



Use of Mobile Application to Support Community Health Workers in Patients' Assessment and Referrals. The Case of Malawi Rural Healthcare

Florence Matewera^(✉)  and Jens Kaasbøll 

Department of Informatics, University of Oslo, Oslo, Norway
florenm@uio.no, jens@ifi.uio.no

Abstract. The dispersion of mobile technology in developing countries especially in rural areas has led to the belief that adopting mobile health applications is beneficial in supporting delivery of healthcare in developing countries. In this study, we explored the affordances of mobile-based Integrated Community Case Management (iCCM) as a protocol that aims at providing basic lifesaving treatment to children who are under five years of age at community level. Using the qualitative approach, this research provides the health informatics and information systems community with an understanding of how the digital iCCM may affect the level of assessment of patients' illness and referrals to higher level facilities. Data was collected through semi structured interviews, focus groups, observation and documents analysis. Thirty-two (32) participants were interviewed. Affordance theory was employed as a lens for analyzing the findings and three functional affordances were identified as diagnosis, treatment, and remote data collection.

Keywords: Referral · mHealth · Affordance · Integrated Community Case Management · Sick Child Recording Form · Integrated Community Health Information System

1 Introduction

There are many technologies that are being used in the provision of healthcare services, one of which is mobile phones. The use of mobile applications in healthcare can bring a wide range of benefits such as: better delivery of care, improved patient safety, more effective communication between providers and increased access to information [1–3].

The dispersion of mobile technology in developing countries especially in rural areas has led to the belief that adopting mobile health applications is beneficial in supporting delivery of healthcare in developing countries [4]. The substantial growth of mobile users in the world has made the field of mHealth which is defined as use of mobile phone technology to deliver health services become more attractive to researchers and health practitioners in the provision of healthcare services [4]. Access to reliable health information by Community Health Workers (CHWs) can bring sustainable improvement in

healthcare in developing countries and one way of providing such information is through mobile applications [4]. Mobile applications can offer opportunities that complement conventional methods of accessing and disseminating healthcare information effectively [5]. Evidence suggests that a range of services provided by CHWs can improve by mobile technology for example, mHealth can enhance the performance of CHWs through communication amongst the health workers, data reporting, dissemination of clinical updates, reminders, assessment, classification, and referral of patients among others [2, 5, 6]. In a study that was conducted in Tanzania where CHWs used smart phones and tablets with an electronic version of Integrated Management of Child Illness (IMCI), an initiative aimed at reducing child morbidity and mortality rate, it was found that the application simplified their work, reduced antibiotic prescription, and gave correct classification and treatment for common causes of illness in children [7]. Another study that was also done in Tanzania found that there was greater adherence to protocol for electronic IMCI than for paper based IMCI [8]. Similarly, a study done in Burkina Faso reported that the eIMCI helped to improve patient management and encouraged rational use of antibiotics [9]. A study done in Uganda that was aimed at supporting CHWs in the treatment of acutely ill children found that 92% of the children from the targeted sites where CHWs were using mobile phones were correctly treated [10].

Many studies on mHealth applications that have been implemented in developing countries focused on maternal and neonatal healthcare, HIV prevention and care and non-communicable diseases [2, 7–9]. Similarly, some mHealth studies done in Malawi have reported their use to support maternal and neonatal healthcare and HIV/AIDs prevention and care [1, 14]. However, most studies have mainly focused on sustainability issues, data reporting practices, acceptability, and impact of mHealth and perception of mHealth interventions [11–15, 19]. Furthermore, a few studies have reported the use of mobile applications in supporting CHWs in assessment, classifying patient's illness, treating, and referring patients who present danger signs to the health facilities for specialized treatment. A pilot study in four districts of Malawi evaluated the use of a mobile application for Integrated Community Case Management (iCCM), a protocol adapted from IMCI aimed at reducing mortality and morbidity for under five children, by CHWs [20]. Findings from this study revealed that using iCCM mobile applications encouraged CHWs to adhere to protocol and to make accurate identification of danger signs in patients requiring referral. The study further found that the application increased the number of referrals that were made to health facilities, prevented unnecessary re-consultations at village clinics and minimized hospitalization rates among under five children. Similarly, a study in Malawi found that, using mobile applications, CHWs adhered to iCCM protocol when assessing and classifying sick children [18]. Another study evaluated the acceptability and impact of the Supporting LIFE Community Case Management App (SL eCCM App) by CHWs and caregivers [21]. The results revealed that most CHWs recommended the mobile application as being more reliable, less error prone, facilitated more accurate diagnoses and treatment recommendations and enhanced prompt decision making in patient referrals by accurately identifying children with danger signs. However, some CHWs believed that additional features were needed to improve the usability of the application while others pointed out that electricity and mobile network outages were some of the challenges affecting the use of mobile applications.

Despite mHealth applications registering greater impact on healthcare outcomes, evidence that is available is based on implementation of pilot projects that have never been brought to scale and are not centrally run by the government [22]. There is also little information about mHealth technologies that support CHWs to identify patients who require specialized treatment by referring them to higher level healthcare facilities hence it is the focus of this study. The study therefore is building on and reinforcing some findings from previous studies. Consequently, this study addresses the following research question.

- *How can the implementation of a mobile-based iCCM module afford Community Health Workers in assessment, classification of child illness, prescription of treatment and referral of patients from community to higher level facility?*

This paper, therefore presents the current activities of CHWs in patient assessment and referrals at the community level during village clinics conducted in hard-to-reach areas of rural Malawi. The paper will further discuss the potential advantages of using mobile technology to support CHWs in patients' referrals.

The paper is structured as follows: Sect. 2, covers the bresearch context including the Malawi health system, its segments, and various players in the value chain at the community level. This section further presents the status of mhealth in Malawi and introduces the Integrated Community Health Information System, which is an initiative that is being implemented by the Ministry of Health. Section 3 discusses affordance as a theoretical lens for this study. Thereafter, we discuss the methodology that was used to collect and analyze data followed by the analysis of the findings. Finally, we discuss the findings and then summarize the study.

2 Research Context

2.1 The Malawi Health System

This study was done in Malawi where 84% of the population live in rural areas and 24% live five kilometers (or more) away from a health facility.

The health sector is divided into four levels of service delivery: community, primary, secondary, and tertiary. The community services are the lowest level and are delivered through community initiatives, village clinics, and outreach clinics by the community health workers. CHWs include Clinicians, Medical Assistance, Community Nurses, Community Midwives, Health Surveillance Assistants (HSAs) and Village Health Committees (Volunteers). HSAs are the primary health providers at community level and each HSA is assigned a catchment area that they serve. The HSA is mandated to serve one thousand people but due to shortage of staff, they usually serve a larger population.

The healthcare system is designed in a way that encourages patients to seek care first at the lowest level and then be referred, if necessary, to a higher level of care. As such, the CHWs play an important role of providing access to primary health services especially in the underserved and hard-to-reach areas. Serious conditions beyond what the CHWs can treat are referred to a health facility for further treatment.

In an attempt to reduce child morbidity and mortality, Malawi adapted the Integrated Community Case Management (iCCM) strategy from World Health Organization (WHO) and United Nations Children's Fund (UNICEF) [20]. The program is administered by CHWs on under five children at community level through village clinics [20]. Under the iCCM program, CHWs are guided by a paper-based Sick Child Recording Form that has a step by step set of questions in assessment, classification of illness and treatment prescription [8, 18]. Depending on the outcome of the assessment, the sick child is either treated at the facility or referred to the nearest hospital if the child presents danger signs, for comprehensive clinical management [20, 21]. For CHWs to make correct identification of the patients requiring urgent referral to a higher-level facility mostly depends on CHW following iCCM guidelines which have been reported as being suboptimal [20]. Incomplete assessment of the sick child may hinder early identification of danger signs which may consequently affect referrals to higher level facilities for specialized care [20]. Management of referrals from community to the health facility are essential to save lives and ensure both the continuity and quality of care [24, 25].

2.2 mHealth Initiative in Malawi

The number of mobile phone users around the world is estimated at 5 billion [26]. Out of this number, it is estimated that 64% of these users are found in developing countries [27]. It was further estimated that half of rural residents would have mobile phones by the year 2020 (ibid). This rapid growth in the use of mobile phones has triggered the growth of mHealth in both developed and developing countries [27].

Malawi, as one of the developing countries, has embraced mHealth as an initiative aimed at improving healthcare more especially at community level. Over 45 mHealth applications have been initiated in various districts in an effort to solve health challenges like HIV/AIDs, maternal, neonatal and child health, nutrition, supply chain management and many others [22, 23, 28]. The majority of mHealth projects have been implemented at community and health facility levels of health sector targeting hard to reach areas. Most of these projects are funded by international donors through Non-Governmental Organizations who have their own areas of interest. Some of these projects have registered positive impacts like increased knowledge of maternal and child health, increased clinic attendance, increased follow-up visits and many more [1, 10]. Despite these results, the implementation of mHealth has also been faced with a number of challenges such as poor infrastructure, lack of financial resources, lack of interoperability standards, poor ICT governance, lack of buy-in from both users and government, lack of coordination among others [22].

In terms of mHealth readiness, mobile phone service providers in Malawi are targeting rural customers in an attempt to increase their subscription customer base because the urban market is becoming increasingly saturated [27, 28]. There have been recent attempts by regulators to liberalize the market so that the cost of usage is reduced [27]. There is also an opportunity to define mHealth-friendly regulations in the health sector as a means to enable phone service providers to participate positively in mHealth [27].

2.3 The Integrated Community Health Information System (iCHIS)

The Ministry of Health and Population in Malawi implemented a five-year National Community Health Strategy (2017–2022). As part of the implementation of this strategy, the Ministry of Health and Population through the Community Health Services Section in collaboration with the Digital Health Department, with technical support from the University of Malawi – Computer Science Department is developing a comprehensive national Integrated Community Health Information System (iCHIS). This is a mobile based system that is aimed at addressing the service delivery and information needs of community health services at all levels.

The development and implementation of iCHIS is expected to improve the quality of community health services and address fragmentation in the delivery of community health services including reporting and information management and to provide multi-level access to data and patient-level data analytics. It is also expected to support improved performance and higher quality service provision through standardized guidance on clinical decision-making and management of longitudinal health data records. iCHIS has three main high-level modules: the household register, the community register and the personal register. This study will mainly focus on the personal register because this is where the iCCM module for under five children belongs. The digital iCCM module is aimed at replacing the paper based Sick Child Recording Form that CHWs are currently using in village clinics.

iCHIS is built on the District Health Information Software (DHIS2) platform. The system is currently being implemented in five selected districts and will eventually be rolled out in all the districts in Malawi and it is expected to eventually completely replace the paper based iCCM protocol. This study is aligned to iCHIS.

3 Theoretical Approach

This study uses affordance theory as a lens to analyze the findings. In particular, the concept of functional affordance will be employed. Functional affordance can be defined as material properties of an information system capable of identifying how an individual may use the system based on their capabilities and goals [29, 36, 37]. This affordance emerges when material properties of information systems that affords action possibilities are congruent with the imposed new action goals of individuals [30].

3.1 Affordance

The concept of affordance originated from James J. Gibson writings and has since been applied in many fields of research [16, 34]. Gibson defined affordance as the relationship between the environment and the animal. He argued that the affordance of the environment are what it offers the animal, what it provides or furnishes, either for good or ill [33]. He further argued that the verb “afford” is found in the dictionary, but the noun “affordance” is not. He actually made it up, to describe something that refers to both the environment and the animal in a way that no existing term did.

Affordance has three fundamental properties. These include: i) affordances exist relative to the action capabilities of a particular actor. An example for this could be a

horizontal, flat, extended, and rigid surface that affords support. The fact that the surface provides support for one actor, does not mean that it also provides support for another actor; ii) the existence of an affordance is independent of the actor's ability to perceive it; iii) an affordance does not change as the needs and goals of the actor change [16, 34]. Therefore, for an affordance to be of use, it must be perceived and actualized.

The concept of affordance has over the years been applied in many fields including human computer interaction. Although the concept has become popular over the years, it has been misunderstood in some cases [16, 34]. For example, Norman's original definition and use of affordances deviated from Gibson's definition where he defined an object as having three major dimensions: conceptual models, constraints, and affordances, leading to varying use of the concept. Norman [34] subsequently clarified that his intention was to advance the notion of perceived affordance (ibid) and not Gibson's real affordances. Norman actually used the concept to refer to both perceived and actual properties of an object, without reference to an associated actor [35]. This ambiguity has contributed to misinterpretation of the concept in the IS field.

3.2 Affordance Theory in Information Systems

Affordance theory has been used in many disciplines including Information Systems (IS). For example, Thapa and Sein [31] used the affordance lens in their case study of a telemedicine project in a remote mountainous region of Nepal in which they looked at how affordances are perceived and actualized and they developed a concept called "Trajectory of Affordances" arguing that for an affordance to be actualized, there must be a goal oriented actor with action capabilities and IT artefacts that afford the possibilities of the action. They further argued that how affordances are perceived and actualized is influenced by cultural, social, and technical factors. [36] extended the definition of affordance to address the organizational context by looking at how the concept applies across organizational levels. In trying to bring clarity to the discussion of affordance and how it may be applied in IS research, Volkoff and Strong [35] defined six affordance principles as follows: i) affordances arise from the relationship between the technology and the actor and are therefore not features of a technology. ii) Affordances relate to potential actions and the purpose they are intended to achieve while actualization relates to a particular individual actor and details regarding the specific actions that actor will take or has taken. Iii) An affordance is about potential action, not about the state or condition that is reached after an action is taken. The focus must therefore be on the action and not the state or condition reached after an action. iv) An appropriate level of granularity for the affordances must be selected. v) Affordances may support other affordances or may interfere with them therefore all salient affordances and how they interact must be identified. vi) Affordances are not actualized in a vacuum, but rather in a social context and therefore there is a need to recognize social forces that affect affordance actualization. Following Volkoff and Strong's affordance principles, we will apply principle number one which talks about the relationship between technology and the actor. In this paper, we aim to identify the functional affordances that can be provided by iCHIS to assist CHWs in patient assessment, classification of illnesses and referral to higher level facilities.

To summarize the discussion above, affordance is not determined by the actor alone nor the artifact alone but the relation between the two [37]. Affordance still exists independent of user perception but remains hidden and can only be actualized by interaction between goal-oriented actors with action capabilities and the IT artifacts that affords possibilities of the action [31].

4 Methodology

This study adopted a qualitative approach. Primary data was collected through semi structured interviews, focus group discussion, document analyses, observation, and informal chats with different stakeholders. The semi structured interviews with CHWs were conducted to get a deeper understanding of their work and activities when conducting village clinics and how iCHIS affords them in assessment, classification, and treatment of the sick children and how those with danger signs may be referred to the nearest health facility. Interviews were also conducted with different stakeholders and mostly those from the Ministry of Health which is the main funder of the project. The reason for conducting these interviews was to get the iCHIS perspective and the purpose of implementing the application across the country. The interviews helped the principal researcher to have a clear understanding of the functional affordances of the application from the stakeholder's perspective. These interviews were very important as they helped the Principal Researcher observe the same occurrences from different perspectives hence having an understanding of the views of the users on the application and how they thought it may help to improve their daily routines. The interviews were carried out face to face and were scheduled according to the availability of the participants. During interviews, some predefined questions were used but there was no strict adherence to them. Some follow up questions were asked depending on how participants responded to the questions and in certain situations, questions had to be paraphrased. These questions were prepared in line with the ethical approval received from the National Health Science Research Committee, a research committee under the Ministry of Health. Thirty-two (32) participants were interviewed and these included Health Facility Personnel (4), Health Surveillance Assistants (20), iCHIS District Coordinators (2), iCHIS Trainers (4) and iCCM Coordinators (2). Consent was obtained from the participants before the date of the interview, and they were clearly informed that the interviews were voluntary and they had the right to withdraw at any stage without penalty. During the interview, the purpose of the interview was clearly explained to the participants, as well as their right not to respond to a question if they were not sure, their right to withdraw and their right to remain anonymous.

Focus groups were conducted during the iCHIS implementation training workshops and the principal researcher attended the workshops in four districts. The researcher took advantage of the workshop to bring together small and carefully selected groups of five to seven CHWs who run village clinics in their respective catchment areas. The focus groups were aimed at sharing CHWs thoughts, feelings and experiences of iCHIS and in particular the iCCM module. These interactions helped to get different opinions of how the village clinics are conducted and how the application may improve their work. Informal discussions which were aimed at getting more insight about the application

were also held with participants during the workshops. The participants were mostly members of staff from the Ministry of Health and district hospitals. Data was also collected through observation of how CHWs' conduct village clinics and how iCHIS was used in four health facilities in Balaka district.

Secondary data was collected by analyzing the documents which helped the principal researcher to have an understanding on iCCM implemented at the community level hence helping to identify the functional affordances of the application. The iCHIS user manual helped the principal researcher to get familiarized with the application. The following documents were reviewed: Malawi National Community Health Strategy, Reports from National Statistical Office, Integrated Community Health Management Information Systems (iCHIS) Phase I and Phase II reports and the annual Integrated Management of Childhood Illnesses Reports (2019/20, 2020/21, 2021/22) and iCHIS manual. For data analysis, the interviews which were mostly done in the local language (Chewa) and translated into English. The transcribed data files were analyzed to identify affordances emerging from iCHIS implementation during village clinics. Similar actions described by participants during the interviews were grouped together and assigned a thematic name hence, the functional affordances were identified and named.

5 Findings

The iCHIS application has eight (8) integrated modules namely; the Community Register that registers villages in each catchment area, the Household register that stores details of households in each catchment area, a Personal Register that records details of household members, Integrated Community Case Management that registers patients and four reporting modules (monthly, quarterly, semi-annual and annual). The area of focus in this study is the Integrated Community Case Management module that is replacing the Sick Child Recording Form, a protocol used by the CHWs during village clinics to assess the patient, classify the illness and refer those with danger signs to the nearest health facility for specialized care. After analyzing the data, three functional affordances were identified.

5.1 Diagnosis Affordance

The diagnosis affordance depends on material properties of the electronic iCCM that allows for the assessment of the sick children. iCCM guides CHWs in assessing a sick child using a step by step set of questions that are strictly followed, as shown in Fig. 1. The iCCM module is built in such a way that the user is not allowed to move forward before completing a particular step hence preventing users from skipping some important steps. This ensures that the assessment of the sick child is complete and effective. This is what one of the CHWs said.

“Unlike the Sick Child Recording Form where CHWs are guided by the color of the form in order not to miss some steps when assessing and classifying the child illness, this application is developed in such a way that one cannot proceed to the next step if the previous step has been missed or skipped. This ensures that

all necessary steps are completed and proper diagnoses is made. This gives us confidence that we have made a full assessment of the sick child.” CHWI

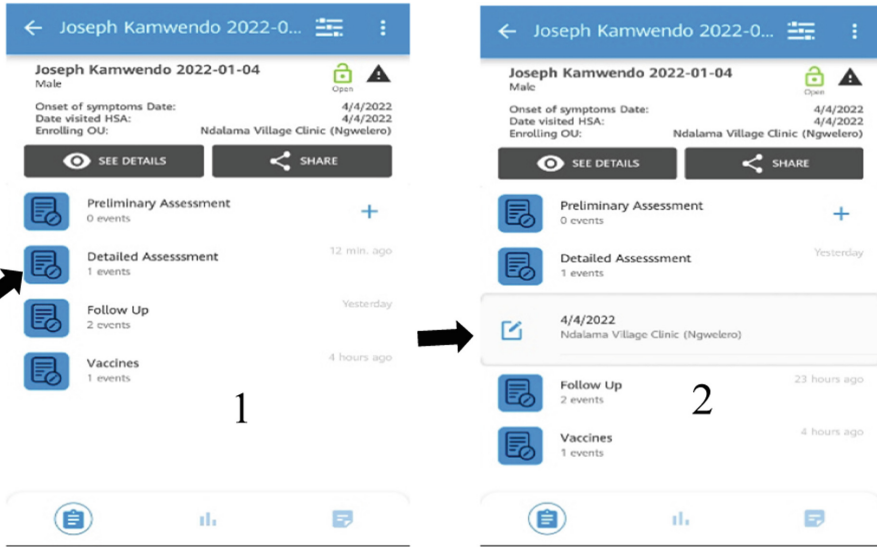


Fig. 1. Patient Assessment Form

5.2 Treatment Affordance

Classification of sick children follows proper assessment. The iCCM module guides CHWs in classifying the illness as either presenting “danger signs” of illness or sickness or as presenting “no danger signs”. CHWs are also guided on what diseases they can treat and what they cannot treat. Therefore, depending on the signs and symptoms that are presented and the number of days that the child has presented with the signs, the application classifies the child as either presenting severe signs of illness or not. Consequently, those presenting with severe signs are prescribed pre referral treatment in order to stabilize their condition and thereafter referred to a health facility without delay. While for those with no danger signs, the application guides them on what treatment to be prescribed. The findings revealed that when set guidelines are followed properly, they afford more accurate diagnosis and treatment recommendation. Where there is incomplete assessment of a sick child, this may lead to wrong classification of the ailment. Consequently, misclassification may lead to delayed referrals that may result in serious complications and in the worst situation may lead to death.

The findings also revealed that the iCCM module aids CHWs in making prompt decisions especially when a patient is to be prescribed treatment or referred to the health facility once they present some danger signs. CHWs argued that although the Sick Child Recording Form (a protocol used by CHWs) has set guidelines on various ailments and

treatment, the final decision on what treatment to be given to the patient was mostly dependent on the CHWs judgment. Wrong judgment would therefore result in wrong treatment. With the mobile application, the decision on what treatment to be given is made by the application itself depending on the information that has been entered into the system. This ensures that accurate treatment is given.

“The Sick Child Recording Form does not have controls. If you miss a step, it will not stop you from proceeding with your assessment hence if you are not careful, you end up with a wrong decision on classification of treatment. At times, we have ended up prescribing wrong treatment due to some steps that were skipped during assessment and classification.” CHW2

“Using this mobile application, if you miss one field, it will not allow you to proceed to the next level. Because of these controls, we are always confident that the treatment recommendations made by the application are always accurate.” CHW3

CHWs felt the application helped them in making accurate referral decisions. They felt some of the referrals made could not have been made had they used the Sick Child Recording Form. There are also times when CHWs have determined a patient to be critically ill when they are not.

“The application has got greater impact on referrals. There are cases when you just look at the child and think they are not supposed to be referred but using the application, it decides that the child should be referred” CHW4

“Based on our experience, we have at times judged the patient as being critically ill and required to be referred to the health facility but the application decides that the patient be treated at home.” CHW5

Patients who present danger signs of illness are supposed to be immediately referred to a health facility. However, CHWs argued that using the Sick Child Recording Form once one skips one step, one may end up not referring the patient as is required.

“The application is capable of telling me that the patient has got danger signs and therefore must be immediately referred to the health facility.” CHW6

“Using the application, the referral decision is made quickly because the moment you finish the assessment process, the decision on whether to refer the child or not would have been made hence saving life.” CHW7

The findings revealed that treatment affordance actualized into follow-up on the patients. The protocol requires that patients must be followed-up three days from their last clinic visit or three days after being discharged. Follow-up allows CHWs to check the progress of the patient and either discharge the patient if they are getting better or refer the patient to the health facility if the condition is not improving. Using the follow-up module, the CHW can set the date of follow up in the system as a reminder as shown in Fig. 2.

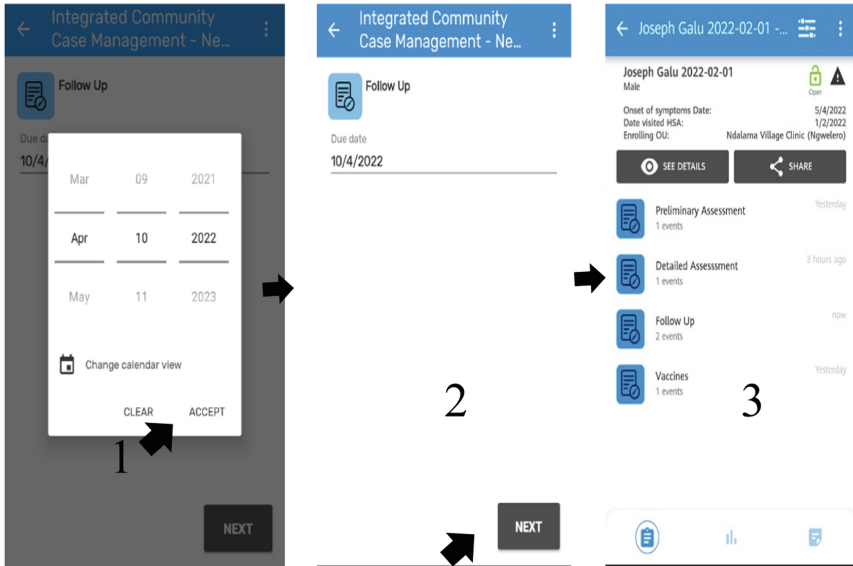


Fig. 2. Patients Follow-up Form

5.3 Remote Data Collection Affordance

iCHIS allows CHWs to collect data as when conducting household visits and during village clinics and thereafter, they sync the collected data to a server. The data can be accessed at any time for instance when they want to retrieve details of household members who were registered in their respective catchment areas, details of household members that have visited village clinics, details of treatment that was prescribed and details of patients that were referred to higher level health facilities. CHWs are able to produce quick monthly reports because they are able to access data at any time. Such data is also easily accessible by other stakeholders with the right to access the system as was commented by one CHW.

“Using this application, we are able to access our data at any time and we can also be able to produce reports quickly unlike the registers. Since the modules are integrated, data that is stored in one module can also be retrieved by another module. For instance, if a child visits a village clinic and is already registered in the personal register module, you don’t need to re-register their details but you can just retrieve from the system. It is very efficient.” CHW10

6 Discussion

We examined iCCM module of iCHIS that is aimed at reducing child mortality and morbidity in hard-to-reach areas in Malawi. CHWs have highly accepted the application and cited reduced errors in assessment and classification of child illness as the key benefits. The application leads them to make more accurate assessments and prompt

decision making. On the referral process, the majority of CHWs reported that the iCCM module has greatly improved and simplified their decision-making process and increased their confidence in the referrals made.

In this study, affordance theory was employed as an appropriate lens to analyze our findings. Following [35] guidelines for using affordance theory, we identified three functional affordances of iCCM modules and their outcomes. The functional affordances were identified based on their material properties affording action possibilities and the action goals [30] as follows: diagnosis, treatment and remote data collection. As for the diagnosis affordance, the findings revealed that through some set validation rules, the application restricts users from skipping rules when conducting an assessment of a child's illness and thereby affords CHWs to provide proper assessment. However, for an affordance to be actualized, there must be a goal-oriented actor with action capabilities and the IT artefacts that affords the possibilities of the action [31]. Our findings resonate with Thapa and Sein [31] that the actualization of proper assessment depends on how the actor perceive the object. If the object is perceived but not properly used, the affordance may not be actualized as intended. For example, using the Sick Child Recording Form, CHWs could sometimes not follow guidelines properly or skip some steps due to the absence of validation checks and this resulted in wrong assessment being carried out that resulted in wrong classification and treatment.

Treatment was another affordance that the application provides. CHWs argued that the application is capable of identifying children who would otherwise not have been referred using the Sick Child Recording Form. Findings reveal that when set guidelines are followed properly, they afford the CHW to classify the child as either presenting danger signs of sickness or not. Where there is incomplete assessment of a sick child, this may lead to wrong classification of the ailment. Consequently, misclassification may lead to delayed referrals that may result in serious complications and in the worst situation may lead to death. Our findings agreed with earlier studies [17, 18] that found that the use of mobile applications by CHWs facilitated decision making in identifying children that needed to be referred to a health facility. This resulted in increased number of referrals to the health facility, prevented unnecessary re-consultations at village clinics and hospitalization rates for children under five years of age [24, 25, 38].

Remote data collection is an affordance that CHWs mentioned that it has simplified their work as it enables them to collect and use their own data and produce reports effectively.

Overall, almost all CHWs felt the application had a great impact on the referral process of the sick children and that it facilitated the referrals decision by accurately identifying all danger signs. However, CHWs varied in the number of patients referred to the health facility. While most CHWs felt the application had increased the number of referrals, some argued that the number had remained the same.

Another affordance which was identified but not implemented in this application is **Communication Affordance**. Communication between CHWs and health facilities personnel is a facilitating condition that would enhance communication between the two healthcare levels. Communication is important especially where the patient is being referred to a health facility and the facility needs to be informed in advance of the impending referral or where a patient has been discharged from the health facility and

there is need for further follow-up by CHW. Communication between the two levels will also ensure that referral feedback is sent to CHWs. Referral feedback is important at every level of healthcare. Feedback from the health facility to community level ensures proper follow-up of patients by CHWs, continuity of care, and improves coordination between CHWs and health facilities [38]. We therefore recommend that further development of the application should include features that will afford communication between CHWs and the health facility to enhance referrals.

7 Conclusion

In this study, functional affordance theory has been applied as a lens for analyzing and discussing our findings. Three functional affordances have been identified as diagnosis, treatment, and remote data reporting. The findings have revealed that diagnosis affordance uses material properties of digital iCCM to strictly assess the sick child resulting in the identification of signs and symptoms for the disease. We also found that digital iCCM provides action possibilities that allow CHWs to classify the illness and eventually prescribe treatment if there were no danger signs, or to refer to the higher-level facility where the patient presented danger signs of sickness. Lastly, we found that the digital iCCM afforded CHWs to collect data remotely and also produce reports.

Our research lends some evidence to the argument that the use of mobile phones and related technologies will continue to enhance healthcare management at the community level [20, 22, 27]. Our findings suggest that the use of mobile applications helps CHWs in making accurate assessment, classification, and treatment of patients. The findings further revealed that the iCCM module has greatly improved and simplified the decision making process and increased confidence of CHWs in patient referrals that they make.

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