

Factors Influencing the Adoption of Mobile Health in Uganda Health Facilities: A Case Study of Mobile Tracking System in Kayunga

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Abstract

Mobile Tracking system (mTrac) is an mHealth systems in Uganda was implemented in all government owned health facilities, with an aim of providing information on epidemic disease out breaks and drug stock outs of essential drugs. Despite its implementation in all government health facilities there is some evidence of low reporting rates by end users. The aim of this study was to investigate the factors influencing the adoption of mTrac system in Kayunga district health facilities. 73 respondents who trained to use mTrac system participated in this study using a questionnaire for data collection. The results indicate that the factors that positively influence the adoption of mTrac system in Kayunga district health facilities are performance expectance, facilitating condition, social influence and effort expectancy. The costs of mobile devices negatively influence the adoption of mTrac.

Keywords: Mobile Health; mTrac system; factors influencing adoptin; Kayunga district.

1. Introduction

The Mobile Tracking System (mTrac) a mobile health (mHealth) system in Uganda is a routine data system that uses rapid Short Message Service (SMS) to accelerate the submission of community and health facility data from local to national levels, including disease surveillance, malaria treatment and drug stock indicators [1] mHealth is defined as medical and public health practice supported by mobile devices such as mobile phones, personal digital assistants and other wireless devices [3].

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The increasing use and capacity of mobile devices is transforming accessibility and coverage in health field [2]. Globally, there are nearly 6 billion mobile cellular subscriptions with penetration reaching 80% in developing world [4] Today cell phones have become a necessity for almost every person throughout the world [5] Mobile phone penetration has experienced a rapid increase in developing countries over the past decade. Out of 5.3 billion mobile phone subscriptions held worldwide, 73% represent individuals living in developing countries and nearly 90% of the world is now covered by wireless signal, ensuring that formerly isolated individuals can be reached [6].

According to the Uganda Communications Commission (UCC) [7], more than 19.5 million Ugandans are connected to different mobile telecommunications network this is the reason why governments and development agencies view them as Information and Communications Technology (ICT) tool to be used to allow data sharing at all levels, reaching the hard to reach remote areas, to improve weak health management system, unreliable supply systems and to improve service delivery in health sector [8] According to Kiria [9] a number of mobile health projects and systems have been implemented in Uganda, these include Uganda National Users/ Consumer Organization (UNHCO), Mobile Vital Registration System (MVRS), mTrac system, among other systems.

Despite the implementation of the mobile health systems in Uganda, there various challenges and barriers that affect its success since it is new health technical innovation. Albabtain and AlMulhim and his colleagues [10] noted that there are a number of challenges in Uganda to allow effective use of mHealth such as network challenges which reduce its effectiveness, internet is unreliable or expensive, inaccessibility of electricity in rural areas remains a challenge. The purpose of this paper therefore is *to investigate the factors that influencing adoption of mTrac system in Kayunga district health facilities.*

There is little literature concerning the adoption of mTrac system, this study provides useful information to the Ministry of Health on the adoption of mTrac system in Kayunga district and the results can be generalized to other districts with similar characteristics in Uganda and other developing countries.

The study also provides new insights to policy makers on the policy issues that need to be addressed to improve the adoption of mTrac system especially in rural districts of Uganda and lastly, this study will further help researchers through contribution of literature on mHealth adoption and the barriers to its adoption in developing countries Uganda in particular.

This paper includes four major sections, the first section presents the introduction and a brief the second section addresses literature on adoption models, the third section looks at the methodology of this research, and third section presents and discusses the findings and the last section addresses the recommendations and conclusion.

2. Literature review

2.1. mHealth systems

Since there are few studies in the field of mTrac system and based on the fact that mTrac system is a type of mHealth system, the literature reviewed based on mHealth to form a better understanding of the concepts

theories and models that influence mTrac system adoption in Kayunga health facilities. mHealth has been incorporated into the field of health care in an attempt to address the wide variety of challenges facing developing countries systems. Developing countries which are constrained by resources have benefited from mHealth through increased access to health care and health related information, especially for hard to reach population [11]. Many developing countries have challenges that range from shortage of medical personnel which are difficult to recruit and retain in rural areas, supervisory and management systems are often weak, there is poor infrastructure that makes it hard for patients to move to places where health services can be provided [12]. This is the reason why governments in developing countries view mHealth as the only technology tool to be used to allow data sharing at all levels, reaching the hard to reach remote areas, to improve weak health management system, unreliable supply systems and to improve service delivery in health sector [13].

Many counties in both developed and developing counties are now taking up mobile health to improve service delivery in their health care sector as Consulting [14] notes that Tuberculosis (TB) patients in Thailand were given mobile phones so that health care workers would call patients on a daily basis to remind them to take their medication which increased medicine compliance rates to 90% due to introduction of this remote monitoring system. Disease and epidemic outbreak tracking applications are being used in Peru, Rwanda and India as an early warning system that allows public health officials to monitor the spread of infectious diseases.

Reference [15] gave an example of South Africa that implemented the Mobile Alliance for Maternal Action (MAMA). It is a global partnership that seeks to accelerate the use of mobile technology to improve the lives of expectant and new mothers in developing countries.

Reference [16] gave an example of Korean researchers who are developing bio sensing capabilities for smart phone screens to detect various diseases from a drop of saliva or blood.

2.1.1. Factors influencing the adoption of mHealth

Reference [17] identified some of the common factors which influence the decision making process of accepting mobile technology in medicine these include, perceived usefulness, perceived ease of use of the technological tool, perceived expectancy, effort expectancy, social influence and facilitating conditions but they urges that the most imperative barrier faced by mHealth users in Africa is that of contextual nature. Reference [18] further noted that many mHealth solutions for use in developing countries are developed in western societies and they fail to recognize the unique contextual factors associated with developing countries. Reference [19] identified a number of factors that influence adoption of mHealth. The studies were made in various countries in both developed and developing countries, these include: Canada, United States, Guatemala, United Kingdom, Ireland, Portugal and Finland. In Africa studies were carried out in Ethiopia, South Africa, Botswana and Uganda.

The studies carried out were to assess the factors that influence the residents, nurses, health workers, pharmacists and other types of providers adopt mobile health. The most influencing factors that were identified

in the studies were the perceived usefulness, which was seen as a facilitator to the adoption of mHealth, Perceived usefulness was defined as an individual's perception that utilization of a particular mobile device will be advantageous in an organizational setting over current practice.

The design and technical concern were perceived mainly as barriers, other factors that were mentioned were, cost issues, privacy and security issues were seen as barriers to adoption of mHealth as professionals were worried about the security and confidentiality of data contained in and transferred through these technologies as well as device theft. Reference [20] identified one barrier to the adoption of mHealth by doctors that is, doctors are compensated for face to face consultations with patients and they receive additional compensation if they travel to rural areas to conduct consultations. Once they adopt mHealth were patients consult often on phone the consultation fees will not be given to them this make them reluctant to adopt mHealth systems. Language barrier was pointed out as a barrier to adoption of mobile health. They noted that the range of spoken languages in developing world is another barrier that could reduce the benefits of mHealth tools such as SMS text message. Many Africans understand their local languages better than English. But all phone applications are in English the language unfamiliar to many of them making it difficult to use mobile health systems in Africa.

Reference [21] stated that according to global survey of 144 health care leaders working in public and private health care, that is pharmaceuticals and biotechnology say that patients have privacy concerns over data security specifically that could be a hindrance to mHealth adoption .Many people have a fear of using mobile phones to send confidential information since they have limited security over the information being transferred on phones. Reference [22] states that, some personal devices such as the cellular phones, smart phones and PDA, have limited security features to restrict unauthorized access to confidential information or they have difficult security mechanism which reduce the accessibility of the device its self. The cost of mHealth devices is another barrier to mHealth pointed out by [23]. They reported that, though mobile devices are becoming affordable for many people in developing world, they are still expensive for large majority especially in rural areas. Those who afford the phones, many find difficulties in loading airtime to consult the health providers and lastly literacy and unavailability of electricity are big barriers to mHealth adoption in developing countries. The last barrier to mHealth adoption Identified by [24] was the mobile service quality which is influenced by a number of things such as battery life and memory storage of mHealth devices. Many phones have small memory storages which makes it hard to send big volume of message and others their phones batteries are ever low which make message sending difficult since electricity in rural areas is still a problem.

3. Literature review on technology adoption models

Many researchers have adopted, modified, and validated many theoretical models to understand and predict acceptance of technology and its usage. Among them are Technology Acceptance Model, Diffusion of innovation theory, and The Unified Theory of Acceptance and Use of Technology briefly discussed below.

3.1. Technology Acceptance Model (TAM) by Davis and Bagozzi [25]

This model states that user's intention to adopt a new technology is determined by two key beliefs that is,

perceived usefulness and perceived ease of use. Perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance [26]. Perceived ease of use is the degree to which a person believes that performing using a particular system would be free of effort [27]. This model was derived from Theory of Reason Action (TRA) by Fishbein and Manfredo 1992) which urges that individual behavioral intention is determined by two factors that is attitude, which is the degree an individual has positive or negative feelings about the target behavior [28] and subjective norm which captures the persons perception that most people who are important to him think He or She should not perform the behavior in question .

3.2. Diffusion of innovation(DoI) theory by Rogers [29]

This theory suggests that population adopts a new technology based on five factors 1) the perceived relative advantage of innovation compared to the current, 2) the complexity of understanding the innovation with existing value, 3) culture of the organization 4) the opportunity for others to observe the results of innovation in practice, 5) the ability to pilot the innovation without a required long term. DoI theory tries to explain the innovation decision process, factors determining the rate of adoption, and categories of adopters. It helps in predicting the likely hood rate of adoption of an innovation. Never the less, it has been argued that the theory does not provide evidence on how attitude evolves into accept or reject decisions, and how innovation characteristics fit into this process.

3.3 The Unified Theory of Acceptance and Use of Technology (UTAUT)

To understand technology adoption, Venkatesh, Thong and Xu [30] empirically compared eight competing models that is Theory of Reasoned Action(TRA), TAM and TAM2, (TPB) and (DTPB), combined TAM and TPB, DoI, Motivational model(MM), model of PC utilization and social cognitive theory (SCT). Venkatesh, Thong and Xu [31] refined the above eight models into a new model named UTAUT which captures the essential elements of different models. The four key constructs of UTAUT model are; performance expectancy (the degree to which the individuals believe that the use of the technologies will results in performance gains). This may also be viewed as the perceived usefulness of technology. Effort expectancy (the ease of use of technology), social influence (the extent to which the individuals believe that important others believe that they should use the technologies) and facilitating condition (the perceived extent to which the organizational and technical infrastructure required for support of the technologies exist). The model also includes four moderating variables that is; gender, age, voluntariness and experience.

Though there are various models for technology adoption, UTAUT model has more predictive power compared to others like TAM model as [31] noted that, TAM is only capable of predicting technology adoption success of 30% and TAM2 can predict 40%. But UTAUT has condensed the 32 variables found in existing eight models into four main constructs and four moderating factors. Oye, Reference [33] further note that the combinations of the constructs and moderating factors have increased the predictive efficiency to 70% a major improvement over previous TAM model rates. In this study therefore, the researcher selected UTAUT model to investigate the factors influencing the adoption of mTrac system in health facilities of Kayunga district. One barrier factor

identified and being very crucial in resource constrained districts in Uganda (costs of mobile health devices) was added on the four constructs of UTAUT model to investigate the factors that influence the adoption of mTrac system in Kayunga district health facilities.

4. Research methodology

Health care providers from Kayunga district health facilities were used as the study population. The people who trained to use mTrac system in all health facilities of Kayunga district that is; Records Assistants, Nurses, Health facility in-charges and the Midwives were identified to receive the questionnaires. This encompassed a total of 73 participants from 23 health facilities of Kayunga district.

This research followed quantitative research approach. Where by questionnaires were used to collect the quantitative data to investigate the factors that influence the adoption of mTrac in health facilities of Kayunga district. The questions of the questionnaire were constructed to measure the four constructs of UTAUT model that is, Performance expectancy, Effort Expectancy, Social Influence and Facilitating Condition and costs of mobile devices which was identified in literature review as a barrier to mobile health usage in developing countries was added as a construct to UTAUT model. A Likert scale ranging from strongly disagrees to strongly agree of each construct was used as a measurement tool.

5. Results

The findings from the field study were guided by one research objective that is; *to investigate the factors that influence the adoption of mTrac system in health facilities of Kayunga district.*

A total of 73 questionnaires were distributed, 60 were returned and 4 were discarded for being incomplete giving a response rate of 76.7% .Demographic questions assessed areas included age of respondents, gender, titles and education levels of the respondents. Descriptive statistics were used to extract important information to understand the characteristics of respondents involved in the study. The data collected from the questionnaire was analyzed using a Statistical Package for Social Scientists (SPSS) version 20.0. Table 1 below shows the demographic information of respondents.

The data collected from the questionnaire were analyzed using (SPSS) version 20.0. validity tests were done to determine how well the questionnaire measured to the variables under investigation, reliability tests were used to measure the consistence of the questionnaire. Cronbach Alpha coefficient and all variables tested had a Cronbach Alpha of 0.785 which shows that the questionnaire was reliable.

5.1. Factors influencing the adoption of mTrac system in health facilities of Kayunga district

Descriptive statistics were used to investigate the factors that influence the adoption of mTrac system in Kayunga health facilities. The results were analyzed and interpreted using a five Likert scale that is 1- strongly disagree, 2-Disagree, 3-Neutral, 4-Agree and 5- Strongly agree.

Table1: The demographic information of respondents

AGE	Frequency	Percentage (%)
20 – 30	7	9.6%
30 – 40	23	31.5%
40 – 50	24	32.5%
50+	2	2.7%
SEX		
Female	32	67.9%
Male	18	24.7%
EDUCATION LEVEL		
Ordinary Level	8	11.0%
Advanced Level	1	1.4%
Certificate	25	34.2%
Diploma	18	24.7%
Degree	4	5.5%
TITLES OF RESPONDENTS		
Records assistants	12	16.4%
Nurses	32	43.8%
In-charges	10	13.7%
Midwives	2	2.7%

Table2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.785	.798	20

4.2. Performance expectancy

This variable measure the degree to which an individual believes that using mTrac will help him/her attain gains in performing his/her duties. Four questions were set to measure the construct using five point Likert scale below are the results.

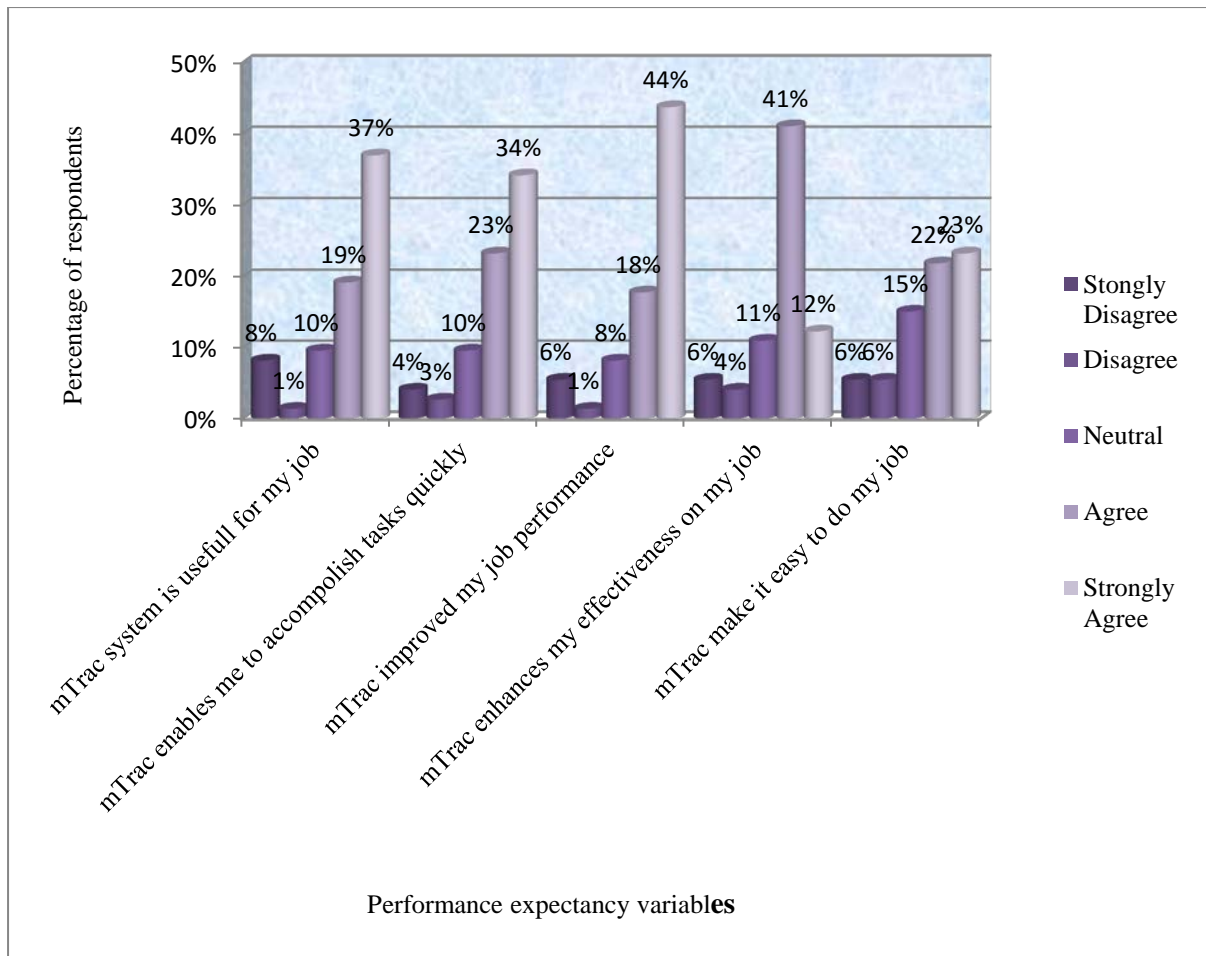


Figure 1: Performance expectancy

Figure 1 shows that the majority of respondents strongly agreed that performance expectance influenced them to use mTrac, this is because the first variable of “I find mTrac useful on my job” 37% of respondents strongly agreed and they were the majority, “mTrac enables me to accomplish tasks quickly” 34% of respondents strongly agreed, 44% also strongly agreed that mTrac improved their job performance and 23% strongly agreed that “mTrac system enhances their effectiveness on their jobs”, since the majority of respondents strongly agreed on the variables measuring performance expectancy as a construct, this factor positively influence the usage of mTrac system in health facilities of Kayunga district.

5.3 Effort expectancy

Reference [33] defined effort expectancy as the degree of ease that information system users think they will have when using an information system. Four questions were set to measure the construct using five point Likert scale and the Table 3 below shows the results obtained.

The figure above shows that the majority of respondents agreed and strongly agreed on all the variables measuring effort expectancy. This means that, mTrac system is easy to use, learn and interact with. Effort expectancy positively influences the adoption of mTrac system.

Table 3: Effort expectancy

Questions to measure the effort expectancy	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My interaction with mTrac is clear and understandable	0%	4.1%	19.2%	23.3%	28.8%
Learning to operate mTrac system was easy for me	1.4%	6.8%	23.3%	21.9%	21.9%
I rarely become confused when using mTrac system	11.0%	4.1%	20.5%	19.2%	20.5%
I rarely get frustrated when using mTrac system	11.0%	13.7%	12.3%	12.3%	24.7%

5.4. Social influence

This is the degree to which an individual perceives that important others believe He/She should use the new system. The influence of the others is an important factor in whether new users believe that they should adopt a particular system. Questions were set to investigate how social influence the use of mTrac system in health facilities of Kayunga district.

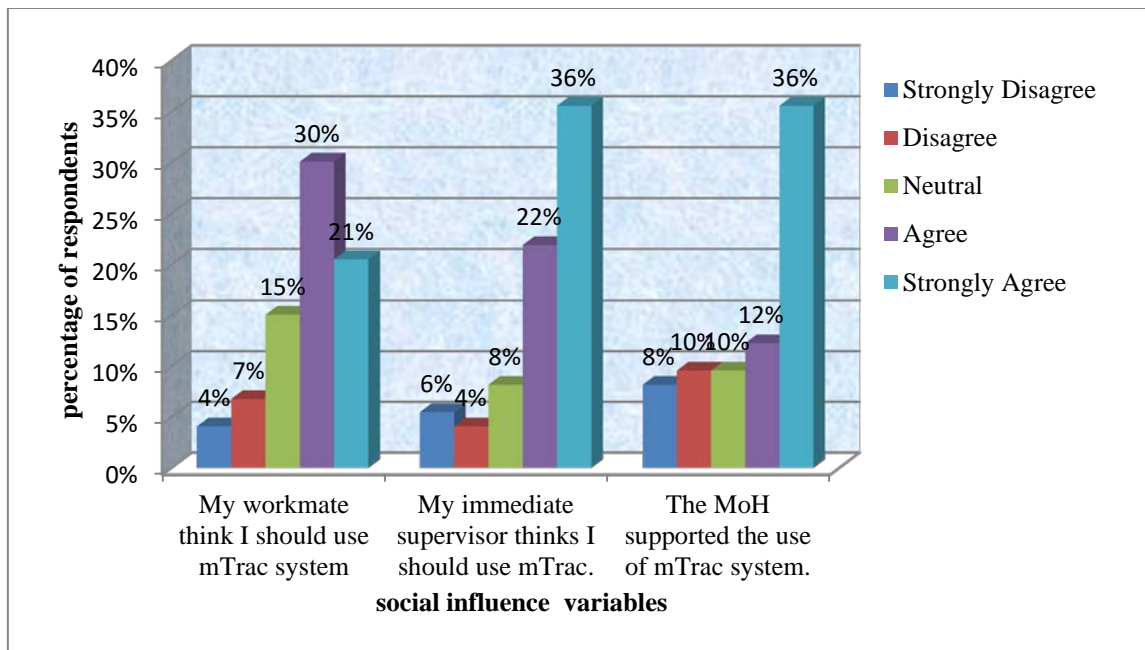


Figure 2: Social influence

Majority of respondents strongly agreed on the variables measuring the social influence as a construct. Three questions were set that is, my workmates think I should use mTrac system 30% agreed with the statement, 36%

strongly agreed that their immediate supervisor thinks that they should use mTrac and 36% of respondents strongly agreed that the Ministry of Health (MoH) has supported the use of mTrac system in Kayunga health facilities. Since the majority of respondents agreed on all the variable measuring social influence, it means that this construct influence the adoption of mTrac in health facilities of Kayunga district.

5.5 Facilitating condition

This is the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. Data was collected to investigate whether this construct influence the use of mTrac system in health facilities in Kayunga district. Four questions were set and answered by the respondents. Results in figure 3, shows the percentages of respondents who strongly disagreed, disagreed, who were not sure, who agreed, and strongly agree to the statements measuring this construct.

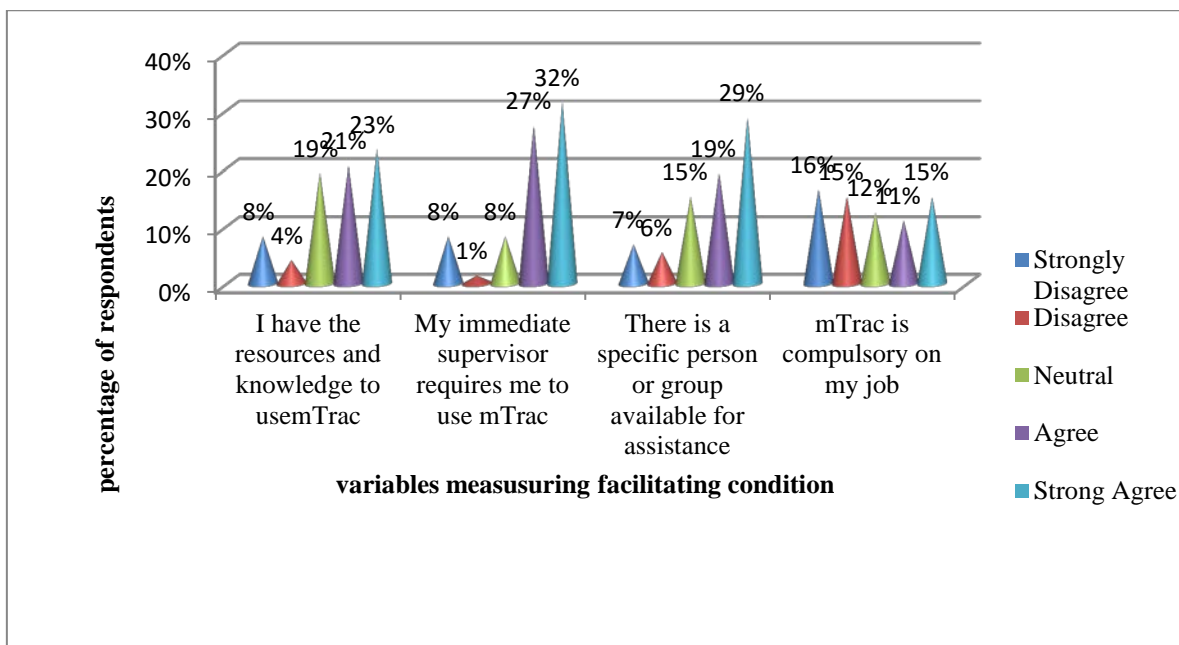


Figure 3: Facilitating condition

Four questions were set to measure the facilitating condition as a construct. These were,

- 1) I have the resources and knowledge to use mTrac system, 23% strongly agreed, 21% per agreed, 19% were neutral, 8% and disagreed that they don't have the resources and knowledge to use mTrac system but they were the minority compared to the majority who agreed that they have the resources and knowledge to use mTrac system.
- 2) My immediate supervisor requires me to use mTrac, 32% and 27 of respondents strongly agreed and agreed respectively that their immediate supervisor requires them to use mTrac system.
- 3) there is a specific person available for assistance, the high percentage was 29% and 19% strongly

agreeing and agreed respectively that there is a specific person to assist them in case of any problem.7%and 6% of respondents strongly disagreed and disagreed that there is no person to assist them and

4) mTrac is compulsory on my job, this variable the majority of respondents disagreed with 16% strongly disagreeing and 15% disagreeing with the statement, the minority strongly agreed with thee stamen. This means this construct positively influence the usage of mTrac system though it is not compulsory to all health care providers in Kayunga health facilities.

5.6. Costs of mobile devices

This refers to the price of mobile phones, the cost of air time, data and the costs involved in charging the mobile phones. Costs of mobile health devices was identified as a challenge in use of technology in developing countries more so in rural areas were the majority finds it had to afford phones and even the few who can afford the phones find it had to load airtime, data and charging their phones.

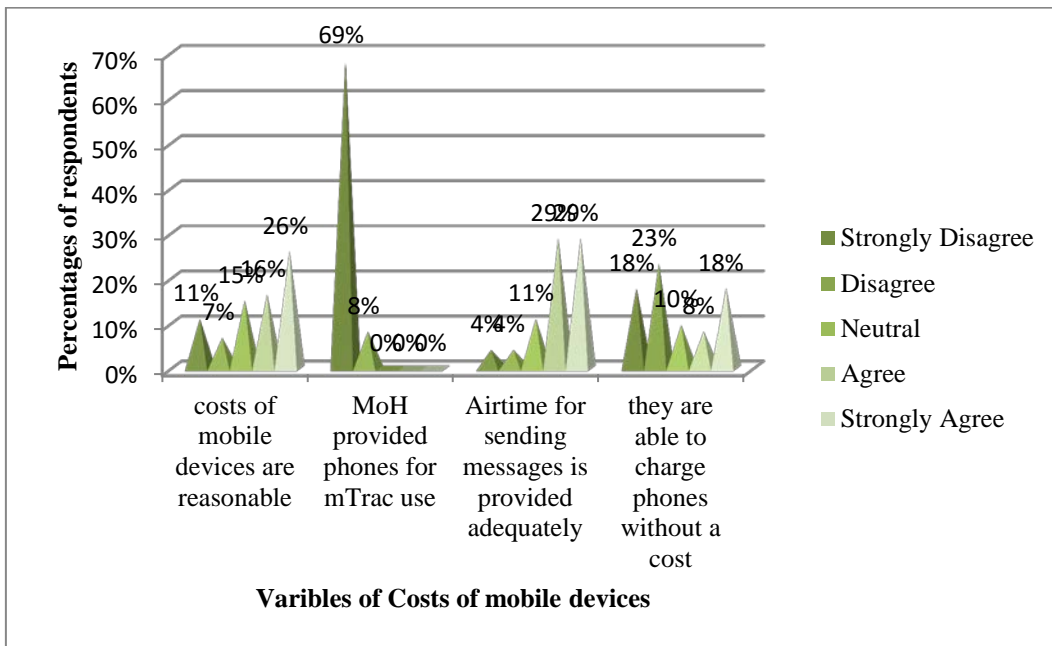


Figure 4: Costs of mobile devices

Figure 4 shows that the percentage of the respondents on the four questions that measured cost of mobile devices. 11% of respondents strongly disagreed that the costs of mobile a devices are not reasonable compared to 26% of respondents who strongly agreed that costs of mobile devices are reasonable. The second variable almost all the respondents69% strongly disagreed that the Ministry of Health (MoH) provided them with phones to use when sending messages and no one agreed on this statement, the third variable it was investigating whether the MoH cater for air time for sending messages. 29% of respondents strongly agreed and agreed respectively that the MoH provides air time for sending messages and 4% of respondents disagreed with the statement. The last variable measuring where they are able to charge their phones without a cost, the majority

disagreed with 23% and 18% compared to 18% and 8% who agreed. In summary costs of mobile devices negatively influence the adoption of mTrac in health facilities of Kayunga district.

5.7 Behavioral intention to adopt mtrac system

In UTAUT model, performance expectancy, effort expectancy, and social factors have direct effects on behavioral intention, which along with facilitating conditions have direct effects on user behavior. Three questions were set to measure the construct using five point Likert scale and the Table below shows the results obtained.

Table 4

Behavioral intention	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I intend to use mTrac in near future	0%	5.4%	0%	57%	37%
I predict to use mTrac in near future	0%	8.9%	1.8%	58.9%	28.6%
I plan to use mTrac in near future	0%	5.4%	14.3%	51.8%	26.8%

The behavioral intention to use is a good predictor for adoption of technology. And the overall results for the questions were answered positively as the majority of the respondents either agreed or strongly agreed to use mTrac in the near future. The last two columns for agree and strongly agreed (57% and 37%, 58.9% and 28.6%, 51.8% and 26.8% respectively, the minority disagreed that is 5.4%,8.9% and 5.4% respectively, and the rest were neutral(1.8% and 14.3%). In summary, the three questions that were asked to measure the behavioral intention to adopt mTrac, the majority of respondents agreed or strongly agreed to the statement and the minority disagreed with the statements.

5.8. Summary of findings

The above findings answered the research objective, for example the factors influencing the adoption of mTrac systems in Kayunga health facilities were identified and these findings were generally in line with the literature on the factors influencing the adoption mobile health in developing countries.

6. Recommendations and Conclusion

The study concludes that all the constructs of UTAUT model positively influence the adoption of mTrac system in health facilities of Kayunga district. though mTrac system was implemented all health facilities of Kayunga, it is mainly used by Records Assistants who use it to send weekly HMIS report to the district but of the health providers are not using the system. For the community they're not aware that this system exists and they have to use it as well. The MoH has not invested in mTrac equipment to facilitate the adoption of the system in resource constrained districts in Uganda. The poor network connectivity in Kayunga district is a challenge for many

mTrac users. They have to look for the network in order to send messages and even after sending the messages sometimes fails to go.

The Ministry of health should provide phones to each health facility to be used to send messages this will help those who cannot afford phones to send messages. Sensitization about use of mTrac system through radio announcements, seminars and workshops should be done to increase the awareness and the importance of using mTrac system to both the community and the health care providers since many of the community members are not aware that they have to use this system and even health care providers they left the system to health facilities in-charges and records assistants. The MoH should provide solar chargers to health facilities without electricity to enable them charge their phones at no cost since many pay a cost to charge their phone of which they use to send message. The District should put best rewards for mTrac users in all health facilities to attract others to use the system.

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