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Mobile phone-based interactive voice response as a tool for improving access to healthcare in remote areas in Ghana – an evaluation of user experiences

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Abstract

OBJECTIVES To investigate and determine the factors that enhanced or constituted barriers to the acceptance of an mHealth system which was piloted in Asante-Akim North District of Ghana to support healthcare of children.

METHODS Four semi-structured focus group discussions were conducted with a total of 37 mothers. Participants were selected from a study population of mothers who subscribed to a pilot mHealth system which used an interactive voice response (IVR) for its operations. Data were evaluated using qualitative content analysis methods. In addition, a short quantitative questionnaire assessed system's usability (SUS).

RESULTS Results revealed 10 categories of factors that facilitated user acceptance of the IVR system including quality-of-care experience, health education and empowerment of women. The eight categories of factors identified as barriers to user acceptance included the lack of human interaction, lack of update and training on the electronic advices provided and lack of social integration of the system into the community. The usability (SUS median: 79.3; range: 65–97.5) of the system was rated acceptable.

CONCLUSIONS The principles of the tested mHealth system could be of interest during infectious disease outbreaks, such as Ebola or Lassa fever, when there might be a special need for disease-specific health information within populations.

keywords mHealth, interactive voice response, child care, System Usability Scale, Ghana, sub-Saharan Africa

Introduction

The millennium development goals (MDGs) have led to substantial progress in reducing child mortality in sub-Saharan Africa [1]. Yet the number of under-five deaths due to preventable causes remains high, and the 2015 millennium targets to reduce child mortality (MDG 4) unachieved in many countries including Ghana [2, 3]. Health systems in the region often face lack of universal access to care and weak infectious disease surveillance and response [4]. Accordingly, innovative approaches supporting access to healthcare, collection and analysis of disease data are urgently needed to implement the 2030 agenda for sustainable development [5, 6].

In response, the use of mobile devices in the health sector (mHealth) provides opportunities for innovative public health solutions in low- and middle-income countries (LMICs) [7–9]. According to estimates from the International Telecommunication Union (ITU) 2015, Ghana is the leading African country in terms of information and communication technology (ICT). The mobile cellular subscription has risen from 71.9 to 114.8 per 100 inhabitants since 2010 and growth in Internet mobile-broadband subscriptions has been substantial [10]. Ghana's government has identified the importance of ICTs for development and has established ICT policies and a national eHealth strategy [11, 12]. Our pilot project 'Mobile Phone-Based Electronic Health Information and

Surveillance System for Sub-Sahara Africa' (eHISS) builds on ICT developments in Ghana; it aimed to collect data on disease symptoms using a spatial–epidemiological approach while providing useful health information to caregivers of diseased children. Although a variety of electronic health (eHealth) projects have been conducted in Ghana, the majority were implemented without assessment and evaluation of technology acceptance [13]. Yet, end-user acceptance and usability are key indicators for successful development and implementation of new mobile health technologies. For this reason, the evaluation of perceived opportunities and barriers from the end-user point of view would substantially improve mHealth programs and thus make them robust and sustainable approaches. This study therefore aimed to evaluate user's experiences with use the use of interactive voice response (IVR) system by [1] assessing self-reported adherence to and usability and [2] identification of participant's perceived opportunities and barriers.

Methods

This study interviewed parents and/or caregivers who accessed health information via a mobile phone-based interactive voice system to care for the sick children. The IVR is a two-way conversation between a real person and a pre-recorded voice in an interactive manner. The IVR is based on an algorithm, designed to systematically assess disease symptoms of sick children and to provide relevant health information to parents/caregivers of these children on the basis of the history of illness received through mobile-based IVR. The algorithm was developed in accordance with the 'Guidelines for the management of common childhood diseases' by WHO [14] and the IVR system was implemented as a pilot project in Asante-Akim North District in the Ashanti Region of Ghana. The study reported here investigated parent/caregiver-users' experiences with using the IVR system in seeking healthcare for diseased children.

Study location and design

The study was conducted in Agogo, the capital of the Ashanti-Akim North District in Ghana with a total population of 149 491. Focus group discussions (FGD) took place on the compound of the Agogo Presbyterian Hospital, a well-established local teaching hospital, in September 2015. Study participants were purposively selected from a larger study population within which the eHISS system was piloted for 6 months. Thirty-seven mothers were selected for the FGDs. They had children under 10 years of age and had used the system at least once within the last few months.

Ethical clearance for this study was provided by the Committee on Human Research, Publications and Ethics, School of Medical Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Written consent of participants was obtained.

Measures and data collection

Four qualitative semi-structured FGDs were conducted. The FGDs were divided into two parts: the first part consisted of standardised questions and the System Usability Scale (SUS) questionnaire. These questionnaires comprised 10 statements with which participants could agree or disagree on a 5-point scale [15]. The answers were summed and multiplied by 2.5, resulting in a score between 0 and 100. A higher score meant higher usability. Following the recommendation of Bangor *et al.* [15], the score was categorised into units of 'not acceptable' (SUS $\leq$ 50), 'marginally acceptable' (SUS 51-69) and 'acceptable' (SUS $\geq$ 70). The second part of the FGDs was a discussion based on a semi-structured interview guide. To develop the interview guide for the FGDs, the unified theory of acceptance and use of technology (UTAUT) [16] was applied as a basic theoretical framework. In addition to the experience gained from earlier FGDs prior to the eHISS pilot phase, discussions among the study team and a literature review on technology acceptance research were considered to develop the discussion guide. Key components were determinants of technology acceptance according to UTAUT and associated behaviour, use and non-use of the system, benefits and barriers to use, and factors related to system improvement. The pilot test of the semi-structured interview guide (seven participants) resulted in minor refinements of the wording of the questionnaire. Discussions were conducted in Twi with simultaneous translation into English and were limited to 60 min.

Data analysis

Recorded FGDs were transcribed verbatim, using f4 software [Dr. Dresing & Pehl GmbH, Marburg] following the programmer's transcription conventions. Transcripts were augmented with field notes made during the discussions. This analysis made use of content analysis by Mayring (2008). Mayring's mixed-methods approach contains a bundle of text analyses procedures including qualitative and quantitative components [17]. The data resulting from transcriptions were evaluated and coded step by step. We initially extracted broad themes and

then followed up with inductive category development and text extraction. Categories were carefully defined and revised within the process of analysis (feedback loops). Transcripts were independently coded by a trained research assistant before categories were discussed and determined by consensus. Categories were listed if they were approved by at least six participants (16.9%). Intercoder reliability of each categories was in accordance with the recommendations of Lombard *et al.* [18] by calculating Krippendorff's alpha for each category [19]. Data were analysed using SPSS 17 (https://www.ibm.com/analytics/us/en/technology/spss/) and applying the Krippendorff's alpha macro [20]. The minimum acceptable level of reliability for categories was fixed at 0.80 or greater for our analysis. Assignment ratings achieved ranged from good to excellent intercoder reliability, as indicated by Krippendorff's alpha [19].

Results

Characteristics of study participants

A total of 37 women aged between 18 and 45 years (mean 30.5 years; standard deviation [SD] ±6.8) participated in the study. All participants were Ghanaian citizens and caregivers of at least one child between 0 and 10 years living in the same household. The majority of participants was married (n = 31; 83.3%), belonged to the *Akan* ethnic–linguistic group (n = 32; 86.5%), and completed a middle (n = 14; 37.8%) or higher (n = 14; 29.7%) education level (Table 1).

Adherence to IVR system

All FGD participants called the IVR hotline during the field phase to get treatment advice for a sick child. The majority of children suffered from fever (n = 28; 75.7%), cough (n = 10; 27.0%) or diarrhoea (n = 9; 24.3%); however, parents also reported to seek healthcare for other disease symptoms (Table 2). The great majority of participants (n = 33; 89.2%) followed the system's recommendations and either visited a hospital (n = 10; 27.0%) or provided home care (n = 23; 62.2%) in accordance with received recommendations (Table 2). However, although recommendations were considered being helpful, women tended to take additional action in order to support their child's recovery. Several participants reported that they went to pharmacy to get additional advice and to purchase medications, and/or they just gave paracetamol syrup in addition to recommendations provided by the IVR system. All participants could recall the recommendations that were provided when they used the system. The level of familiarity with the health information provided by the system differed between study participants. Many women were aware of the healthcare recommendations by the system although others were hearing or receiving the recommendations for the first

Table 1 Sociodemographics of participants (n = 37)

Age (years) Mean (SD)*	39.6(±7)	
	N	%
Sex		
Female	37	100
Ethnic group		
Akan	32	86.5
Grusi	2	5.4
Mole-Dagbani	1	2.7
Other	2	5.4
Marital status		
Married/living together	31	83.8
Never married/lived together	5	13.5
Divorced	1	2.7
Education		
None	1	2.7
Primary	8	21.6
Middle JSS**	14	37.8
Secondary SSS** or higher	14	37.8
Children living in the same household/age between 1–10 years		
1	6	16.2
2	14	37.8
3	10	27.0
4–10	7	18.9
Subtotal (n)	37	100

Table 2 Self-reported system use during the field phase (n = 37)

	N	%
Number of calls to try the system		
None	8	21.6
1–4 times	28	75.7
5–9 times	1	2.7
Number of calls in case of a diseased child		
Once	20	54.1
Twice	9	24.3
3–4 times	8	21.6
Symptoms of diseased child(multiple entry)		
Fever	28	75.7
Cough	10	27.0
Diarrhoea	9	24.3
Running nose	6	16.2
Vomiting	3	8.1
Other	5	13.6
Action taken after the call		
Hospital admission(system advice)	10	27.0
Home care (system advice)	23	62.2
Personal action taken	1	2.7
No action taken	3	8.1

time. Further, women emphasised that it was irrelevant if mothers were already aware about the recommendations, as in stressful situations (child sickness), they tend to forget and the provided health recommendations can serve as a reminder.

System Usability Score (SUS)

The SUS acceptability range indicates whether the evaluated system usability is acceptable or not. Study participants rated the IVR system with a medium acceptability SUS score of 79.3 (SD ±7.4) indicating a good usability. However, relatively wide variation in individual scores was observed which ranged from 56 to 97.5 (32.5-point range). The 25% percentile was calculated with a score of 72.5 indicating a moderate usability, whereas the 75% percentile indicated a good usability with a score of 82.5 (Figure 1). The translation of the usability scores into an adjective ratings scale is supposed to help researchers to interpret the meaning of calculated SUS usability scores. Quartile ranges illustrate the average SUS score based on an empirical evaluation of the system [15, 21].

Benefits and acceptance to use the system

The 10 categories developed during FGD on willingness to use the IVR system are shown in Table 3. One of the most frequently reported themes was previous experience advantage in child health performance when using the system (n = 29; 78.4%). Mothers reported the system was a useful first aid to manage illnesses at home and/or helped to avoid child admission to hospital. Indeed, they felt supported in decision-making regarding whether or not sending a sick child to the hospital was necessary. Further, more than half (n = 22; 59.5%) felt that the system would serve as first aid reference and was particularly valuable to rural areas and/or situations where no healthcare facility was available.

Almost half of the study population perceived the system as useful health education tool in child health and for preparing parents towards situations when child are taken ill (n = 18; 48.6%). This was discussed as of particular importance for inexperienced mothers, and young women who may struggle with making decisions on whether or not to send sick children to the hospital or those who lack support, be it financial pressure or otherwise. Furthermore, mothers underscored the importance of an easy-to-use system, a feature that would facilitate rapid acceptance of the system in the community (n = 14; 37.8%) as well as the importance of trust in the source of information (n = 11; 29.7%; Table 3). The participants generally agreed that the technology was able to provide emotional support to users (n = 14; 37.8%). For example, participants felt that healthcare personal at the hospital sometimes do not take mother's concerns seriously/do not take time to listen to the patient and/or is perceived as intimidating by young mothers. Therefore, mothers felt that the IVR technology provided support in care and empathy, and had a high degree of trust in the system.

Approximately 22% (n = 8) of participants said that the availability of the system in local languages was crucial to use the system, as Ghana was a multilingual country with nine government-sponsored languages. The system should be available in most dominant indigenous languages spoken in different parts of the country. Further, participants were of the view that particularly in rural areas in Ghana mothers often do not have access

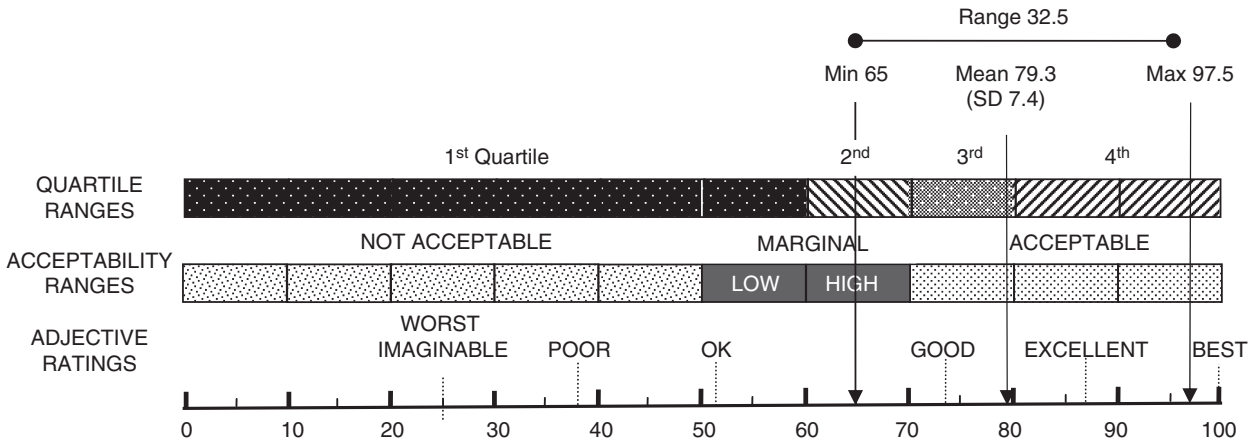

Figure 1 Overview of SUS rating table with inserted value ranges [21].

Table 3 Definition of categories for identified supportive factors

Supportive factors	Allocated codes/definition	No.	%	α
1 Advantage in individual child health	Participants felt that using the system helped to attain advantage in individual child health performance; to realise what action to take, consider stage of child's sickness	29	78.4	0.92
2 First aid	Participants felt that system can serve as first aid; support healthcare structures; if child falls sick in the night/no health facility is available/in rural area	22	59.5	0.95
3 Health education	Participants felt that the system is useful to provide health information about child health protection, useful tool, teach how to react in case the child will fall ill	18	48.6	0.95
4 Ease of use	Participants felt using the system is easy, learning how to use the technology/to become skilled was easy, and interaction was understandable	14	37.8	0.94
5 Emotional support and empathy	Participants felt supported because the IVR operated with kind of 'empathic' behaviour; listened to the participant, understood the participant's state and fears, provided comfort, can be trusted	14	37.8	0.88
6 Trust in source of information	Participants felt that they could trust the source of information/ and felt safe in following the advices	11	29.7	0.87
7 Cultural/language factors	Participants felt supported as the system is available in local language, language can be chosen	8	21.6	0.92
8 Availability and accessibility	Participants felt supported as the system is available to provide health information anywhere and anytime	9	24.3	0.84
9 Reduced costs	Participants felt that use of the system enabled to safe costs (transport costs, costs for medical advices/treatment)	6	16.2	0.91
10 Empowerment of women	Participants felt that the system enables mothers to take responsibility, supports gender equality in taking decisions about child's healthcare/household resources	14	37.8	0.82

α = Intercoder reliability calculated by Krippendorff's alpha.

and control over resources within their household and are therefore not the ones to take decisions to admit the child to the hospital without financial support and permission of their partner. Thus, the IVR system was discussed as a means to empower women by providing reliable information, giving them more control over their healthcare and greater participation in decision-making about their own health and those of their children (n = 14; 37.8%; Table 3).

Barriers to acceptance and recommendations for improvements

Eight components were identified as constituting infrastructural, technical, behaviour and attitudinal barriers to the use of the tool (IVR system). More than one-third (n = 14; 37.8%) of participants said that the country currently has an insufficient or weak ICT infrastructure to fully support a mobile phone-based IVR technology (Table 4). Also participants faced challenges in using the system due to lack of familiarity with the technology (n = 12; 32.4%), and it was reported that training on how to use the device was greatly needed, particularly for the older and illiterate mothers. The lack of human interaction or human factor was further discussed in greater detail among 30% (n = 11) of participants who expressed some misgivings about the use of the system during an actual crisis: it was doubted that in the case of severe child sickness, mothers will think about calling a machine and/or if a child's sickness can be determined unless medical examination, wherefore mothers wished the system would provide the additional option to speak with a health professional on phone.

In this context, the importance of building social contacts at the hospital and the role of the health facility as public gathering places and centres of activity were also discussed. Another common complaint from participants (n = 12; 32.4%) was that the information provided by the system was not updated regularly and could therefore be outdated or deficient regarding emerging new diseases (Table 4). A lack of novel recommendations on a sustained basis may serve as a disincentive for mothers to use the system in the future on a regular basis. Furthermore, participants would prefer to share the recommendations received among each other (family members, friends, neighbours) instead of calling the system separately. It was suggested to provide incentives for the use of the system. This could include current health information, short games, short commercials, quizzes and interviews with professionals and/or persons of public interest such as famous Ghanaian football players and other public figures. Further, approximately half of the participants

Table 4 Definition of categories for identified barriers to use

Barriers to use	Allocated codes/definition (short version)	*N*	%	α
1 Facilitating conditions	Participants felt that the national organisational/technical infrastructure is lacking, for example irregular/unpredictable power outages and mobile network restrictions	14	37.8	0.88
2 Not easy to use	Participants felt learning how to use the technology/to become skilled was not easy; interaction was not self-explanatory	12	32.4	0.83
3 Lack of human interaction	Participants were reluctant to rely on a machine/sensitive field of healthcare; would like to have the opportunity to speak with somebody in person after end of algorithm	11	29.7	0.93
4 Information timeliness/ lack of additional value	Participants felt that the provision of updated health information/ tips/advices is missing in order to keep people motivated to call; systems information is easily exhausted; no additional benefit	12	32.4	0.94
5 Complexity of health problems	Participants felt that it was not possible to describe all aspects of the child's disease/ situation; health is a state of complete physical and mental well-being; can't be addressed by IVR	9	24.3	0.92
6 Limitation of addressed symptoms	Participants felt that the disease symptoms addressed are too limited; wished for broader spectrum of addressed symptoms/advices	18	48.6	0.84
7 Social factors/lack of integration into the community	Participants felt that the system was not enough integrated into community culture; opinion leaders should be included in introduction/training; lack of announcement of the system	27	73.0	0.93
8 Short-time support only and no drug prescribed	Participants felt that the system provides support for a specific situation only; no recognition of patient; no drugs prescribed.	15	40.5	0.89

α = Intercoder reliability calculated by Krippendorff's alpha.
IVR, interactive voice response

(*n* = 18; 48.6%) reported that the symptoms addressed by the system were too limited and wished for expansion of the choices/options currently available. Child health nutrition and other typical childhood diseases were discussed. Approximately 25% (*n* = 9) of participants felt that health by the definition of complete physical, mental and social well-being was too complex to be addressed adequately by an IVR system (Table 4). Mothers doubted whether an IVR system will be able to request sufficient details to cover all determinants of the child health status. Furthermore, the lack of integration into social life of the communities was shown as a significant barrier for adoption of the IVR system. The use of mobile telecommunication in seeking healthcare was perceived as an integral part of the community, and for that reason, 73.0% (*n* = 17) of participants reported that community health workers and leaders or other persons of respect in the community should play a key role in the introducing the system to the communities: mothers argued that due to cultural factors, older persons and/or persons who are highly accepted in the communities have high influence in opinion making. In addition, the system should be introduced by various communication channels, such as radio (*n* = 7, 18.9%), information van (*n* = 7; 18.9%), television (*n* = 5; 13.5%), an information centre (*n* = 5; 13.5%), mother's welfare clinics (*n* = 6; 16.2%), hospitals (*n* = 5; 13.5%) and churches (*n* = 5; 13.5%). Another common barrier reported by participants (*n* = 15; 40.5%) was the fact that the system was able to provide short-term support but lacked follow-up and/or consideration of patient history (Table 4). Five (*n* = 5; 13.5%) mothers reported that they would prefer to register on the system including personal data and medical records.

Discussion

The objective of this study was to determine key barriers and opportunities for the use of a mobile phone-based IVR system for seeking healthcare. for diseased children in Ghana and to assess the usability of the system. Evidence highlights that IVR has proven to be a reliable and inexpensive tool in mobile healthcare. For instance, IVR has been applied in low- and middle-income countries for remote education of health personal, for example in the field of family planning [22], for diagnostic and treatment support [23], to enhance medical adherence [24], for the management and monitoring of psychiatric conditions and mental health [25, 26] as well as for education and behaviour change communication in the field of sexually transmitted infections [27] and chronic diseases [28]. The results of our study contribute essential empirical findings to the neglected area of mHealth user acceptance in sub-Saharan Africa. The usability of the IVR system was reported to be good in accordance with the SUS [15]. The results of the FGDs indicated ten (*n* = 10) categories

of factors which facilitate the use of IVR intervention, and a total of eight (n = 8) categories hindering the adoption and acceptance of the IVR mHealth system. In social sciences, a number of theoretical models have been proposed; focusing on factors imparting the acceptance of information technology, of which the unified theory of acceptance and use of technology (UTAUT) model [16] served as a theoretical framework for our study. Study results confirmed four key constructs of UTAUT as factors influencing IVR adoption as (i) the degree to which an individual believes that using the system will help to attain advantage in individual health performance was mentioned as facilitating factor by the majority of participants, whereas (ii) the degree of ease associated with the use of the system was mentioned as both barrier and facilitator to use (iii) the existence of facilitating conditions, such as organisational and technical infrastructure to support use of the system, was discussed by 37.8% of the participants as being a barrier due to the fact they are poorly developed (iv) social factors were viewed as barrier to use or adoption of the technology, although our definition of social factors differed substantially from that of UTAUT model. Besides, health education and first aid were identified as two further factors that facilitated the use of the system. According to the United Nations women's access to child healthcare services, including first aid and mother's health education are crucial factors to address the sustainable development agenda [29]. Results also illustrated that the lack of human interaction (or human factor) and the complexity of health problems were perceived as important barriers to IVR adaption. These findings confirm the results of FGDs conducted prior to the field phase [30] and are in line with previous research in the field of mHealth acceptance [31]. Further, results of our study emphasised that the access to child health information through use of an IVR system by mothers is an essential factor contributing to their empowerment. This might support the importance of mHealth interventions in overcoming women's low control over household resources which translates into low decision-making power to seek healthcare in sub-Saharan Africa as one crucial factor that could support the sustainable development agenda [29].

Limitations of the study include methodological restrictions of the qualitative approach as well as restrictions of analytical techniques and applied instruments such as the SUS. For instance, we included mothers who were part of eHISS pilot study, and who tried the IVR algorithm at least once. The results of the qualitative data are based on a small, purposively selected sample size and are not representative of the entire population. Therefore, data are prone to selection bias. Besides, the data are self-reported and may be affected by information and recall biases. Another limitation could have been caused by the fact that discussions took place in an 'official framework' at the hospital compound together with members of the project team. Therefore, adults who may have faced serious challenges in using the system were more likely to decline in participating in the FGDs. For analysis of the qualitative data, a content analysis in accordance with Mayring [17] whose approach offers high value of validity and reliability compared to other quantitative research methods was applied. Nevertheless, limitations of the content analysis include the possibility of researcher bias and lack of control of confounding extraneous factors. Therefore, intercoder reliability in content analysis studies is crucial to assess the level of agreement between coder's decisions [32]. We computed the intercoder reliability by calculating Krippendorff's alpha, and as compared to other methods, it is able to measure observed and expected disagreement independent from sample size. In addition, it is flexible with multiple coders or missing data, and is therefore discussed as most reliable with acceptable reliability coefficient [19, 33]. Due to the small sample size, demographic characteristics reported in Table 1 were not controlled or adjusted either for use of the system or to build categories of the content analysis.

Whereas the most suitable approach to measure and incorporate acceptance in new technologies is still under debate, it was evident that sociocultural norms and perceptions have some influence on the perceived benefits of and barriers to the use of technology and may therefore shape the determinants of its ultimate acceptance by communities. This research has the merit in contributing to the understanding of user perceptions and factors that mediate mHealth technology acceptance in the sociocultural context in sub-Saharan Africa. The results will support future research in that there is better understanding of the factors mediating users' willingness to use IVR applications in the context of healthcare or to develop an improved prototype with wider user acceptability. In addition, evidence may be used for future research to integrate the mediating factors with an existing empirically tested technology acceptance model and to modify a conceptual framework to be validated in the sociocultural setting of sub-Saharan Africa.

Conclusion and implications for practice

We have learned that users are generally open for mHealth and interested in new technologies. However, regular use of the mHealth system is only acceptable to participants if the system offered promise providing not only standard

health information but also additional value such as daily updates of health news or nutrition tips. As regular use of the system is prerequisite for wide acceptance and adoption of the technology, this factor should be thoroughly considered in the developing process of future mHealth approaches in the region. The principles of eHISS could be of particular interest to be applied during infectious disease outbreaks, such as Ebola or Lassa fever, when there might be an increased interest for disease-specific health information during epidemics. This evaluation confirmed and highlighted the key role of users' experiences in the design process of new mHealth approaches. We suggest a systematic assessment of technology acceptance among users as part of best-practice guidelines to be provided by national governments in countries of sub-Saharan Africa. Guidelines may be included into the already existing partial eHealth agenda in the region.

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References

1. Molyneux M, Molyneux E. Reaching Millennium Development Goal 4. *The Lancet* 2016: **4**: e146–e147.
2. UN. Ghana Millenium Development Goals 2015 Report United Nations Ghana, 2015.
3. UNDP Ghana. Millenium Development Goal 4; Reduce Child Mortality 2016. (Available from: http://www.gh.undp.org/content/ghana/en/home/post-2015/mdgoverview/overview/mdg4/.)
4. UN. *The Millenium Development Goals Report 2015*. United Nations: New York, 2015.
5. Piette JD, Lun KC, Moura LA Jr *et al.* Impacts of e-health on the outcomes of care in low- and middle-income countries: where do we go from here? *Bull World Health Organ* 2012: **90**: 365–372.
6. UN. Sustainable development goals. 17 goals to transform our world. The Sustainable Development Agenda: United Nations 2016. (Available from: http://www.un.org/sustainabledevelopment/development-agenda/.) [18 Jan 2016]
7. WHO. *mHealth: New Horizons for Health Through Mobile Technologies: Second Global Survey on eHealth*. World Health Organization: Geneva, 2011 97892415642502305-0934 (Online) -2220-5462 (Print) Contract No.: 3.
8. Mehl G, Labrique A. Prioritizing integrated mHealth strategies for universal health coverage. *Science (New York, NY)* 2014: **345**: 1284–1287.
9. Lee SH, Nurmatov UB, Nwaru BI, Mukherjee M, Grant L, Pagliari C. Effectiveness of mHealth interventions for maternal, newborn and child health in low- and middle-income countries: systematic review and meta-analysis. *J Glob Health* 2016: **6**: 010401.
10. ITU. *Measuring the Information Society 2015*. International Telecommunication Union: Geneva, Switzerland, 2015.
11. Gyaase PO, Takyi A. A case for public financing of broadband internet infrastructure in Ghana. *Int J Sci Tech Res* 2014: **3**: 60–68.
12. WHO. *Atlas. eHealth country profiles*. World Health Organization: Geneva, 2011.
13. Afarikumah E. Electronic health in ghana: current status and future prospects. *Online J Public Health Inform* 2014: **5**: 230.
14. WHO. *Pocket Book of Hospital Care for Children: Second edition Guidelines for the Management of Common Childhood Illnesses*. 2nd edn. World Health Organization: Geneva, 2013; 412 p.
15. Bangor A, Kortum PT, Miller JT. An empirical evaluation of the system usability scale. *Int J Hum Comput Interact* 2008: **24**: 574–594.
16. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. *Mis Quart* 2003: **27**: 425–478.
17. Mayring P. *Qualitative Inhaltsanalyse: Grundlagen und Techniken (Qualitative content analysis. Basics and methods)*. 12 edn. Weinheim Beltz: Weinheim, 2015.
18. Lombard M, Snyder-Duch J, Bracken CC. Intercoder reliability. Practical resources for assesing and reporting intercoder reliability in content analysis research projects 2010. (Available from: http://matthewlombard.com/reliability/#How%20should%20content%20analysis%20researchers%20properly%20assess%20and%20report%20intercoder%20reliability.) [updated 2010; cited 2016]
19. Hayes AF, Kripendorff K. Answering the call for a standard reliability measure for coding data. *Commun Method Meas* 2007: **1**: 77–89.
20. Kripendorff K. Computing Krippendorff's alpha-realibility: University of Pennsylvania, 2011. (Available from: http://repository.upenn.edu/asc_papers/43.) [updated 25.11.2011; cited 2016 04.03.]
21. Bangor A, Kortum P, Miller J. Determining what individual SUS scores mean: adding an adjective rating scale. *J Usability Studies* 2009: **4**: 114–123.
22. Diedhiou A, Gilroy KE, Cox CM *et al.* Successful mLearning Pilot in Senegal: delivering Family Planning Refresher Training Using Interactive Voice Response and SMS. *Glob Health Sci Pract* 2015: **3**: 305–321.
23. Rodrigues R, Poongulali S, Balaji K, Atkins S, Ashorn P, De Costa A. 'The phone reminder is important, but will others get to know about my illness?' Patient perceptions of an mHealth antiretroviral treatment support

intervention in the HIVIND trial in South India. *BMJ Open* 2015: **5**: e007574.
24. Daftary A, Hirsch-Moverman Y, Kassie GM *et al.* A Qualitative Evaluation of the Acceptability of an Interactive Voice Response System to Enhance Adherence to Isoniazid Preventive Therapy Among People Living with HIV in Ethiopia. *AIDS Behav*. 2016: doi: 10.1007/s10461-016-1432-8.
25. Hamdani SU, Minhas FA, Iqbal Z, Rahman A. Model for Service Delivery for Developmental Disorders in Low-Income Countries. *Pediatrics* 2015: **136**: 1166–1172.
26. Janevic MR, Aruquipa Yujra AC, Marinec N *et al.* Feasibility of an interactive voice response system for monitoring depressive symptoms in a lower-middle income Latin American country. *Int J Mental Health Syst* 2016: **10**: 59.
27. Agarwal A, Hamdallah M, King EJ *et al.* Implementation of a confidential helpline for men having sex with men in India. *JMIR Mhealth Uhealth* 2015: **3**: e17.
28. Piette JD, List J, Rana GK, Townsend W, Striplin D, Heisler M. Mobile Health Devices as Tools for Worldwide Cardiovascular Risk Reduction and Disease Management. *Circulation* 2015: **132**: 2012–2027.
29. UN Women. *Monitoring Gender Equality and the Empowerment of Women and Girls in the 2030 Agenda for Sustainable Development: Opportunities And Challenges*. UN Women: New York, 2015.
30. Brinkel J, Dako-Gyeke P, Krämer A, May J, Fobil JN. An investigation of users' attitudes, requirements and willingness to use mobile phone-based interactive voice response systems for seeking healthcare in Ghana: a qualitative study. *Public Health* 2017: **11**: 125–133.
31. Parker SJ, Jessel S, Richardson JE, Reid MC. Older adults are mobile too! Identifying the barriers and facilitators to older adults' use of mHealth for pain management. *BMC Geriatr* 2013: **13**: 43.
32. Lombard M, Snyder-Duch J, Bracken CC. Content Analysis in Mass Communication: assessment and Reporting of Intercoder Reliability. *Human Commun Res* 2002: **28**: 587–604.
33. Kripendorff K. Agreement and Information in the Reliability of Coding. *Commun Method Meas* 2011: **5**: 93–112.

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