Validation of Mobile Health Conceptual Model for Health Organisation in Nigeria

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Abstract: **This paper developed and validated a conceptual model for Mobile Health (M-health) adoption in health organizations in Nigeria. The sound knowledge of Readiness and M-health Acceptance among health staff has made developing the M-health conceptual model easy and simple. M-Health implementation is facing a lot of challenges working against its deployment and continuous use. Amongst the factors are: resistance to change by stallholders, lackadaisical attitudes of users of such technology, poor technical support, poor funding by government, epileptic quality of services and lots more. Therefore, there is a need for more effort from the government, stallholders and the entire Caregivers to overcome all the challenges militating against the successful implementation and continuous use of M-health system in Nigeria. The paper proposed, develops and evaluates a sustainable M-health deployment model for health organizations with pre and post-deployment stages. The study also encapsulates all the critical success factors that are essential for a successful deployment of this technology in health organizations in Nigeria.**

Keywords: **M-health, Conceptual, Model, Sustainability, Framework, Adoption, Deployment.**

I. INTRODUCTION

The use of technology has modified the manner in which numerous things are done, its effect even in the health establishments are felt everywhere round the world. This days, technology on plays a substantial role in consulting with patients and reporting health problems. The revolution in information structures aided by way of computer systems and internet has brought about easy and **flexible** access to health care facilities. This technology has led a few health establishments to integrate M-health into their system whilst others have not(Tuon, Gasparetto, Wollmann, & Moraes, 2017).

The availability of hand held cellular gadgets in form of Smartphones, PDAs and Tablets gave Caregivers the opportunity to get access healthcare facilities whenever and everywhere (Kim, Lee, Hwang, & Yoo, 2016). This cell era is considered novel and the gadgets at the moment are available, inexpensive, effective and easy to use. They make communication easy and flexible between staff, stallholders and even patients in the health organization. (Ndayizigamiye et al., 2018).

Despite the development and multiplications of cell phones in the social insurance segment and the tremendous advantages it offers, this new innovation (M-health) can't absolutely supplant the conventional one – on-one counseling where brain science of the patient and other significant variables are considered during diagnosis and treatment. This new methodology (M-health) fills in as a help not an absolute substitution to the customary approach (Woldeyohannes and Ngwenyama, 2017).

The potentials of M-health had been noticed all over the global and plenty of researches tried to observe the adoption of this technology at user or even organizational level. Many researchers tried to explore how this new technology enables healthcare delivery (Zhao, Ni, & Zhou, 2018).In any case, the technology (M-health) is effective, mobile and collaborative. It improves communication among all Users' and encourages feedback for both the staff and Stallholders in the health organization.

M-health is still its early stage of development, the technology has not been adopted in lots of health organizations in developing nations (Ndayizigamiye, 2018) There are numerous elements affecting the adoption of M-health among are which are not completely restricted to : technical barriers; the connectivity (network); the telephone size(display screen), inadequate memory, and transmission speed (Gücin & Berk, 2015). The list is incomplete if Users acceptance (both staff and stallholders) is not addressed, since the rejection of this technology by users can cause drastic failure and of no advantage to the health organization. The success of this technology relies totally upon users (Gücin & Berk, 2015; Khan, 2017).

The adoption of this technology requires a number of effort to curb all of the factors militating against its success, these elements can be the human or material resources packaged in form of; Awareness, Perceived Usefulness, Perceived Ease of Use, Reliability, Dependability, Subjective Norms, Organizational Size, Organizational Culture, Government Policy(Estuar et al., 2014); sustainability of the mobile smartphone and internet connectivity issues(Khan, 2017) and resistance to change(Haenssgen, 2015). For this reason, the adoption of M-health in health organization necessitates conceptual framework on how to prepare a great and possible M-health system that attracts all users and give them essential services as a way to meeting their demands. While managing infrastructural challenges and organizational resistance to change syndrome. It is important to explore all the critical

success elements that helps easy deployment/ adoption of M-health in health organizations.

This paper aimed at evaluating a conceptual framework for M-health adoption in healthcare organization in Nigeria. It critically explores the organizational Readiness and User's Acceptance of M-health Technology in the health sector. A thorough review of literature was done on frameworks and models related to M-health in health organizations. The study then modified the proposed framework after real life data was captured from Caregivers and stallholders in the health sector. A modified framework is then presented as an improvement on the proposed or initial model.

The paper covers introduction, Literature review, proposed model, then methodology which discussed the method applied to validate the model, the refined model, discussion. Finally, conclusion and references were given.

Aim and Objectives of the study

The study aims at developing and validating a conceptual framework for successful deployment of M-health in health organizations in Nigeria. The objectives are:

- To propose a model based on existing literature on M-health systems in health organizations
- To validate or refine the model based on data collected from the stallholders and staff of health organization.

II. LITERATURE REVIEW

Alalwan et al. (2018) examined factors affecting behavioral intention to adopt mobile health in Jordan. They tried to test the most important factors that could shape the intention of Jordanian people to use M-health. They used: Perceived Usefulness, social influence, awareness and innovation as constructs. They apply structural Equation modelling tools for analysis on a Sample size of 365 participants. They discovered that the drivers for adoption are: Perceived Usefulness, social influence, awareness and innovation. Amongst the identified constructs, they did not identify the most important constructs as suggested in Multi decision criteria (Taha, Mohammad & Northita, 2015). Ndayizigamiye et al. (2018) worked on factors motivating the adoption of self- healthcare mobile monitoring applications by South African Youths. The study tried to explore and integrate factors that can motivate the use of mobile healthcare application. They use ease of use, demonstrability, accessibility, privacy, user satisfaction and affordability as key constructs. Also, Xu et al. (2018) designed and tested a Model for adoption and Continuous use of Personally Controlled Electronic Health Record (PCEHR) Systems Amongst Australian Customers. A preliminary study, the authors investigated the factors influencing adoption and Continuous use of PCEHR systems in Australian customers. They developed questionnaires and collected qualitative data which was subjected to analysis using the Structural Equation Modelling (SEM). The result showed that external factors and influence, individual difference influenced (perceived benefits); external factors, influences and individual difference influenced (perceived user friendliness); facilitating factors influenced both realized benefits and realized friendliness and voluntariness. They did not look at organizational adoption. Their interest is adoption at individual level.

Woldegohannes et al. (2017). Investigated factors influencing acceptance and contrived use of M-health Apps. The main aim of the study was to investigate factors that predicts the adoption of M- health apps. Unified Theory of Acceptance and use of Technology 2 (UTAUT2) model was used, 11 participants were selected within the ages of 18-65. Analysis was done using close coding, thematic analysis, and co-occurrence analysis. Performance expectancy, effort expectancy, and habit were the constructs to predict adoption of the apps. Flexibility of personal preferences contributes to performance expectancy. The shortcoming is that significant factors were not captured in UTAUT2 constructs; Price value, facility conditions were not captured. The sample size was small, the study supposed to be more targeted to M-health than been generic. Reid (2016) worked on Exploratory Framework Assessing Intrinsic and Extrinsic Motivators Related to Mobile Device Applications and Attributes for Canadian Seniors. He designed a conceptual framework and concludes that seniors have extrinsic and intrinsic motives that needs to be integrated when designing app.

Dolnicar et al. (2017). Worked on Understanding Acceptance Factors for Using e-care systems and devices: insights from a mixed method intervention study. Mixed method was used; the study exposed the heterogeneous needs and expectations on e-care systems. Fear of not getting help during emergency and perception of safety and peace are the key factors identified in the study. The gap indentified in the study is that small sample size was used and statistical significance as not tested. In a similar study (Forchuk et al , 2016) evaluated a framework for Smart Technology Mental Health Intervention. They evaluated a Framework used in mobile study in Canada, the results showed that: Effectiveness, economy, policy and ethics analysis are crtitical in the study.

Mburu & Oboko (2018) designed a Model for Predicting Utilization Of M-Health Interventions In A Low-Resource Settings: Case Of Maternal And New Born Care In Kenya. They proposed a theoretical model to predict the utilization of M-health products In low resource setting. Partial least square method (PLS), Repeated Measures of Analysis of Variance (RM- ANOVA) and Bonferron test was used. The result showed that 60.3 fit, 53.7 utilization predictive approach to user-predictive centered design, offers greater flexibility in aligning attributes of an M-health intervention to full users' needs and expectation. The weakness identified in the study is that most of the M-health interventions has failed to justify

value proposition to inspire utilization in low resource settings. An empirical study of M-health adoption in a developing country was carried (Hoque , 2016): the moderating effect of gender concern. The study was carried out in Bangledash. The TAM model was used to identify the factors that influence the adoption of M-health services amongst young younger people in Bangledash. Partial List Square Method (PLS) part of SEM was used for the analysis. The result showed that Gender was strongly associated adoption and use of M-health in developing countries. Even though the focused on rural areas and only a small sample of young people was used in the study not the general population.

Haenssgen (2015) tried and explore the Mismatch between Mobile Phone Adoption and Use through survey, data from rural India and China were collected. The study investigated the relationship between mobile phone adoption and utilization. The research took place in China and India. The researcher found it difficult to establish causal claim and this was seen as a weakness of the study. Ndayizigamiye & Moharaj (2016) studied Mobile Health Adoption in Burundi. The research investigated factors that prompted the use of M-health in Burundi. A population of 212 primary health care professionals were interviewed in 5 provinces in Burundi. UTAUT constructs were used. Effort expectancy, performance expectancy and facility conditions were identified as a possible predictors for M-health adoption in Burundi. The three (3) construct were believed to be significantly correlated. The researchers proposed the use of Regression analysis to individually predict capability acceptance.

Kim et al. (2016) analysed the Factors Influencing Healthcare Professionals Adoption of Mobile Electronic Medical record (EMR) using Unified Theory of Acceptance and Use of Technology in a tertiary Hospital.The study was to confirm factors that influence User's intention to utilize a new system (M-Health). They designed and distributed questionaire to 942 heath care professionals and log file analysis was performed on it. Structural Equation (SEM) and AMOS was used for data analysis. A model was developed with positive end users response, positive attitude.

Hammed & Arachchilage (2017) developed a Conceptual Model for Organisational Adoption of Information Systems Security Innovations. A theoretical model was developed for adoption of process of I.S security innovations in Organisations. The model was derived from the combination of Diffusion Innovation Theory (DOI), Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB) and Technology Organisation Environment (TOE) frameworks. The model captures the organizational users aspect of technology adoption. The researchers recommend that the model be validated, refine relationship using empirical investigations to establish a causal relationship. Banna & Andri (2018) went on a pilot study on unbiased empirical evaluation of stakeholders towards e-health delivery solutions and services in Kuwait. They used TAM and TOE framework to evaluate stallholder's adoption factors. The results showed that Perceived security was least obstacle, Usefulness and Ease of Use are the most apparent factors.

Gagnon et al. (2016) did a systematic literature review on M-health Adoption by healthcare professionals: The study synthesizes factors influencing healthcare professionals' adoption of M-health apps. They reviewed related literatures from four databases from year 2000-2014. The results showed that Perceived Usefulness, Uase of Use, design and technical concerns, cost, time, privacy, and security issues, familiarity with technology, risk benefit assessment, and interaction with others as factors influencing healthcare professionals adoption of M-health apps .

Marafu and Maboe (2017). Worked on Utilization of Mobile Health by Medical Doctors in Zimbabewen health care facility. The study investigated the potentials and challenges of M-health in delivery of healthcare service. Quantitative, Descriptive, Cross Sectional and Analytical Design was used. The results showed that 83% believed that m-health is here to improve healthcare delivery, 93% are of the opinion that m-health has potential for future use. A study (Uddin et al., 2017) was done on the Impact of Mobile Phone-based Technology to improve health, population and Nutrition services in rural Bangladesh: a study protocol. The study aimed at developing a phone-based system to improve health, population and nutrition services in rural Bangladesh. The authors used a Quasi – experimental pre-post design. Though no meaning outcome was obtained as the research was just a feasibility study.

III. METHODOLOGY FOR CREATING THE CONCEPTUAL MODEL

The model was designed on the basis of an analysis of the existing M-health literature and the results of the researcher's prior work (Nathan, Che, Longe, 2020; Ahmad, 2014). The conceptual M-health deployment model is a guide to the introduction of an M-health system in Nigeria. The model is made up of two phases, pre- and post-deployment, and does not include fully integrated M-health systems. The model would, however, use M-health as part of the E-health system. Figure 1 defines the framework.

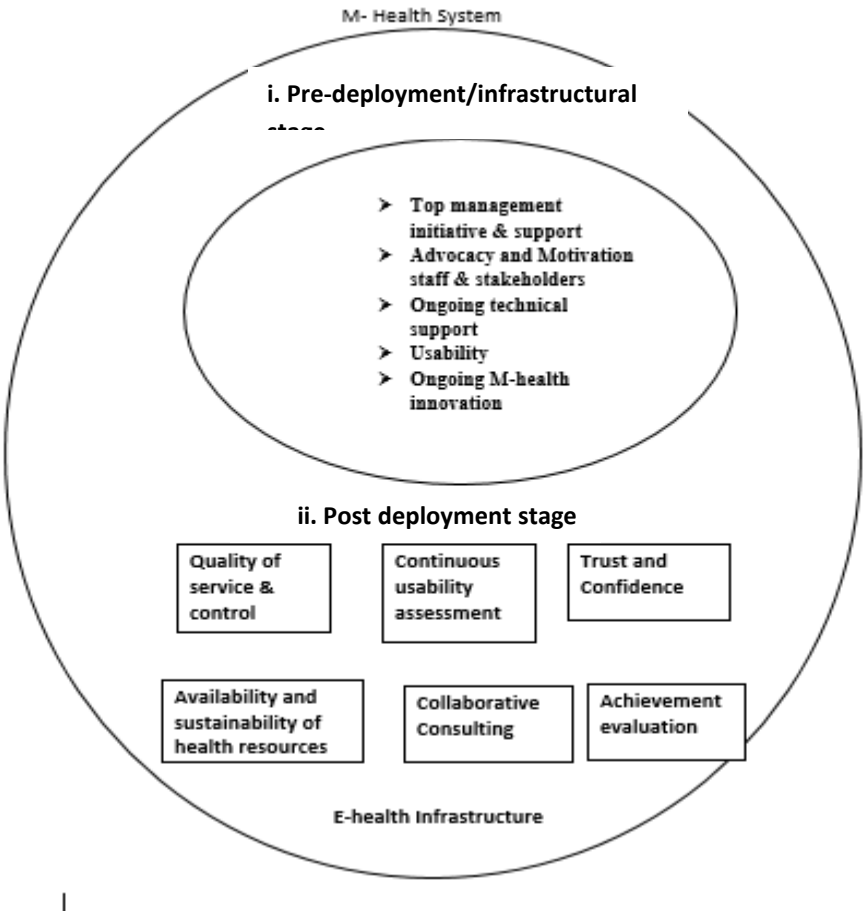

Figure 1: The Initial proposed model presented for evaluation (Nathan, Che, Longe, 2020; Ahmad, 2014)

IV. MODEL COMPONENTS

1. Top management initiative

The introduction of M-health in health organizations will by no means face change resistance. There is a need to "lobby" for top management support in terms of resources to make the project a reality. Successful M-health projects require the top management support, well-desired plans policy statements, and the provision of sufficient resources (human and materials). More so, the sector has to support the creation of every infrastructure that will make adoption a reality.

2. Advocacy and motivation: Caregivers and Stakeholders

Before they are asked to begin using the program, all stakeholders and staff should be aware of the advantages and uses of any M-health program. In this context, motivation refers to the extent to which the M-health environment motivates staff to engage with their organization and support stakeholders in developing innovative ways to use devices that complement traditional methods of consulting or access to health facilities.

3. On-going technical support

M-health is an innovative platform that incorporates various technologies (wireless network, mobile devices, etc.) so users need to be provided with technical support. Help is required to tackle system failure, trouble-shooting, and provide productive services with a secure environment (Okuboyejo and Eyesan 2014).

4. Usability and continues assessment

The term usability can be defined as effectiveness; users derive efficiency and satisfaction that help to achieve a specific goal(Nielsen, 1993). Usable systems need to be easy, flexible, easy to learn, efficient, easy to remember, limited errors and capable of satisfying the users needs. Evaluation of mobile technology and the efficacy of its mixing with M-health remains a high priority in assessing a specific system's performance (Howarth, Smith-Jackson and Hartson, 2009).

5. On-going M-Health Innovation

It is necessary to investigate the viability when a new system is introduced. The system must be able to develop to accommodate changes in the fast-growing mobile environment. M-health is vital technology and it gradually advancing by the day. This is triggered by a lot of researches

trying to explore mobile technology. The need for mobile consulting solutions is paramount to compliment several obsolete approaches.

Quality of service

Consumers of any technology will always be affected by the quality and nature of service such technology provides. Control of the quality of the M-Health services offered is therefore significant. It's also important to provide M-health organizations with a quality control mechanism to ensure some degree of consistency. M-health service quality needs to be measured from both the technological and the learning perspectives. There are quite a few indices that will be used from the technical side to assess M-health quality of service (mobility, reliability, network connectivity, and wireless connection speed).

M-health content format needs to be consistent and operate from the reporting perspective across the different types of a mobile platform, M-health systems need to provide a reporting platform suitable for reporting health related issues and needed in a way that it makes reporting simple and versatile across different interfaces.

6. Trust and confidence

Trust and confidence should integrate both the government and stakeholders in the health sectors and as well as various staff within the health organization. This is very important when it comes to maintaining or sustaining the system. Trust fosters communication between the stakeholders and also increases their willingness to share ideas and open up communication among themselves. Moreover, the trust will allow employees to share responsibility for devices used in M-health technology handling (Ng and Nicholas, 2012).

7. Availability and suitability of M-health resources

It is important to make M-health resources available. It is also important to think of restructuring the interfaces and create a suitable effective and interactive interface suitable to a particular mobile device. The development should take into cognizance the different levels of understanding, capability, and perception about M-health technology. The platform should be easy to use as less prone to error. The interfaces should have a feedback and storage mechanism to guide effective reporting and continuous use of the platforms.

8. Collaborative Consulting

Collaborative consulting was seen as the most important motivating factors for the successful use of mobile devices in a health organization. Wireless collaborative consulting can avoid the weakness of impairment and communication, organizational negotiation, interactivity, and mobility that can occur in the more traditional consulting process. Collaborative consulting components are seen as critical success factors that determine the success of mobile health adoption. Collaboration and communication are very important in health system. Staff should communicate amongst themselves and also with patients and even stakeholders in the health organization.

9. Achievements and Evaluation

Achieving a particular goal could be a strong factor that makes users of M-health technology to always go for it. Achievement and assessment are key to mobile health sustainability for a range of reasons. Firstly, achievement and assessment tend to test the efficacy of M-health projects. The second thing is that it offers certain metrics of the project's benefits and cost performance. Ventola (2014) believes that feedback gathered on report delivery helps to update the tools and techniques used in the hospital system and ensure continuous improvement, allows results to be the central factor for any project. The real-time use of M-health technology needs to be closely monitored to give more room for constructive criticism and improvement.

Model Validation

The proposed model was validated by a sample of health staff and stakeholders in the health organization in Adamawa State.

Participants

82 health workers and 10 directors of health took part in the study. The target participants were found during their review meeting held in the Primary Healthcare Development Center in Yola, Adamawa State.

Research instruments

Two questionnaires were designed to assess and refine the proposed conceptual model for both Caregivers and stallholders (Directors). The questionnaire items were derived from a grounded-approached M-health study by (Nathan, Che, and Longe, 2020) and similar technology adoption study by (Vukovic, 2018; Ahmad, 2014). The questionnaire for health care employees consisted of three parts. The first part contains a brief research summary and how the model was developed. Part two of the questionnaire includes information about the demographic profile of the respondent. The last section (section three) featured 34 questions that could be answered on a Likert scale of five points, ranging from strongly disagreeing to strongly agreeing. This was deliberately developed to measure Caregivers thoughts, perceptions about the factors that will affect M-health deployment

The questionnaire for the stallholder was composed of four parts. The first part clarified the purpose and goals of the study, part two consisted of general questions about the stallholder's (stakeholders status, experience, and familiarity with M-health) part three included eleven (11) questions answerable with five Likert points to determine the pre- and post-deployment stages of M-health. (Part four (4) consisted of eleven questions on a five point Likert-scale as a general assessment of the model (i.e. the proposed model would promote the continuous updating of M-health programs and services). Two more open-ended questions were introduced to both staff and stakeholders to enable participants to share their

views on the obstacle they can face in the successful implementation of the technology in a health organization.

V. DATA COLLECTION AND ANALYSIS

A total of 82 health staff from different units participated in the study and their demographic characteristics was captured in Table 1. Cronbach Alpha test was carried out to determine the reliability of the data collected. However, the Cronbach Alpha values are prone to a variety of effects in the scale. It is normal to have a low value for Cronbach's Alpha when dealing with a short scale (with less than 10 items). In this case, the mean inter-item association for the items could be even better examined, Table 2 indicates the mean, standard deviation, and inter-item correlation of the questionnaire for health care employees. For any inter-item association, the optimal suggested range is 0.2-0.4 (Briggs and Check, 1986). The findings for each scale of the inter-item correlation are shown in Table 2.

Table 1 Demographic data of health staff

Characteristics	Frequency	Percentage
Gender		
Male	49	60
Female	33	40
Age		
<24	5	6
24 – 34	28	34
34 – 44	40	49
>44	9	11
Profession		
Doctor	10	12
Nurse	45	55
Lab. Scientists	7	9
Pharmacist	9	11
Medical Record	3	3
Comm. Health Worker	8	10
Using M-health		
Yes	53	65
No	29	35
M-health knowledge		
Very Poor	4	5
Poor	10	12
Moderate	26	32
Good	31	38
Very good	11	13

Table 2: Mean, Standard Deviation and Inter-item correlation of health staff's questionnaire

S/N	Items	Mean	Standard Deviation	Inter-item correlation
1.	M-health needs support from stakeholders to make it successful	4.0192	0.63180	
2.	The health sector has to provide the appropriate structure to manage M-health content and infrastructure	3.9679	0.62190	0.460
3.	The stakeholders need to work with the government to develop workable policies regarding M-Health	3.9399		
4.	There should be advocacy and awareness by health specialist to stakeholders and health staff on appropriate skills needed for M-health	3.9677	0.61110	
5.	The health/IT specialist need to design applications that can make M-health motivating and engaging	3.9670	0.61073	.0331
6.	IT specialist should develop objects to help stakeholders in deploying M-health in the health organization	4.0191	0.66510	
7.	The health staff need prompt and effective technical support as required when using M-health system	3.94050	0.6571	0.3440
8.	The technical infrastructure should make "Help" resources available on staff's mobile devices			
9.	There should be M-health technical support to aid maintenance and adequate service delivery	4.250	0.61610	
10.	The health organization need to keep up-to-date changes in M-health technology provision	4.3176	0.73912	
11.	The health organization should upgrade the M-health system where necessary	4.2972	0.61122	0.3771
12.	The health organization should work with mobile technology companies to develop applications suitable for on-going changes in the health sector	4.001	0.69984	
13.	The M-health application should be easy to use	4.60114	0.55590	
14.	The interfaces need to be a flexible and attraction to users	4.3520	0.58170	
15.	The M-health system interfaces should facilitate reporting health issues and consulting	4.4130	0.58238	0.378
16.	The assessment of M-health usability in terms of accessibility, interactivity and interface design will affect the success of M-health deployment	4.3580	0.58332	
17.	It is important to control the quality of M-health services for successful system deployment	4.2839	0.54770	
18.	The quality of M-health services needs to be defined at the level for a diverse professional group	4.1212	0.64855	0.284
19.	The quality of M-health services need to be up to date and meet the users need (staff)	4.5067	0.58896	
20.	M-health system should provide a collaborative consulting with and various stakeholders	4.0675	0.60230	
21.	Effective communication between health staff and stakeholders will increase usage of M-health system	3.8377	0.89649	0.359
22.	M-health system should enable staffs to provide feedback on their work and experience	3.8514	0.84409	
23.	Enhancing confidence and trust among mentors of M-health management team as well as other staff (colleague) will improve their willingness to use M-health system	3.7159	0.72880	0.291
24.	Everyone involved in the M-health system should have some sort of ownership of the system	3.4055	0.71749	
25.	A level of trust between all M-	3.7297	0.68616	

	health system users will open up communication and increase the sharing of information			
26.	M-health outcomes need to be reviewed at regular interval to ensure that stated goals and objectives are achieved	4.0135	0.58301	
27.	Regular monitoring and evaluation should be performed to check users perspective about M-health	3.8242	0.72577	0.377
28.	M-health should be regularly monitored ensure it is been used in health organization	3.9797	0.73301	
29.	Creating flexible and attractive interfaces will improve the sustainability of M-health	4.1553	0.61401	
30.	M-health resources should be designed to enhance better consulting and meet the basic health requirement of the people	4.2701	0.65493	0.339
31.	M-health content needs to be readily available and compatible with many mobile devices	4.5810	0.59471	
32.	M-health system can easily be implemented within the E-health environment	3.9181	0.64431	
33.	Integrating M-health into E-health platform will aid acceptance of the technology	3.5611	0.68240	0.439
34.	Integrating M-health into E-health platform will complement the issue of lack of M-health infrastructure in health organization	3.8111	0.75911	

Using the one-sample t-test, the mean was compared to a normal single value. The object of the one-sample t-test is to decide if there is sufficient evidence to conclude that the population mean from which the sample taken varies from the stated value (Foster, 2001). This review will put the hypothesis below to the test.

H_o: $\mu \leq 3$ (the population means is equal or less than the hypothesized value 3 which is the average scale value.

H1: $\mu \geq 3$ (the population mean is greater than 3)

A one-sample t-test was carried out to check the hypothesis that the staff score average is greater than 3, the value 3 is obtained from a five point Likert scale neutral level. The test on normality was performed using SPSS. The Kolmogorov Smirnov statistics P- values are 0.200, which is greater than 0.05. This justifies the assumption that Qmean (the mean of each question) is normally distributed. Table 3 displays the results of the normality test.

Table 3: Test of Normality (staff data)

	Kolmogorov – smirnov[a]			Shapiro – wilk		
	statistic	Df	Sig	statistic	Df	Sig.
Qmean	0.99	34	0.200[x]	0.981	34	0.798

a = Lilliefors Significance Correlation, × = the lower bound of the true significance. The data is normally distributed

Table 4, shows that the 95 percent Confidence Interval of Caregivers score means using 33 degrees of freedom t-distribution (3·976, 4·179). Although this interval does not include the test value 3, there is clear evidence that the mean scores for the workers are greater than 3.

Moreso, p-value is less than 0.05 and the t-value is positive, dismissing the null hypothesis and supporting the alternative hypothesis and conclude that the population mean is greater than 3

Table 4: descriptive statistics of staff score means

			Statistic	STD error
Qmean	Mean		4.085913	
	95% Confidence interval for mean	Lower bound	3.985935	
		Upper bound	4.185892	
	5% trimmed mean		4.091991	0.491409
	Median		4.043950	
	Variance		0.8201	
	Std. deviation		0.2865398	
	Minimum		3.4055	
	Maximum		4.6014	
	Range		1.1960	
	Interquartile range		0.4003	
	Skewness		-1.77	0.4031
	Kurtosis		-2.84	0.788

Stakeholder results

The task of addressing the validity of the proposed model requires review and assessment by stakeholders in the health sector. The demographic characteristics of the stallholders was captured in Table 5. A total number of 10 stakeholders participated in the study 80% were males while 20% were female. With respect to experience, 30 percent of participants had more than 5years of experience in their report, 50 percent had 2-5 years of experience, 20 percent had less than 2 years of experience. Twenty percent of the participants reported that they had a very good level in terms of experience with the M-health, and 50 percent moderate and 30 percent found themselves to be at a very good level. A Cronbach alpha test was performed to test the reliability of the data collected. The Table 6 below represents the Mean, standard deviation and Cronbach's alpha of stakeholders obtained from the data.

Table 5: Demographic data of the stakeholders

Characteristics	Frequency	Percentage
Gender Male Female	 8 2	 80 20
Position Directors Community	 6	 60

Health Services Directors Primary Health care System Development Permanent secretaries health	3 1	30 10
Years of experience <2 2-5 5-10 >10	 2 3 2 3	 20 50 30 30
Familiarity Moderate Good Very good	 3 2 5	 30 50 20

Table 6: Mean, standard deviation and Cronbach's alpha of stakeholders

S/n	Items Pre-deployment stage/Infrastructure	Mean	SD	Cronbach's alpha
1.	the successful deployment of M-health need various support from the health organization	4.4913	0.51002	
2.	IT specialist should raise awareness between staff and stakeholders on M-health and motivate them by giving appropriate skill to use it	4.4372	0.5113	
3.	It is important to give health staff prompt and effective technical support to facilitate the deployment of m-health system	4.6910	0.44137	0.747
4.	The Health Organization needs to keep Up-Date development about M-Health Post-deployment stage sustainability stage	4. 7133	0.4173	
5.	The M-Health should be user friendly, attractive and flexible	4.7785	0.41969	

S/N	Item Post-deployment (sustainability)	Mean	SD	Cronbach's alpha
1.	It is very important to control the quality of M-health service to ensure successful deployment and use.	4.321	0.6091	
2.	A sustainable M-health system needs to be used in a collaborative consulting to ease communication and information sharing amongst heath care givers	4.4732	0.6312	
3.	The measurement of M-health usability in terms of accessibility, Interactivity, and interface design affects the successful deployment of M-health	4.6391	0.4871	
4.	Enhancing trust and confidence amongst members of M-health management as well as between staff and stakeholder will positively affect the willingness to use m-health	4.2211	0.6832	0.781
5.	Making M-health platform flexible and attractive will affect the success of M-health deployment	4.3214	0.61181	
6.	To ensure sustainability, there is a need for feedback on the impact of the system in terms of meeting the user's requirement	4.3791	0.49736	

SN	General evaluation of the framework	Mean	SD	Cronbach's
1.	Deploying and using the proposed framework will make M-health meet user's need	3.8311	0.6131	
2.	The proposed framework can easily be implemented within the available E-health system environment.	3.6777	0.76637	
3.	Merging the two technologies: M-health &E-health will minimizing resistance of the M-health system	4.0132	0.7813	
4.	Integrating M-health & E-health platform will eliminate the problem of lack of M-health infrastructure in health organizations.	3.9311	0.6631	0.891
5.	Using the proposed framework will create more awareness and build confidence in using M-health among staff and stakeholders	4.2817	0.59981	
6.	The proposed framework gives room for continuous updating of m-health services	3.9301	0.61001	
7.	Using the proposed framework will help in design application and platforms to support good healthcare delivery	4.0111	0.71902	
8.	The proposed framework will support developing and maintaining of the M-health system	4.001	0.60910	
9.	The proposed framework will ensure an effective administrative system for successful deployment of M-health	3.8911	0.63120	
10	The proposed framework will enhance feedback mechanism and support in viability of the M-health system	4.000	0.60858	

A sample t-test was carried out on the data gathered to check the hypothesis that the stakeholder score average is greater than 3, i.e the Likert scale neutral level ranging from 1-5. The normality test was carried out using SPSS to assess the normality of the distribution of the scores. The Kolmogrove Smirnov test statistics p-value is 0.200 which is higher than 0.05. That implies that we can conclude that Qmean(the mean of the question) distribution is normal. The normality test is seen in the table 7:

Table 7: The test of normality (stakeholder data)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	DF	Sig.	Statistic	DF	Sig.
Qmean	0.132	22	0.200*	0.960	22	0.485

*a = Lilliefors Significance correction, * = Lower bound of the true significance.* The Data is normally distributed.

Table 8 (Stakeholder Descriptive Statistics) indicates a 95 percent Confidence Interval on stakeholder's score means using 21-degree of freedom on t-distribution (4.095, 4.3730). Because this interval does not contain the test value 3, there is clear proof that the mean stakeholder scores are greater than 3. We can also see the p-value is below 0.05 and the t-value is positive which implies that the null hypothesis is rejected and the alternative hypothesis is accepted.

Table 8: Descriptive statistics of the stakeholders score means

			Statistic	STD error
Qmean	Mean		4.23053	
	95% confidence interval for mean	Lower bound	4.090960	0.671130
		Upper bound	4.370096	
	5% trimmed mean		4.230171	
	Median		4.250001	
	Variance		0.99	
	Std. deviation		0.314787	
	Minimum		4.7859	
	Maximum		3.6787	
	Range		1.1072	
	Interquartile range		0.5671	
	Skewness		0.131	0.490
	Kurtosis		-1.055	0.953

The result of the two open-ended questions

The open-ended questions were intentionally designed to explore the challenges that could threaten M-health delivery and invite participants to suggest other considerations that add to and enrich the proposed model. Responses from both the caregivers and stakeholder were examined thematically. The results of the frequency of each theme suggested by the stakeholder and Caregivers was can be seen in Table 9. The themes were generated using the following built steps as suggested by (Silverman, 2001; Ahmad Abu-Al-Aish, 2014).

- Familiarization with data sets through nothing initial comments and ideas.
- Generating initial code through the act of coding the data set
- Searching for themes which can be done through collecting similar codes and arrange them to thematic clusters
- Review themes and test whether created themes function with respect to their dataset.
- To optimize themes by refining specifications of themes and potential linkages.

Table 9: Shows the frequency of each theme suggested by the stakeholder and staff to be added to the refined model.

Items identified	Frequency, stakeholder responses (Total =10)	Frequency of staff responses Total=82
Cost of implementing M-health	6	10
Lack of awareness, knowledge, and skills	4	09
Lack of basic training	5	08
Availability of technical infrastructure	5	09
Staff's resistance to change	2	-
Availability of suitable mobile devices with internet connectivity	1	08
Compatibility of the phones	5	07
Satisfying users needs	1	08
Availability of rich, flexible platform	2	02
Usability issues	2	14

Staffs most identified obstacle

Cost of implementing M-health: "cost of implementing the system", mobile devices are costly "you can just easily a cheap good one".

Awareness and motivation: "attracting staff and encouraging healthcare access while on the move". "This can be emphasized by stakeholders through one-one approaches". "The attractiveness of the services is paramount, the purpose for deploying M-health will fail when a lot of people are not going to use it".

Availability of suitable mobile (android, phone, iPhone) with an internet connection. "if the users have the required mobile device to use M-health then it becomes meaningful".

Usability issues: "Designing the system to encourage people to constantly use them for M-health", "the M-health system needs to be easy to navigate", "look slightly simple and flexible".

Meet the user's needs: - " A reliable system that provides the users with all the relevant information when and where needed", "creating an M-health system that will aid many departments", "lack of communicable between the end-users and the health organization".

Compatibility issues: staff indicated that mobile devices have a different operating system, "compatibility across different devices", "there are different mobile devices platforms, which are been updated more often".

Update the M-health system: "keep the system up-to-date to flow with the changes in technology", "up-to-date with new technology."

Stakeholder most identified obstacles

Cost of implanting M-health system: "M-health implementation might face services and financial problems at the start".

Lack of basic training: a stakeholder mentioned that "lack of training and insufficient technical guide to exploring the system".

Availability of technical infrastructures: "M-health takes resources from advanced technology combining them to achieve a purpose". To this end, "the technical infrastructure is critical to deployment".

Lack of awareness, knowledge, understanding, and skills: - "staff and stakeholders' engagement "lack of understanding consequently leading to lack of acceptance". "If staff were fully knowledgeable about the benefits, they will be more eager to go for M-health", "the idea of M-health can still not be compared with the face –to- face consulting"

Stakeholder resistance to change: "stakeholders do not like to change their current traditional method of doing things or practice", they tend to be conservatives", they are so affected to be old laid down bureaucracy, change become difficult".

Meet the user's needs: "we have a large scale of medical staff with different talents, capabilities, and expertise".

Compatibility between mobile devices/development platform issues: "M-health contents need to be suitable to download/upload. On multiple handheld devices, as uses of such systems may have different phone systems packages. "The system should be compatible to android, iPhone, etc".

Availability of high-quality packages: "high-quality resources attract usage of M-health", "Easier to use, flexible platforms serve as encouragement for use of M-health system".

Staff and stakeholders' concerns and recommendations

The negation of what M-health is all about: some opined that "staff can explore other platforms e.g social media than using the device for the purpose to which the phone is supplied".

M-health will make e-Health obsolete: someone opined "developers will concentrate on developing M-health package than e-health thereby making e-health obsolete".

M-health will create a communication gap between staff and stakeholders. "it is obvious that must staff/caregivers and stakeholders will concentrate on using the M-health system than communicating face-to-face with each other and also the stakeholders".

Lack of health organizations support for M-health design and development: "M-health is not a priority in most health organizations", "the health staff is reserved and comfortable with the old way of doing things". "we are sure that no technology can replace the traditional consulting system".

VI. DISCUSSION

The proposed model tries to build a road-map for health organizations in deploying usable and sustainable M-health systems within the health sector. In this section, the contribution of the participants will be discussed; factors that affect the deployment. The study outcome suggested that participants had a good model evaluation; the questionnaires were structured to examine staff and stakeholders' thoughts on the factors influencing the implementation of the M-health program and how they felt about M-health. Based on the data collected, the mean scores ranged between 3.40 and 4.60 for the staff questions (out of a scale of 5) and the mean for all questions was 4.09, which is more than 3(Likert scale midpoint). This means that the variables discussed in both infrastructural-resources and sustainable stages would impact the implementation of M-health directly from the workers perspective. Results from stakeholders indicate that the average is between 3.68 and 4.79, and the mean for all questions is 4.23, which is greater than 3(mid-point of the Likert scale). This proves that all stakeholders agree with the factors involved in the model.

Nonetheless, some participants raised their views on the open question about the factors that could impede the successful implementation of the M-health system; as indicated by most participants, the cost of implementing M-health was the main obstacle. It is a very important problem especially in the process of pre-deployment (Ng and Nicholas, 2012). All aspects of costs (infrastructure, training, and connectivity) need to be considered. More so, service and maintenance are required. The participants also identified fast internet access and the availability of appropriate mobile devices. This very important aspect must be taken into account in the search for the successful implementation of the M-health program in a health organization. The issue of size, accessibility and coverage is also paramount, mobile device to be used in M-health needs to be of high definition. The outcome has also shown that mobile app accessibility is another problem in the use of the M-health program. There has been no unified interface across mobile devices, so flexibility has been emphasized by both workers so stakeholders to have emerged a strong obstacle. Many mobile devices operate on the various platforms (android, windows, apple, etc.). M-health applications therefore need to be compatibility with multiple handheld devices. Looi et al., (2010) think that when accessing common tools, mobile devices must require compatible apps. Robust software needs to be delivered when accessing common resources. There is also a need to provide more flexible and attractive software that can accommodate different types of mobile devices. This should be done in the interest of integrating different users into the M-health system with different kinds of devices to operate.

Albert, participants agree it would be of great help to incorporate user needs as a dimension to the proposed model. M-health should be built in such a way as to meet the needs of the patient. The needs of users may rely on different occupations and areas of expertise.

The implementation of M-health into health organizations would require a considerable level of training both for health professionals and other stakeholders (Hung &Chang, 2005). Staff need the training to enhance the usability of M-health

and stakeholders need training on the other side so that there can be some form of flow and understanding when it comes to important M-health issues. Finally, we have looked at the reluctance of stakeholders for innovations and new ideas. Stakeholders who have used the conventional approach for a long time in their bureaucratic settings would be "ambivalent" in their nature about the design of the M-health system. They still have the desire to continue to use their established method of doing things. Therefore, there is a need to encourage and motive them to adopt a new approach to address health issues using M-health.

Model refinement

New factors were added to the model, based on the results obtained from the open-ended questions. The following considerations were added during the pre-deployment stage: cost, availability of suitable devices and internet access, reliability, and also needs of the user. The following factors were considered important and added for the post-deployment stage: Training and tackling stakeholder's resistance to change.

Costs:-M-Health system deployment requires mobile devices to be purchased with its associated infrastructure, connectivity payments, training costs for stakeholders and health workers, and the deployment of M-Health content suitable for all mobile devices (Nai Smith and Corlett, 2006). The costs of implementing M-health are expected to be reduced to meet the budget of the organization

Availability of suitable mobile devices and internet connectivity:-Availability of suitable mobile devices used by both health workers and stakeholders is essential to the effective implementation of the M-Health system (Ventola, 2014) not all staff have top-end phones. In terms of functionality, internet connectivity and coverage, mobile devices need to be high-definition one. it should be compliant to most recent generation of mobile services (4G, 5G etc). The desired devices should be available with basic requirements to smoothly run all the M-health applications.

M-health compliant applications:-Mobile devices are accepted to have specific operating systems (Ventola, 2014). Some are Android, Blackberry, Symbian, iPhones and others. Therefore, M-health applications need to be developed which are compatible (can be run smoothly) with all the operating systems available. Looi et al., (2010) "Mobile devices must deliver applications compatible when accessing the general education resources or materials".

Meet user's Needs: - The M-health system should be developed in a way that can meet a variety of needs of all users. Health staff might come from different professions e.g. doctors, nurses, pharmacist Lab-scientist et.c, and with different skills, and different knowledge of information systems, the M-health system should be developed in a way that it meets all the user's requirements.

Training: - the advent of new technology in any organization requires training and even re-training (Wu, Hwang, Su and Huang, 2012). Therefore, implementing M-health in health organizations requires training for both the staff and stakeholders. This is important because it will enhance their usability with mobile technology and enable new reporting Health activities (William, 2013).

Tackling the resistance of stakeholders to change:- stakeholders may be resistant to change, and may wish the system to continue as it is used to. There is a serious need to motivate them to adopt a new way of doing things (technology), or encourage them. It can be done by learning experiences (workshops, seminars) that discuss the advantages of using M-health technology, integrating real-time presentations using M-health applications, celebrating successful M-health experiments. Some stakeholders believe that certain factors need to be removed from the pre-deployment stage since they considered these factors to be found at both stages (pre- and post-deployment). Such factors, such as ongoing technical support, management / installation program, and promoting and continuing progress in M-Health. It is then determined that all preceding variables will be included in the refined model to feed both stages of pre and post-deployment. Looking broadly at the Readiness in M-health perspective (Nathan, Che and Longe, 2020) and exploring Acceptance of M-health using UTAUT modified model (Nathan, Che and Longe,2020) and other relevant literatures on mobile-health implementation, the pre-deployment stage was refined to include the following factors:

- Provision of cost-effective solutions
- Conduct advocacy and sensitization campaigns to both the staff and stakeholders
- Availability of suitable devices and internet
- Give compatible M-health applications
- Treat usability issues
- Meet user's needs

These factors are very essential for the infrastructure and preparation stage. Also Looking broadly at the Readiness in M-health perspective(Nathan, Che and Longe, 2020) and exploring Acceptance of M-health using UTAUT modified model (Nathan, Che and Longe,2020) and other relevant literatures on mobile-health, the post-deployment sustainability stage was refined to include the following factors:

- Quality of service control
- Continuous usability assessments
- Trust and confidence
- Training
- Collaborative consulting
- Achievements evaluations, tackling stakeholders resistance to change
- Availability and sustainability of the M-health apps.

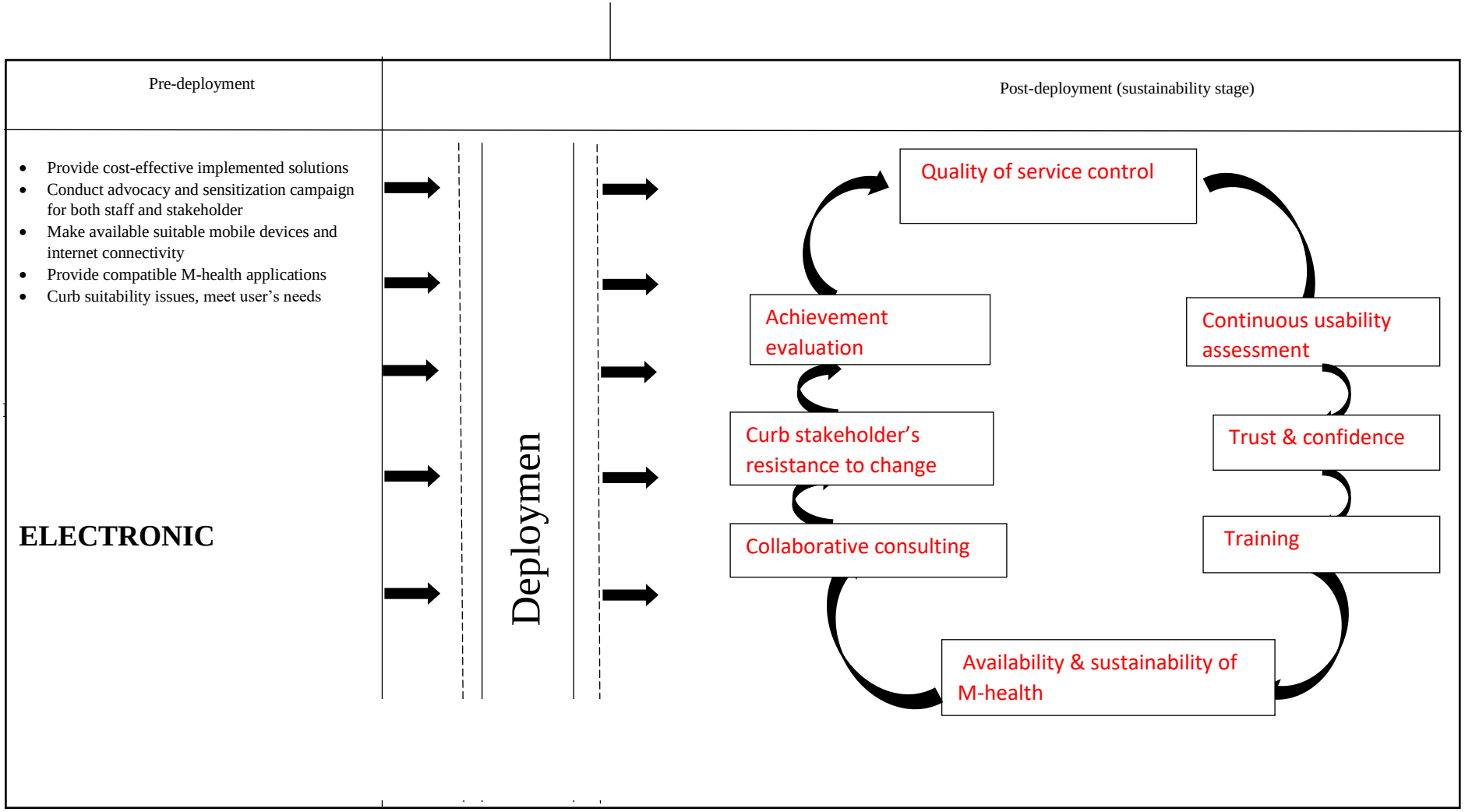

Figure 2: Illustrating Refined M- health Framework.

VII. CONCLUSION

The study aimed to develop a model that can be used as a guide for both stages of M-health pre-deployment and post-deployment. The variables used to develop the initial model have been tested with 82 healthcare workers from diverse backgrounds and 10 stakeholders. Both staff and stakeholders agreed with the model and suggested adding additional factors that altered the initial model. Such considerations include implementation costs, availability of suitable phones, compatibility issues and user needs. These are critical and were added to the pre-deployment phase. Training and curbing the resistance to change of stakeholders is also critical and was added to post-deployment stage. The initial conceptual model was modified, based on respondents ' responses.

The robust conceptual model offers a detailed overview of all elements that need to be implemented into an M-health system, which fills the void associated with pre- and post-implementation phases to ensure effective implementation and sustainability. Moreover, the findings obtained sfrom both sides of the theory of M-health and reflect the thoughts and ideas of staff and stakeholders in health organisations.

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