNOT system adoption model (extension of TAM)



Source: TAM model by Davis (1989) and Venkatesh et al. (2003)

Hypotheses:

- H1 (+) Content increases perceived usefulness of IMUNOT system.
- H2 (+) Acquisition of ICT skill increases perceived usefulness of IMUNOT system.
- H3 (+) Acquisition of e-health knowledge increases perceived usefulness of IMUNOT system.
- H4 (+) Knowledge sharing increases perceived usefulness of IMUNOT system.
- H5 (+) Accessibility is associated with increase in the level of perceived usefulness of IMUNOT.
- H6 (+) Support is associated with increase in the level of perceived usefulness of IMUNOT.
- H7 (+) Awareness increases the level of perceived usefulness of IMUNOT system.
- H8 (+) Trust is associated with increase in the level of perceived usefulness of IMUNOT system.
- H9 (+) Funding is associated with increase in the perceived usefulness IMUNOT system.

3 Research methods, sampling and data collection

Descriptive survey design was used to carry out the study in Northern Uganda with the use of 51 respondents (health workers and mothers) from Gulu referral and independent hospitals. Descriptive survey design provides answers to ‘why’, ‘what’ and ‘how’ questions in addition to giving room for generalisation (De Vaus and de Vaus, 2001). Purposive sampling technique was used to make the sample representative of the purpose of the study (Barreiro and Albandoz, 2001). Structured questionnaire was used for collecting data from doctors, nurses, clinical officers and mothers. Questionnaire is quick to administer and it provides valuable information on beliefs of the respondents. Questionnaire validation was done to ensure consistency in what the researcher expected to measure. This was accomplished through expert reviews, pre-tests and assessments using item scale correlation and coefficient alpha with the help of windows statistical package for social sciences (SPSS). Prior to data collection, ethical issues were considered to build trust and confidence in respondents (White-Williams and Oetjen, 2015). This was achieved by availing the respondents with introduction letters to explain the purpose of the study. Two field assistants were trained and closely supervised by the researcher to ensure accuracy and timeliness in data collection. The data collected was validated and analysed with the help of SPSS. The identified constructs were then used to extend TAM including discussing the influence and interrelationships of the model constructs. The proposed model was finally validated with the overall aim of showing its acceptance and continued usage.

4 Results and analysis

Demographics: Table 2 shows that the sample comprised 47% males and 53% females. The finding also shows that 41.1% males and 37.3% females have ICT skills. Similarly, 23.5% males and 19.6% females have e-health knowledge. In general, 78.4% and 43.1% of the respondents have ICT skills and e-health knowledge respectively thus enhancing the intention to adopt IMUNOT (Hage et al., 2013; Woodward et al., 2014).

Table 2 Demographic profile of the survey respondents

Variable	Category	Frequency	Response (%)							
			ICT skills				e-Health knowledge			
			Disagree	Agree	Not sure	Total	Disagree	Agree	Not sure	Total
Gender	Male	24	5.9	41.1	0.0	47	13.7	23.5	9.8	47
	Female	27	13.7	37.3	1.9	53	23.4	19.6	9.8	53
Total		51	19.6	78.4	1.9	100	37.1	43.1	19.6	100
Age	20–29	20	9.9	29.4	0.0	39	15.7	15.7	7.8	39
	30–39	23	5.9	37.3	1.9	45	17.6	21.6	5.9	45
	40–49	05	1.9	7.8	0.0	10	3.8	3.9	2.0	10
	≥50	03	1.9	3.9	0.0	6	0.0	1.9	3.9	6
Total		51	19.6	78.4	1.9	100	37.1	43.1	19.6	100

4.1 Factor analysis on the validation questionnaire

The convergent and discriminant validity of the questionnaire was obtained with the help of the principal component analysis (see Table 4) after the extraction of the components was done (see Table 3).

Table 3 shows that nine components with eigenvalue > 1.0 were extracted and Table 4 shows how the different items in the construct loaded on their respective components as a measure of convergent validity. All the factors loaded greater or equal to 0.5 on their respective components and hence discriminant validity was achieved. The reliability of the factors explains the variation in the opinions of the respondents by about 67% (see Table 3).

Regression analysis was used to measure the relationship between each of the independent variables and the 'perceived usefulness' of the system (see Tables 5 and 6). The independent variables include: e-health knowledge; funding; access to the system; skills; awareness; support; trust; knowledge sharing and content.

In Table 5, R shows the degree of correlation between the observed value and the predicted value of the dependent variable (perceived usefulness). R-squared is a statistical measure of how close the data are to the fitted regression line. R-squared indicates the proportion of the variance in the dependent variable explained by the combined impact of the independent variables. The closer R-squared is to 1.00, the better the model fits the study data. The R^2 is normally measured by the coefficient called adjusted R-square because R-squared tends to overestimate the fitness of the model. Table 5 shows that the model explained the variability of the response data around its mean by 87.8% and hence fits the study data. Five predictors which contributed to the fitness of the model include: trust; content; support; e-health knowledge and accessibility as indicated by their respective significance values (p value) in Table 6. The p values give the impact of each independent variable on the dependent variable.

Table 3 Total variance explaining eigenvalues

Component	Initial eigen values			Extraction sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.913	18.705	18.705	9.913	18.705	18.705
2	7.278	13.732	32.436	7.278	13.732	32.436
3	3.620	6.830	39.266	3.620	6.830	39.266
4	3.425	6.462	45.728	3.425	6.462	45.728
5	2.800	5.284	51.011	2.800	5.284	51.011
6	2.579	4.866	55.877	2.579	4.866	56.877
7	2.116	3.993	59.870	2.116	3.993	59.870
8	2.029	3.829	63.699	2.029	3.829	63.699
9	1.765	3.330	67.029	1.765	3.330	67.029

Note: Extraction method: principal component analysis

Table 4 Component factor loading of the validation questionnaire

Construct	Component								
	1	2	3	4	5	6	7	8	9
ICT3				.500					
ICT4					.500				
EHK3			.632						
EHK4			.510						
PU1	.604								
PU2	.690								
PU3	.616								
PU4	.688								
PU5	.600								
PEOU1									.517
PEOU2	.506								
PEOU3							.500		
AW1						.500			
AW2	.500								
FUND2								.519	
FUND3		.614							
ACC2	.621								
ACC4	.516								
SUP1	.709								
SUP2		.596							
SUP3		.642							
SUP4		.689							
SUP5		.565							
SUP6		.713							
SUP7		.574							
SUP10		.668							
TRUST1	.724								
TRUST3	.589								
ATT1	.550								
ATT2	.618								
ATT3	.698								
KSHARIN1	.568								
KSHARIN3		.564							
CONTENT2				.500					
CONTENT3	.591								
CONTENT4	.609								

Notes: Extraction method: principal component analysis.

Rotation method: Varimax with Kaiser normalisation.

Key: ICT: ICT skills; EHK: ehealth knowledge; PU: perceived usefulness; PEOU:

perceived ease of use; AW: awareness; FUND: funding;

ACC: accessibility; SUP: support; TRUST: trust; ATT: attitude;

KSHARIN: knowledge sharing; CONT: CONTENT.

Table 5 Model summary

<i>Model</i>	<i>R</i>	<i>R square (R²)</i>	<i>Adjusted R square</i>	<i>Std. error of the estimate</i>
1	.937	.878	.644	.380

Note: Predictors: support, trust, content, e-health knowledge and accessibility.

Table 6 Multiple regression analysis results

<i>Variables</i>	<i>Unstandardised coefficients</i>		<i>Standardised coefficients</i>	<i>t</i>	<i>Sig (P).</i>
	<i>B</i>	<i>Standard error</i>	<i>Beta</i>		
ICT skills	-.120	.138	-.142	-.864	.393
e-Health knowledge	.326	.139	.399	2.337	.025
Perceived ease of use	.488	.129	.522	3.790	.000
Awareness	.131	.164	.141	.798	.430
Funding	.316	.241	.230	1.310	.197
Accessibility	.342	.170	.350	2.007	.050
Support	.677	.131	.629	5.161	.000
Trust	.457	.138	.469	3.325	.002
Knowledge sharing	.336	.190	.312	1.765	.085
Content	.518	.159	.498	3.262	.002

Notes: R-square (R^2) = .878

Dependent variable: perceived usefulness

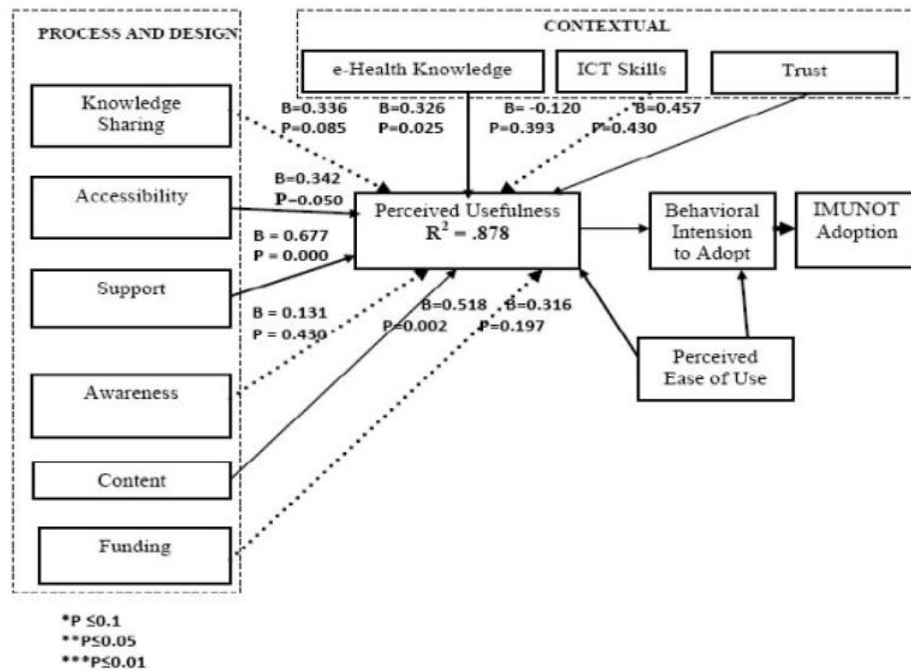
Table 6 shows how each of the independent variables impacts on the perceived usefulness at p value of 0.05. An independent variable has an impact on the dependent variable when its p value is ≤ 0.05 . The unstandardised B coefficient presents the direction and the weighting of an independent variable in relation to others. The unstandardised B coefficient was preferred to *Beta* (β) because the constant (*beta zero*) is included. The tolerance (*t*) values present the degree of correlation between the independent variables ranging between 0 and 1. When the *t* value for an independent variable is closer to 0, its relationship with other independent variables is predicted to be stronger. Table 6 shows that five independent variables impact on the perceived usefulness because their p values are $\leq .05$. The five independent variables are: e-health knowledge ($B = .326$, $P = .025$); access ($B = .342$, $P = .050$); support ($B = .677$, $P = .000$); trust ($B = .457$, $P = .002$) and content ($B = .518$, $P = .002$).

5 Discussion

Figure 2 shows that *support* was the most critical factor that relates with perceived usefulness i.e. $***P \leq 0.01$. *Access* to ICT infrastructure (internet; mobile devices; experts; power supply and training) relates to perceived usefulness at the level of $**P \leq 0.05$. ICT infrastructure is the backbone of e-health and hence need for adequate government and private sector support (Omary et al., 2010). *e-Health knowledge* has a

significant link with perceived usefulness at the level of $**P \leq 0.05$. Studies have demonstrated that users with e-health knowledge are more likely to recognise the usefulness of an e-health than those who do not have (Hofstede et al., 2014). *Trust* relates to perceived usefulness at the level of $***P \leq 0.01$. *Trust* is an expectation that alleviates fear in users from misuse and disclosure of private information to third parties. Therefore, improving information security through awareness and sensitisation is vital. *Content* has significant link with perceived usefulness at the level of $***P \leq 0.01$. The *content* of the IMUNOT system should reflect the users' job responsibilities, values and responsibilities for it to be accepted. It is important to develop skills and trainings consistent with the local cultures, languages and the design of the system for users to realise the benefits of the e-health (Yusif and Jeffrey, 2014).

Figure 2 Results of the regression analysis



Note: Significant relationship at $P \leq 0.05$

The regression confirms the relationship between the perceived usefulness of the IMUNOT system and e-health knowledge; accessibility; support; content and trust. The results of the regression show that the model is applicable for IMUNOT system adoption based on perceived usefulness with variance of 87.8%. The study makes contributions by highlighting the significance of the perceived usefulness and its antecedents in the adoption of the system. This helps to encourage the practitioners and designers of the system to consider perceived usefulness as a vital factor for its adoption. TAM has linked the adoption of a system to only 'perceived usefulness' and 'perceived ease of use' while ignoring other external factors such as trust. Trust of IMUNOT services involving private data of the patients in cyber space has to be evaluated to improve the capability of the model. The findings of the study were limited to two hospitals and hence compromising

the generalisation of the outcome of the study. Therefore, a number of healthcare units need to be covered in future to overcome such gaps. The validated model measures perceptions that are liable to change with the experience and demands of the users and this may influence their intention to adopt IMUNOT in future. The research also provides a number of implications for research and practice.

A model that was developed with the help of validated questionnaire and multiple regressions is presented in the study. The model can be used as a point of reference for future research. The study highlights the key role the perceived usefulness plays in adopting IMUNOT system. Future research can explore more of the contextual, process and content factors where 'perceived usefulness' becomes vital to explain most of the variances for IMUNOT adoption. The study extends literature on e-health to help researchers understand how to deploy; implement and manage e-health systems. The literature provides more understanding of the antecedents of the perceived usefulness in the context of IMUNOT. Future research can study these characteristics in a greater detail to expand the list of antecedents of perceived usefulness. By investigating the antecedents of perceived usefulness, the need for understanding the role of the users in the adoption of IMUNOT is highlighted. Future research can examine the impact of the characteristics of the mobile service providers on the adoption of IMUNOT system.

6 Conclusions and future research

The researcher evaluated the proposed model for effective user adoption of IMUNOT system based on the 'perceived usefulness' of the system. The study highlights the key antecedents of the 'perceived usefulness' as e-health knowledge, access, support, trust and content. The findings guide the practitioners and designers on how to foster 'perceived usefulness' for the adoption of IMUNOT system through strong ICT infrastructure and meeting the needs of the users. Future research can explore more of the contextual, process and content factors such as 'trust' where 'perceived usefulness' explains most variances in the intention to adopt IMUNOT system.

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