Interdisciplinary Journal of Information, Knowledge, and Management

An Official Publication of the Informing Science Institute InformingScience.org

IJIKM.org

Volume 17, 2022

TOWARDS A FRAMEWORK ON THE USE OF INFOMEDIARIES IN MATERNAL MHEALTH IN RURAL MALAWI

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ABSTRACT

Aim/Purpose	The aim of the study is to explore factors that affect how healthcare clients in rural areas use infomediaries in maternal mHealth interventions. The study focuses on maternal healthcare clients who do not own mobile phones but use the mHealth intervention.
Background	Maternal mHealth interventions in poor-resource settings are bedevilled by inequalities in mobile phone ownership. Clients who do not own mobile phones risk being excluded from benefiting from the interventions. Some maternal mHealth providers facilitate the access of mobile phones for those who do not own them using "infomediaries". Infomediaries, in this case, refer to individuals who have custody of mobile phones that other potential beneficiaries may use. However, the use of infomediaries to offer access to the "have nots" may be influenced by a number of factors.
Methodology	The study uses a case of a maternal mHealth intervention project in Malawi, as well as a qualitative research method and interpretive paradigm. Data was collected using secondary data from the implementing agency, semi-structured interviews, and focus group discussions. Empirical data was collected from maternal healthcare clients who do not own mobile phones and infomediaries. Data were analysed inductively using thematic analysis.
Contribution	The study proposed a theoretical framework for studying infomediaries in ICT4D. The study may inform mHealth designers, implementers, and

Accepting Editor Maureen Tanner | Received: April 27, 2022 | Revised: August 4, August 22, 2022 | Accepted: August 23, 2022.

Cite as: Maliwichi, P., & Chigona, W. (2022). Towards a framework on the use of infomediaries in maternal mHealth in rural Malawi. *Interdisciplinary Journal of Information, Knowledge, and Management*, *17,* 387-411. https://doi.org/10.28945/5015

	policymakers on how infomediaries could be implemented in a rural setting. Consequently, understanding the factors that affect the use of infomediaries may inform mHealth intervention implementers on how they could overcome the challenges by implementing mHealth interventions that reduce the challenges on the mHealth infomediaries side, and the maternal healthcare clients' side.
Findings	Characteristics of the maternal healthcare client, characteristics of the mHealth infomediary, perceived value of mHealth intervention, and socio-environmental factors affect maternal healthcare clients' use of mHealth infomediaries.
Recommendations for Practitioners	Implementers of interventions ought to manage the use of infomediaries to avoid volunteer fatigue and infomediaries who may not be compatible with the potential users of the intervention. Implementers could leverage traditional systems of identifying and using infomediaries instead of reinventing the wheel.
Recommendations for Researchers	This research adopted a single case study to develop the theoretical framework for mHealth infomediary use. We recommend future studies are conducted in order to test and develop this framework further, not only in ICT4D, but also in other areas of application.
Impact on Society	People still lack access. The lack of ownership of technology may still exclude them from participating in an information society. The use of infomediaries may help to provide access to technologies to those who do not have them thereby bridging the digital divide gap.
Future Research	We propose herein that traditional systems may offer a good starting point for designing a system that would work for communities. We, therefore, recommend that future research may explore these possibilities.
Keywords	infomediaries, mHealth, maternal mHealth interventions, volunteers

INTRODUCTION

An infomediary is a liaison or broker between the source of information, on the one hand, and consumers of information, on the other (Gould & Gomez, 2010). In Information and Communication Technologies for Development (ICT4D), the use of infomediaries has been considered an option to provide access to technology and information to those who do not have their own access. It can be argued, therefore, that infomediaries help to bridge the digital divide, and have the potential to enable people who may be excluded from the information society to be included. Infomediaries have been used to provide information in communities, as well as access to ICTs for communities to access and other digital services, such as in mHealth and e-government (Maliwichi, Mthoko, et al., 2021). Infomediaries may be either formal or informal (Lorini et al., 2014). In the case of the former, the intervention sets up the infomediaries as part of the design of the intervention, while in the latter, individuals could volunteer to serve in that role independent of the intervention (Lorini et al., 2014). In this study, we are concerned with the factors that affect the use of infomediaries by maternal healthcare clients who do not own mobile phones when accessing an mHealth intervention. mHealth refers to the use of portable devices such as mobile phones and personal digital assistance to deliver healthcare services and information to health consumers (Odendaal et al., 2020). Some mHealth interventions use infomediaries to provide mobile phone access to healthcare clients who do not own a mobile phone (Larsen-Cooper et al., 2015). Our focus on maternal healthcare is driven by its significance as noted in Sustainable Development Goal 3.1. Furthermore, maternal healthcare is ensconced in cultural beliefs that can affect the use of technology and infomediaries.

Despite the growth in mobile phone penetration globally, mobile phone ownership remains far from universal (GSMA, 2019). Women in low- and middle-income countries are 10% less likely than their

male counterparts to own a mobile phone (Barboni et al., 2018). South Asia and Sub-Saharan Africa are the most affected regions, with women 28% and 15% respectively less likely to own a mobile phone than men (Barboni et al., 2018). It is likely, therefore, that maternal healthcare clients, especially in rural areas, may not own a mobile phone that they would use to access maternal mHealth interventions. The use of infomediaries in mHealth may enable such maternal healthcare clients to use mHealth interventions.

Most of the studies in mHealth have so far focused on the feasibility, implementation, adoption, use, and acceptability of mHealth technologies (Carreiro et al., 2020; Gurupur & Wan, 2017). Other studies have assessed the use of online health infomediaries (Khuntia et al., 2017; Yim et al., 2015). In maternal mHealth interventions, a few studies have assessed maternal outcomes, as well as business outcomes of mHealth interventions (Ngabo et al., 2012). Other studies have focused on how maternal healthcare clients who own mobile phones use mHealth interventions (Barron et al., 2018; Willcox et al., 2019). In yet other studies, the focus has been on the infomediaries rather than the maternal healthcare clients. In these interventions, the infomediaries are health extension workers, who can diagnose and treat minor maternal health-related problems (Kok et al., 2015; Olaniran et al., 2017). However, there is still a dearth of studies on the use of infomediaries in mHealth interventions for clients who do not own mobile phones (Maliwichi, Chigona, & Sowon, 2021). In addition, little is known about factors that affect the use of mHealth infomediaries (Khuntia et al., 2017). We posit that a myriad of factors may affect the use of infomediaries, and consequently, the use of the intervention.

Therefore, the study responds to the following research question:

What factors affect how rural-based maternal healthcare clients use mHealth infomediaries?

To answer the research question, we used the case of Chipatala Cha Pa Foni (CCPF) – (translates to Health Centre by Phone) project, a maternal and child mHealth intervention in Malawi. The mHealth intervention provided maternal healthcare clients with pregnancy tips and reminders, where, in addition, maternal healthcare clients could call a hotline for health information and advice. The primary reason for the selection of the CCPF case study is its significance in including maternal healthcare clients who do not own mobile phones in its program. The intervention allowed maternal healthcare clients who do not have mobile phones to use the mobile phones of family members, community members, and community volunteers. Community volunteers, who serve as mHealth agents of the intervention in their communities, were provided mobile phones by the intervention. In this study, mHealth infomediaries were community volunteers, family members, and community members who provide a connection between the mHealth intervention and health information consumers (maternal healthcare clients), who do not have their own mobile phones to access the intervention. Malawi offered an ideal case for the study since it has one of the highest maternal death rates in the world (World Health Organization [WHO], 2019), and has low mobile penetration, especially for women (National Statistical Office [NSO], 2020).

This study contributes to Information Systems research, specifically on the use of mHealth infomediaries (Larsen-Cooper et al., 2015). On a practical level, the study may inform mHealth designers, implementers, and policymakers on how infomediaries could be implemented in a rural setting. Rural communities have their traditional systems, which can be leveraged when designing and implementing mHealth interventions.

The rest of the paper is arranged as follows: the next section contains the literature review, which highlights the concepts of maternal healthcare, mobile phone ownership, and infomediaries in healthcare. After that, the paper presents a case description. This section provides an overview of CCPF as well as its context. The subsequent section, the methodology, presents the data collection and analysis used in the study. Further to this, the section presents the ethical considerations for the study. The methodology section is followed by the findings section, which presents the results of the study. The finding section is followed by the discussion section, which discusses the factors that

affect the use of infomediaries in mHealth interventions in association with other literature. Lastly, the conclusion and recommendation section conclude the paper.

LITERATURE REVIEW

MATERNAL HEALTHCARE AND MHEALTH INTERVENTIONS IN LOW-INCOME COUNTRIES

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. This includes family planning, preconception, prenatal, and postnatal care (WHO, 2012). Due to inequalities in access to quality healthcare services, there is a high number of maternal deaths in some parts of the world (WHO, 2019). The maternal mortality ratio (MMR) in low-income countries in 2017 was 462 per 100,000 live births compared to 11 per 100,000 live births in high-income countries (WHO, 2019). As many as 94% of these deaths occurred in rural settings, with Sub-Saharan Africa recording approximately 196,000 deaths (WHO, 2019). Sub-Saharan African countries have higher MMR; for example, South Sudan, Chad, and Sierra Leone have more than 1000 deaths per 100,000 live births. Other African countries, however, have lower MMR; for example, Cape Verde, Mauritius, and Seychelles have MMR of lower than 70 deaths per 100,000 live births (WHO, 2019).

mHealth interventions can be implemented to focus on professional communication among healthcare professionals or healthcare provider-to-patient communication. For instance, mHealth interventions for health professionals are designed to improve healthcare delivery processes by providing support in diagnosis and patient management (Gagnon et al., 2016). By way of contrast, healthcare provider-to-patient mHealth interventions are designed to improve medication adherence and health information literacy to reduce mortality (Schooley et al., 2015). For maternal mHealth, which is the focus of this study, the healthcare provider sent health information to pregnant women, targeting those who live far away from the health facility, to reduce MMR. Maternal mHealth interventions are used to unlock access to reproduction health information and improved access to health facilities during pregnancy and delivery (Nyemba-Mudenda & Chigona, 2018). The most widely used method to communicate to maternal healthcare clients are tips and reminders, delivered via voice messages and SMS (Nyemba-Mudenda & Chigona, 2018). Voice messages and SMS are commonly used since they are readily available even on a basic mobile phone, and prove to be affordable and convenient compared with other applications (Crawford et al., 2014). Mobile phones used to access health information and healthcare services can generate opportunities for women's health, but also their informational wellbeing (Larsen-cooper et al., 2015; Nyemba-Mudenda & Chigona, 2018).

MOBILE PHONE OWNERSHIP

Since the study focuses on women who do not own mobile phones, it is necessary to problematize the concept of ownership. Ownership of an item can refer to legal ownership or psychological ownership. Legal ownership constitutes the right to use and transfer ownership of the item (Pierce et al., 2004); for instance, when a couple purchase a house and the house is in their name, in that case, both partners have legal ownership of the house. Psychological ownership refers to a feeling of possession of an object, even when the object does not legally belong to the individual. That is, the feeling that this object "*is mine"* (Pierce et al., 2004). For instance, children claiming ownership of their parent's house as *"their house"*.

Mobile phone ownership and access in low-income settings

In affluent settings, such as in developed countries, mobile phones are hardly shared. In most cases, an individual who legally owns a mobile phone is the sole user of the phone (Chipchase, 2009). In contrast, in less affluent settings, mobile phones are shared; more individuals are likely to use a phone that they do not legally own. In rural settings in Sub-Saharan Africa, individuals who do not own mobile phones may have psychological ownership of a mobile phone that belongs to family members

and community members in their settings (Pierce et al., 2004). Psychological ownership of mobile phones enables access of mobile phones to marginalized communities. Psychological ownership of mobile phones is vital, since it unlocks the barrier of reaching non-mobile phone owners and consequently, enhances the inclusivity of people who do not own a mobile phone in developmental interventions.

Mobile phone ownership of mHealth infomediaries in healthcare

In low-income countries, mHealth infomediaries have different types of mobile phone ownership. These mobile phone ownership types can be categorized as personal mobile phone, family mobile phone, and project mobile phone. Some mHealth infomediaries may own personal mobile phones (Chipchase, 2009). However, in low-income settings such as Malawi, personal mobile phones could be used by other people (Blauvelt et al., 2018). This is attributed to the sharing culture in such a context (Zamani & Sbaffi, 2020). In contexts where a sharing culture exists, the sharing of personal property constitutes a norm (Zamani & Sbaffi, 2020).

In low-income settings – which rural settings often are – ownership of property may be regarded as family property (Chipchase, 2009). In these settings, a mobile phone owned by one family member may become a home or family mobile phone (Chipchase, 2009). This could be attributed to the fact the not all family members can own personal mobile phones. In such case, if the family mobile phone is used for health purposes by family members, the owner of the mobile phone may become an mHealth infomediary.

Infomediaries

The term infomediary is formed from a combination of the words "information" and "intermediary" (Brown & Hussain, 2016), which refers to an intermediary between the source of information and the consumer of information. In low-income countries, community services using ICTs are sometimes centered on infomediaries (Ngabo et al., 2012; Ramachandran et al., 2010). In a number of cases, staff working in public access facilities serve as infomediaries enabling less technologically savvy users, as well as less literate users, to access the technology (Clark & Gomez, 2012). In the Western Cape (South Africa), staff at a telecentre would print and publish weather reports for fishermen who had little opportunity to access the telecentre as well as had limited skills to use the technology (Chigona & Mbhele, 2008). Infomediaries operate in different spheres of society (whether public or private) to provide a link between sources of information and the consumers of information. Private infomediaries tend to be more technologically advanced than public infomediaries. This was more pronounced between public libraries and cafés. This could be because private cafés are more business-oriented than public libraries (Gould & Gomez, 2010).

Infomediaries in mHealth

In most mHealth projects, health infomediaries have been CHWs or community volunteers (Brown & Hussain, 2016). A community volunteer is a person in a community involved with an mHealth intervention outreach program without pay (Larsen-Cooper et al., 2015). For example, "Info Ladies" in Bangladesh were infomediaries who provided healthcare information and family planning to villagers (Brown & Hussain, 2016). In contrast, CHW refers to a person within a community employed by a government or non-governmental organization, whose roles include health promotion and disease prevention, treatment of basic medical conditions, and the collection of health data (Olaniran et al., 2017).

Due to low mobile phone ownership in rural areas, mHealth interventions provide mobile phones to designated infomediaries to serve as a link between maternal healthcare clients and the project. In Malawi, studies on infomediaries in maternal healthcare show that clients who do not own mobile phones prefer using project mobile phones over mobile phones owned by other people (Nyemba-Mudenda & Chigona, 2018). This could be because healthcare clients harbour a sense of ownership

over project phones. Moreover, the mobile phone could be mostly available for them to use. In a context where cultural norms would restrict women from using mobile phones owned by other people, especially men, project mobile phones are preferred. For example, in Burkina Faso, community volunteers of an mHealth intervention attested to the fact that clients preferred using project mobile phones, since cultural norms limited maternal healthcare clients from using other people's phones (International Development Research Centre [IDRC], 2018). Even the community volunteers themselves had to seek permission from their husbands to work on the project (Duclos et al., 2017).

Large-scale adoption and deployment of mobile phone interventions using informal infomediaries or formal infomediaries offer promising approaches to improving healthcare delivery (Ngabo et al., 2012). However, using formal infomediaries, such as CHWs in mHealth, presents its own challenges. For example, in Burkina Faso and Malawi, replacing the mobile phone is a challenge when the provided mobile phone is lost or malfunctioning (Duclos et al., 2017; Larsen-Cooper et al., 2015). In addition, the provision of airtime and internet data is a challenge to sustain. For the most part, airtime and internet data is available when donor-funded projects are active. In some cases, CHWs have to use their own airtime and internet data (Källander et al., 2013). By way of contrast, mHealth interventions that target maternal healthcare clients who own mobile phones tend to focus on the availability of the intervention itself, rather than on how consumers access the intervention (Seebregts et al., 2016). The implication is that the implementation of these interventions has the potential to exclude other potential maternal healthcare beneficiaries. However, mHealth interventions could leverage the use of informal infomediaries to boost the accessibility of infomediaries and to overcome the non-availability of mobile phones.

CASE DESCRIPTION OF CHIPATALA CHA PA FONI (CCPF)

CCPF was founded in Malawi in 2011. The initiative was piloted in the Balaka District. Balaka has a low performance when it comes to maternal and child health issues.

MALAWI CONTEXT

Malawi is a country in Southern Africa with a population of about 17.5 million people. About 85.6% of the population resides in rural areas (NSO, 2020a). The country has a Gross Domestic Product (GDP) per capita of US$411 (NSO, 2020a). The literacy rate for women is lower than that for men. About 12% of females and 5% of males have no education (NSO, 2020a). In the rural areas of Malawi, girls are five times more likely than boys to drop out of school (Sunny, 2018). MMR in Malawi is at 349 per 100,000 live births (NSO, 2019).

Mobile phone ownership in Malawi

Malawi has two dominant mobile operators, namely: (i) Airtel Malawi (52.2% market share); and (ii) Telekom Networks Malawi (TNM) (48.6%) (NSO, 2020b). Over the years, ownership of mobile phones in the country has increased rapidly, where at present, approximately 43.2% of the population owns a mobile phone (72.3% urban, 37.3% rural) (NSO, 2020b). Mobile phone ownership by males is at 44.9%, while females is at 37.7% (NSO, 2020b). Blauvelt et al. note that "Mobile phones are commonly shared within families and communities in Malawi" (2018, p.1), a fact rendering it an ideal context for the current study.

CCPF CASE STUDY

The underlying ideas for CCPF were two-way communication between clients and health personnel via a hotline for timely access to health information and advice, the use of mobile phone technology for tips and reminders on maternal healthcare issues, and a booking system and databases at health facilities to improve documentation. The ideas were piloted in Balaka District which is one of the poorest performing districts in maternal health.

The main objective of the CCPF project was to maximize healthcare access and utilization by remote maternal healthcare clients, who were facing so many challenges, such as walking long distances to access a health facility, resulting in delays in seeking care and unnecessary expenditures.

Components of the CCPF system

At first, CCPF had two main components, namely: (1) a toll-free case management hotline (which is available on an Airtel line), and (2) tips and reminders. These components were designed to work on a basic mobile phone, which is common in poor-resource settings. The booking system faced several challenges and was never implemented in the pilot phase.

Case management hotline: The toll-free case management hotline was stationed at the district hospital and was managed by qualified hotline workers (HLWs). The HLWs were trained in maternal and child health community case management as a form of training also provided to CHWs. The hotline was available for 12 hrs per day (7:00 am to 7:00 pm). On their first call, the clients were registered (their personal details captured) and oriented as to how the system works. The women were told about their expected date of delivery (EDD) and the current stage of pregnancy.

Tips and reminders: Tips were personalized messages, according to the stage of the pregnancy. Reminders were messages for antenatal appointments, medication, and supplements during pregnancy. The messages were in two vernacular languages of the District. The voice messages were retrieved on any Airtel line upon authentication, using the EDD and password (voice messages were common for non-mobile phone owners). Text messages were sent directly to the personal mobile phone.

After the pilot phase, CCPF was scaled-up and handed over to the Malawi Government in 2018. CCPF is now available in all districts of Malawi 24/7. The tips and reminders component has been replaced with pre-recorded voice messages, and everyone can access them using an Interactive Voice Response (IVR) system when they call the toll-free number. The callers choose whether they want to talk to a hotline worker or listen to the voice messages.

Infomediaries in CCPF

The implementing agency recruited about 400 community volunteers across the four catchment areas. Each village was assigned a community volunteer. Community volunteers were individuals from within the community. The minimum qualification for the volunteers was that they have basic literacy and could use a mobile phone. The volunteers were not CHWs. The role of the community volunteers was to provide maternal healthcare clients with access to a mobile phone for the intervention and demonstrate how to use the system. In addition, community volunteers visited maternal healthcare clients in their homes to register them for the intervention. This process allowed maternal healthcare clients to listen to follow-up on tips and reminders on the volunteer mobile phone on demand. The project provided volunteers with mobile phones to be used for CCPF for maternal healthcare clients in their communities.

Some infomediaries in the system were not appointed by the intervention; they were either community members, or family members, who provided mobile phone access to maternal healthcare clients. For this reason, maternal healthcare clients who did not own mobile phones could call the hotline using the mobile phone of community volunteers, community members, or family members. Some took on the role of infomediary, due to their traditional roles in the community; an example was a wife of a village headman.

METHODOLOGY

The study used a qualitative research method and an interpretive paradigm. Qualitative research was appropriate since it is subjective, in the sense that it points to the role of human subjectivity in the research process and provided new meaning to knowledge (Creswell, 2014). The study employed a single, holistic case study. Single case studies are appropriate for studies focusing on individuals in

one environment because they are unique or extreme (Yin, 2003). This study examined a group of women within the same environment or context who do not own a mobile phone but access the mHealth intervention using infomediaries. These women represent a minority of the population of maternal healthcare clients who used the mHealth intervention. The study used a case of CCPF and data was collected in Balaka District in Malawi, where the initiative was piloted.

Data Collection

Data were obtained using documents on CCPF, semi-structured interviews with maternal healthcare clients, family members, community volunteers, and Focus Group Discussions (FGDs) with the maternal healthcare clients. Data were collected in three phases, as presented in Table 1.

Table 1. Phases of data collection

Phase	Data types and method	Dates
First Phase	Secondary data collection using the project website and peer-reviewed journals	January 2019
Second Phase	Semi-structured interviews	June 2019
Third Phase	FGDs	August 2020

Secondary data collection

Documents relating to the project were collected from the internet and peer-reviewed research outputs, as well as accessed directly from the project. For project documents from the internet and peer-reviewed articles, we used Google, Google Scholar, and Web of Science databases to search for articles using relevant search terms. Appendix A summarizes these documents. We used documents to develop the context of the study and to triangulate with empirical data. Project reports provided a good window into the background and the main objectives of the intervention, and highlighted some activities and processes involved in the maternal healthcare clients' use of the intervention. Appendix A summarizes documents and peer-reviewed articles used in this study.

Sampling technique for participants

A purposive sampling method was used to select appropriate maternal clients who used CCPF mHealth intervention but did not own a mobile phone and the owners of the mobile phone (husbands, family members, friends/community members, and community volunteers). The study used typical case sampling of purposive sampling to select maternal healthcare clients from the same socio-economic region. The study sampled maternal healthcare clients based on the CCPF monitoring and evaluation data.

Inclusion and exclusion criteria for maternal healthcare clients

The study recruited only maternal healthcare clients (previously pregnant) who did not own mobile phones but had registered for tips and reminders of maternal and child health components of CCPF mHealth intervention or listened to tips on maternal health and called the hotline to seek advice on maternal-related problems on CCPF. The mobile phone might have belonged to a family member (husband, daughter, or son), friend, or community volunteer. To ensure that the maternal healthcare clients in the sample group had listened to tips on CCPF, the researcher tested the maternal healthcare client's knowledge of CCPF. Potential respondents who just narrated what they learned from the antenatal care clinic were excluded from the study.

The study excluded all maternal healthcare clients who: (i) owned a mobile phone and appropriated CCPF mHealth intervention during pregnancy; or (ii) owned a mobile phone but did not have an Airtel line, which was free, but had a Telecom Networks Malawi line and accessed CCPF using other people's mobile phones with Airtel line. This was done to ensure that the sample should have the

same characteristics; otherwise, maternal clients with a mobile phone would have had an advantage over the ones who do not own a mobile phone in terms of mobile phone usage skills. In addition, these were able to receive tips and reminders on their mobile phones if registered.

Semi-structured interviews

We conducted semi-structured interviews with the maternal healthcare clients as well as the infomediaries (refer to Table 2). The sample comprised maternal healthcare clients with low parity (number of live births less than five), and high parity (the number of live births equals five or more), respectively. The sample had 20 maternal healthcare clients and seven infomediaries. All the maternal healthcare clients had attended the minimum required antenatal visits and they all delivered at the health facility. The demographic profiles of the maternal healthcare clients in this study are summarised in Appendix B. We used the following procedure to access the respondents:

- The project team queried the Caller Database for CCPF from August 2017 to December 2018 to obtain mobile numbers for maternal healthcare clients who indicated that they were using a mobile phone which was not theirs. We chose this period to find more active mobile numbers. We identified "hotspots" (areas that made more calls from the caller's database) in Balaka District.
- We obtained mobile numbers of mobile phone owners from the Callers' Database of CCPF. We asked the mobile phone owners to identify maternal healthcare clients who used their mobile phones for the initiative. We interviewed both the maternal healthcare clients and the owners of the phones.

We interviewed two community volunteers and a community member. We asked them to identify maternal healthcare clients who were using their mobile phones. We asked the community volunteers and the community member to invite these women to participate in the FGDs.

The interviews took between 45 to 60 minutes each. They were conducted in Chichewa, the national local language of Malawi, so that all respondents understood the language of engagement. For each interview, the researcher took notes and recorded the calls using CallX mobile application.

Focus group discussions

We had two FGDs with maternal healthcare clients who were using community volunteer and community member mobile phones. We used the community volunteers and the community member as facilitators of the FGDs in two catchment areas; the researchers could not travel to the interview sites due to Covid-19 travel restrictions. The facilitators identified a quiet place where they could conduct the FGDs. We used an interview guide to ask focused questions and facilitated the discussions by encouraging participation and points of view. During the FGDs, the researchers, the community volunteer, and a community member put the mobile phone on the loudspeaker for all the participants to hear the discussion at each end of the call. We audio-recorded the discussions using CallX mobile application, and a research assistant took notes of the discussions. The maternal healthcare clients and the facilitators were compensated for the transport used to attend the FGDs. The discussions each lasted two hours on average.

Table 2 summarizes the sample of mobile phone owners and maternal healthcare clients who used their mobile phones. The study reached saturation point after the second focus group discussion, where there was no new information solicited from the participants. Moreover, triangulation of empirical data (for both mobile phone owners and maternal healthcare clients) and secondary data played a greater role (Lincoln & Guba, 1985). The study has provided the case description and context of the study, thereby making the results drawn from this study applicable in similar settings. The transferability of qualitative research results is important to ensure the trustworthiness of the study (Cypress, 2017).

Table 2. Mobile phone owners and maternal healthcare clients who used their mobile phones

Mobile phone owners	Maternal healthcare client
Husband 1	Client 1
Husband 2	Client 2
Husband 3	Client 3
Husband 4	Client 4, Neighbours (other maternal healthcare clients in his community)
Mother-in-law 1	Client 5
Community Volunteer 1	Client 6 – Client 13
Community Member 1	Client 14 – Client 20

Data Analysis

We analysed the data in two phases. The first phase focused on document analysis. The second phase triangulated data from secondary sources and empirical data collected using semi-structured interviews and FGDs. The audio-recordings were translated and transcribed from Chichewa into English. The raw transcribed data (including the notes) was then imported into Nvivo 12 for analysis. We employed an inductive thematic analysis to analyse the data, using an inductive approach, since we could not find an existing framework that could explain the factors affecting the use of infomediaries. Several phases, as stipulated by Braun and Clarke (2006), guided the analysis process. Appendix C summarises the activities of data analysis.

Both researchers independently analysed the data. We used the concepts that we identified to create themes and subthemes (nodes and sub-nodes) in NVivo 12. Data from secondary sources and empirical data was then coded in NVivo 12. Using the whole data set, the researchers exchanged notes, agreed on the final nodes and sub-nodes, and finalized the data coding. Appendix D summarises the themes and sample codes. We reviewed the coded data extracts, where collated data extracts of each theme were read to determine whether the current themes make a coherent pattern. Where the data extract did not fit, they were moved to themes where they did fit. The validity of individual themes in relation to the entire data set was also checked. The researchers developed a thematic map to see if it accurately reflects the meaning of the whole data set. Figure 1 shows the thematic map of the study.

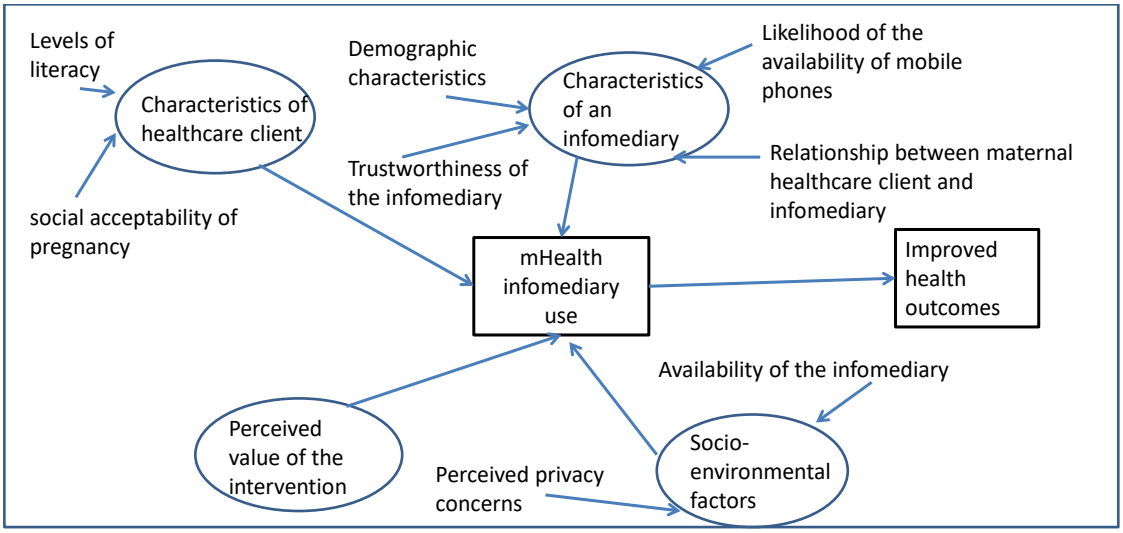

Figure 1. Thematic map of mHealth infomediary use

Ethical Considerations

Before data collection, we obtained permission to use CCPF as a case study from the implementing agency of CCPF, the Malawi Ministry of Health, and the Balaka District Health Office. Further, we obtained ethical clearance from the National Health Sciences Research Committee (Malawi).

During the interview sessions, the researchers introduced themselves as researchers studying CCPF Project. Consent was sought before interviews started, and issues of privacy and confidentiality of the data collected were discussed. For FGDs, the participants were told that privacy and confidentiality of that which was discussed were difficult since the discussion involved the group. We were aware of the risks of interviewing pregnant women, where there could be an emergency during interviews, or women could recall traumatic experiences related to the pregnancy. To mitigate against this risk, our sample was limited to mothers who were not pregnant at the time of data collection. They were all women who had previously used the system. Furthermore, we informed the respondents that participation in the study was voluntary and that they could withdraw from the study at any time. For the analysis, we anonymized the maternal healthcare clients as Client X.

Findings

The study found that several factors affected how maternal healthcare clients used mHealth infomediaries in maternal healthcare. Figure 2 presents a proposed framework of factors that affect mHealth infomediary use and could be considered when implementing mHealth interventions that use infomediaries. The framework was drawn from concepts based on empirical data and existing literature. As summarised in Figure 2, these factors can be categorized into: (i) perceived value of the mHealth intervention; (ii) characteristics of the healthcare client; (iii) infomediary characteristics; and (iv) socio-environmental factors.

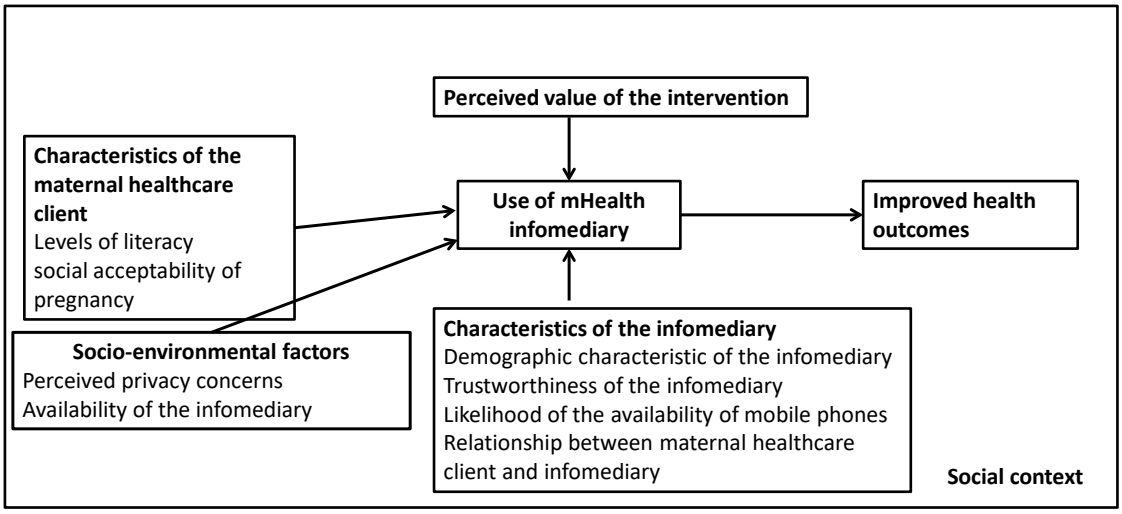

Figure 2. Proposed framework of factors that affect mHealth infomediary use

Perceived Value of the mHealth Intervention

Maternal healthcare clients in this study sought to use infomediaries since they perceived the mHealth intervention as valuable. The use of infomediaries involves social costs, such as negotiation and, in some cases, being obligated to gift back to the infomediary.

> *"Sometimes we give airtime to the owner of the mobile phone, just to thank them for allowing us to use their mobile phone …"* [Client 10].

A healthcare client is likely to use the intervention and the infomediary if they perceived the service the intervention offered to be valuable. The maternal healthcare clients perceived CCPF as useful, and the information received from the intervention as quality information. The maternal healthcare clients felt that they learned new information and practices on safe motherhood through CCPF.

> *"CCPF information is very helpful. We were just staying and we were ignorant. We didn't know what to do. Most women were dying because they did not know when to go to the hospital when problems arise, because of lack of proper advice …"* [Client 17].

The clients perceived the information to be valuable, partly because they believed that it was provided by the Ministry of Health.

Characteristics of the Maternal Healthcare Client

Characteristics of maternal healthcare clients that affected how maternal healthcare clients used the infomediaries include levels of literacy and social acceptability of the pregnancy.

Levels of literacy

Levels of literacy of maternal healthcare clients affected how maternal healthcare clients who needed to use mHealth technologies actually used them. On the one hand, maternal healthcare clients with low literacy levels depended on mHealth infomediaries to operate the mobile phone on their behalf to use mHealth interventions [Project Document 5]. On the other hand, clients with high literacy levels used the infomediary just to access the mobile phone. The latter group tended to use the interventions with ease since they might have had technology self-efficacy. The implication of depending on mHealth infomediary to operate the mobile phone on behalf of the maternal healthcare client is that the privacy of the conversation may be compromised. In addition, a maternal healthcare client may not be free to discuss sensitive issues in the presence of the infomediary. A maternal healthcare client who operated the mobile phone on their own, could take the mobile phone and make the call somewhere private.

Most maternal healthcare clients in this study, like women in most rural parts of Malawi, had low literacy; most of them were lower primary school dropouts. These healthcare clients depended on the infomediary to operate the mobile phone on their behalf.

> *"The method that was used to access CCPF was difficult at first. It depended on the level of education to use it comfortably. But now it is easy, they have simplified everything ..."* [Community Volunteer 1].

Social acceptability of pregnancy

The social acceptability of pregnancy affects how maternal healthcare clients used mHealth infomediaries. Many societies have norms prescribing the conditions for a pregnancy to be acceptable, who can get pregnant, and when can they get pregnant. In this study, unacceptable pregnancies were common among unmarried teen maternal healthcare clients. An mHealth intervention offers the opportunity for such women to obtain medical information without dealing with the stigma. However, when the women do not have their own phones, they would still have to go through an infomediary within their society to access the information [Project Document 5]. This was a barrier for the women to access the service.

> *"I remember starting to attend antenatal care when I was six months pregnant and registered for CCPF ... it was shameful to approach people on anything"* [Client 1].

The perception of society, that is, of what is an acceptable pregnancy, may affect the use of mHealth infomediaries. Thus, in a society that frowns upon teenage pregnancy and pregnancies out of wedlock, teen maternal healthcare clients could find it challenging to use maternal mHealth infomediaries. To mitigate against this challenge, interventions ought to make deliberate efforts to reach out to women who may be excluded from accessing the infomediaries.

Characteristics of the Infomediary

Characteristics of the infomediary affected how maternal healthcare clients used the infomediary. These characteristics include demographic characteristics (such as gender, age, and technical skills to support the maternal healthcare client), the trustworthiness of the infomediary, and the likelihood of the availability of the mobile phone.

Demographic characteristics of the infomediary

The gender and age of the infomediaries affected how comfortable the maternal healthcare clients were to use the services. The maternal healthcare clients were more comfortable using a mobile phone owned by a woman than those owned by a man. Due to the cultural beliefs around pregnancy, maternal healthcare clients found it challenging to visit and negotiate the use of a mobile phone from a man who was not their husband. It would be socially unacceptable for a maternal healthcare client to make this agreement with a man other than her husband. Furthermore, maternal healthcare clients were not comfortable using a community volunteer who was younger than themselves.

For cultural reasons, women prefer seeking assistance and advice on pregnancy-related matters from other women, especially older women. Old women are perceived as custodians of maternal health matters in their communities (Nyemba-Mudenda & Chigona, 2018). However, the design and implementation of CCPF did not involve older women. It would have been beneficial for the project to involve them as custodians of the mobile phones for the project. The implication of this was that the women could delay access to services from the intervention.

The study also found that, when the infomediary struggled to use the mobile phones on behalf of the maternal healthcare client, the maternal healthcare clients were discouraged from continuing to use the infomediary. This was common during the pilot phase because retrieving their personal messages was neither straightforward nor efficient. *"Sometimes, even some community volunteers were finding it difficult to use the intervention"* [Project Document 5]. Clients likely felt they were burdening the infomediary.

Trustworthiness of the infomediary

In Malawi, as in most developing countries, cultural beliefs dictate that women do not disclose their pregnancy to anyone except their husband and mother. Pregnancy is somewhat secretive, and women find it easier to discuss pregnancy-related issues with other women, rather than with men. Moreover, maternal healthcare clients would prefer to discuss their pregnancy with someone whom they trust, who would keep their pregnancy a secret.

> "*Normally, I receive maternal related advice from my older aunt or grandmother because they take my pregnancy seriously and they cannot disclose my pregnancy to anyone*" [Client 1].

The trustworthiness of infomediaries in maternal mHealth interventions is fragile since maternal healthcare clients could stop using infomediaries if the maternal healthcare clients encounter a bad experience with the mHealth infomediary.

Likelihood of the availability of mobile phones

The likelihood of the availability of mobile phones at the infomediaries affected the experience of the maternal healthcare clients. Factors contributing to the phones at the infomediaries not being available for use include battery challenges, faulty mobile phones, as well as the mobile phones being not easy to use. The area where we conducted the study, like most rural parts of Malawi, did not have grid power, and this resulted in difficulties in charging mobile phones. Most users had to pay for charging their phones. It is, therefore, foreseeable that mobile phones may not be charged.

> *"Most of the times the problem is with the volunteer's mobile phone … sometimes the phone is not charged … so she tell us to come again …"* [Client 15].

Furthermore, the maternal healthcare clients walked a long distance to the community volunteer to use a mobile phone. Consequently, they felt discouraged when they found the mobile phone not working. Hence, the likelihood of the availability of technologies has the potential to exacerbate inequalities in the poor-resource setting.

Relationship between maternal healthcare client and infomediary

Maternal healthcare clients chose infomediaries where there was a high likelihood of being granted permission to use the mobile phone, as well as where the interaction with the infomediary would be perceived to be within acceptable social norms. Maternal healthcare clients noted that *"sometimes other people do not allow us to use their mobile phones"*. Consequently, *"most of the times, we used our relative's mobile phones ..."* [Client 17]. Due to social norms surrounding pregnancy, the negotiations for phone use were not always like other "*standard personal calls*".

The study noted that most maternal healthcare clients were using a particular mobile phone for CCPF after creating a relationship with the mobile phone owner. This was particularly true for non-emergency maternal issues. During an emergency, maternal healthcare clients could use mobile phones from anybody. For this reason, family members and relatives are crucial in providing mobile phone access to maternal healthcare clients on maternal health issues.

Socio-Environmental Factors

Socio-environmental factors that affected how maternal healthcare clients used infomediaries include: (i) choice of infomediary to provide mobile phone access; (ii) perceived privacy concerns; and (iii) availability of infomediaries.

Perceived privacy concerns

In this study, maternal healthcare clients perceived privacy concerns affected the use of mHealth infomediaries. Maternal healthcare clients were more comfortable using mHealth infomediaries, and they believed that their privacy would not be compromised.

The maternal healthcare clients in this study perceived the use of a Personal Identification Number (PIN) to retrieve voice messages as a way of securing messages, which they considered personal. Even though the PIN was intended for identification in CCPF, it was perceived as a privacy and security feature by the women using shared phones: "… *once I key in the secret number; they know it's me and give me my messages ... and only me can listen to them* …" [Client 8]. The majority of the maternal healthcare clients using infomediaries preferred voice messages to text messages because anyone could read text messages and some women felt that their privacy would be invaded.

> *"I used to get messages on my mother's phone ... what was happening was that she could open my message, read it first, and then give it to me. Sometimes she could tell me that I received a message from CCPF, but someone was playing with her phone, and it got deleted"* [Client 8].

Availability of infomediaries

Availability of the mHealth infomediary affected maternal healthcare clients' use of mHealth infomediaries, and consequently, the use of the mHealth intervention. When maternal healthcare clients live far away from the potential infomediary, they find it difficult to access the infomediary and the mobile phone. Furthermore, if the maternal healthcare clients experienced a maternal health-related problem at night, it was not easy to visit the mobile phone owner and access the mobile phone before planning to go to the hospital [Project Document 5].

> *"You know in a village setup, houses are far apart, so to travel to the mobile phone owner who lives far away and find that the mobile phone owner is not at home is disappointing"* [Client 11].

Maternal healthcare clients who reside in poor-resource settings may struggle to find access to a mobile phone since mobile phone ownership in these areas is low [Project Document 5]. This is evident, especially when the maternal healthcare client is at an advanced stage of her pregnancy and cannot travel long distances [Project Document 5]. Furthermore, when the infomediary has travelled from their respective base, the maternal healthcare client may not have access to the mobile phone.

The study also noted that there was volunteer fatigue that affected the level of motivation and, consequently, the availability of the volunteers. This could have been attributed to volunteers not being compensated for their work and having to look for financial resources to support their families. This affected their work. Proper volunteer management would contribute to mitigating this.

DISCUSSION

The findings of this study suggest that when implementing mHealth interventions, which use infomediaries, the intervention ought to consider the following: cultural considerations, technological considerations, and infomediary management.

CULTURAL CONSIDERATIONS

Societies, where mHealth interventions are implemented, may practice different cultures and traditions compared with that of the implementers of the intervention. For example, most mHealth interventions in Africa are implemented by non-governmental organizations from the global north, where cultural and traditional norms are different from those in Africa. Therefore, mHealth intervention implementers ought to understand African traditions to implement interventions that leverage the traditional systems in place. The findings of this study suggest that demographic characteristics of the infomediaries (such as age and gender) matter in maternal mHealth. This could be that maternal-related issues are sensitive and that there are social norms and rules which need to be followed when a woman is pregnant. In the rural areas of Malawi, elderly women are the custodians of maternal information. Leaving these elderly women out of a maternal-related intervention would bring confusion to pregnant women, who follow existing systems. The implication would be that these pregnant women would shun the intervention. There was a need, therefore, to leverage the existing cultural systems and include the elderly women as infomediaries for the intervention.

When using infomediaries in maternal mHealth intervention, the gender of the infomediary matters. mHealth beneficiaries prefer using female infomediaries. When an infomediary is male, the beneficiaries were not comfortable using them, since existing cultural and traditional norms would not allow beneficiaries to interact with males in their communities. For this reason, mHealth implementers ought to use female infomediaries in maternal mHealth interventions. This finding is similar to other studies, which found that the gender of an infomediary may affect the use of mHealth infomediaries (Duclos et al., 2017; Nyemba-Mudenda & Chigona, 2018).

The findings of this study also suggest that mHealth interventions have the potential to reach women who become pregnant at what society may consider an unacceptable time. These women may experience stigmatization (Hamal et al., 2020). Malawi, especially the rural parts, is a conservative society, and as such being pregnant out of wedlock is a taboo (Nyemba-Mudenda & Chigona, 2018). Women, especially, teenagers who get pregnant out of wedlock, are stigmatized, and may even be cast out of their families (Levandowski et al., 2012). As such, young unmarried women who fall pregnant struggle to inform other women about their pregnancy (Hackett et al., 2019), or reach out to healthcare workers. A study in India found that even maternal healthcare clients who were married but under-age find it difficult to use maternal healthcare services (Hamal et al., 2020). The implication is that these cultural norms and traditions may have negative consequences on the health of the pregnancy. The anonymity offered when using mHealth interventions like the CCPF has the potential to provide the women in such situation reprieve. However, for the clients with no phone who may need to access the intervention through an infomediary, the veil of the anonymity would fall away.

They would still need to engage with a person within the community regarding their pregnancy. For this reason, mHealth intervention implementers ought to train infomediaries on how they could handle such situations so that all pregnant women have access to the intervention. Moreover, infomediaries need to be trustworthy. A study in South Africa found that maternal healthcare clients accept interventions at the community level if they trust the CHWs in their community (Grant et al., 2017). Trustworthiness at an individual level for CHWs, community volunteers and community members who are involved in maternal healthcare is important for maternal mHealth interventions to succeed (Grant et al., 2017).

Technological Considerations

mHealth interventions using infomediaries are bedevilled with several technological challenges, such as malfunctioning project mobile phone keypad and battery. In other circumstances, the project mobile phone is completely dead after a few years into the pilot phase (Duclos et al., 2017; Larsen-cooper et al., 2015). These challenges are common to project mobile phones owned by volunteer infomediaries (Ngabo et al., 2012). mHealth intervention implementers ought to plan for the sustainability of the project mobile phones of interventions in poor resource settings, since most of the infomediaries may not afford to replace the malfunction mobile phones. The implication is that some beneficiaries may not be able to access the intervention meant to help them. For this reason, it is necessary for mHealth implementers to develop ways to sustain the availability of project mobile phones beyond the pilot phase. For example, implementers could partner with government or telecommunication companies (as part of social-corporate responsibility programmes) to continue supplying mobile phones so as to ensure that the availability of mobile phones is sustainable. In addition, the type of mobile phone issued to infomediaries matters. If the mobile phones issued to infomediaries are not durable, mHealth interventions cannot be sustainable. Thus, mHealth implementers ought to issue durable phones, so that the mobile phones are able to handle high volume usage from beneficiaries.

Previous studies note that maternal healthcare clients prefer to use project mobile phones for maternal-related issues since there is guaranteed access to the mobile phone from the infomediary (Duclos et al., 2017; Larsen-Cooper et al., 2015). Consequently, project mobile phones are prone to malfunction easily since the majority of beneficiaries are using them. Other studies state that maternal healthcare clients prefer the mobile phones of family members since they cannot deny them access to their mobile phones (Nyemba-Mudenda & Chigona, 2018). These findings suggest that, even though mobile phone sharing is common in poor-resource communities, long-term sharing of mobile phones is still a challenge in maternal-related issues (Duclos et al., 2017).

Infomediary Management

There is a need to manage infomediaries, especially volunteer infomediaries. The motivation of these infomediaries is important since they are not compensated for their work. The infomediaries spend most of their time engaging in other personal activities (Nyemba-Mudenda, 2017). mHealth interventions depending on volunteer infomediaries suffer when infomediaries find other things to do or when they have so much work to do and are tired of volunteering as an infomediary. Hence, mHealth implementers ought to find ways of compensating infomediaries for their work. One option would be to frame the issued mobile phone as compensation for their work and additional knowledge on how to use technology in maternal health as beneficial to them (Derenzi et al., 2016).

mHealth interventions may also align themselves with the government system of CHWs since they are already compensated by the government and the intervention may pass on the management of the infomediaries to the government post-pilot phase. In India, Accredited Social Health Activists (ASHAs) who are CHWs employed by the government of India are normally used by mHealth implementers as infomediaries for their projects (Srinidhi et al., 2021). For this reason, management of infomediaries in terms of workload, opportunities for further training, and strong supervision is

crucial (Derenzi et al., 2016; Hodin, 2017). In most circumstances, there is inadequate compensation for infomediaries (Hodin, 2017), where using them for other mHealth projects could motivate them since the projects would compensate them for their work.

CONCLUSION AND RECOMMENDATIONS

Despite the global increase in mobile phone ownership, there are still inequalities in mobile phone ownership; with limited people in rural settings owning a mobile phone. The poorest of the poor still face challenges in accessing mobile-phone-mediated interventions that are meant to serve them. Use of shared mobile phones has the potential to mitigate these challenges. This study focused on the use of infomediaries in maternal mHealth interventions in a rural setting. The use of infomediaries may help to provide access to technologies to those who do not have technologies, thereby bridging the digital divide. Furthermore, mHealth infomediaries have the potential to contribute to reducing MMR since they are the front-line health workers in their communities. For the beneficiaries of mHealth interventions to utilize them more, mHealth interventions that use infomediaries ought to emphasize the benefits of the intervention when marketing it. Maternal healthcare clients are more likely to use infomediaries when they know the benefits of the mHealth intervention.

The study concludes that the perceived value of the intervention, the characteristics of the maternal healthcare client, the characteristics of the infomediary, as well as the social context, affect how maternal healthcare clients use and benefit from infomediaries. This study points to the need for managing infomediary systems to increase the chances for people at the bottom of the pyramid to benefit from the interventions. In addition, mHealth implementers ought to consider cultural and traditional norms, as well as technological issues, when implementing mHealth interventions.

Developmental interventions ought to acknowledge that there are already people who serve as informal infomediaries for other purposes in communities. A number of women in the study used mobile phones belonging to family members and other members of the community, as well as traditional leaders. Such traditional systems already define who may be acceptable infomediaries in a community. Developmental interventions, such as CCPF, ought to leverage such systems instead of reinventing the wheel. For example, community members are likely to accept and use traditional leaders as infomediaries, since they already value them as infomediaries for other needs in the community. We acknowledge that the traditional infomediary systems may be fraught with challenges that may exclude other potential beneficiaries. For example, a system based on traditional arrangements may still be punitive to young women falling pregnant out of wedlock. However, we propose that the traditional systems may offer a starting point for designing a system that would work for communities. For example, one of the limitations of the study was the use of male infomediaries, instead of the use of elderly women as infomediaries in the communities.

One challenge the study noted was volunteer fatigue. We argue that managing the volunteer system in a way that would reduce the burden on volunteers would ensure the longevity of the volunteer enthusiasm. Further to this, the intervention ought to be designed in a way to minimize the burden on the infomediaries. Increasing the number of infomediaries would share and thereby lessen the burden for individual volunteers. For instance, the use of frugal technologies, such as basic mobile phones, may ensure that there are more informal infomediaries, since the mobile phone, would be readily available. This, in turn, would increase the proximity of mobile phones to be accessed by beneficiaries. Furthermore, there would be little effort required on the part of infomediaries to train potential beneficiaries, since the majority of users would already be familiar with the use of basic phones. In addition, the provision of alternative off-grid power sources would make it easy to charge the phones and make the phones available for more time. This may address the limitation of mobile phone batteries not being charged when the beneficiaries want to use the mobile phone. At the same time, it would reduce the burden on volunteers walking long distances to the trading center to charge it.

Potential Future Research

Traditional systems may offer a good starting point for designing a system that would work for communities. We, therefore, recommend that future research explore these possibilities, such as, for instance, the use of elderly women as informal infomediaries, as they are the custodians of maternal information in communities.

The study is limited to a single case study to develop the framework for factors that affect mHealth infomediary use. We, therefore, recommend further research to test and develop the proposed framework in a broader context. It would also be useful to explore how this framework would be useful beyond the field of mHealth.

Acknowledgments

An earlier version of the paper appeared in the proceedings of the NEMISA Summit and Colloquium 2022 with the title: *Factors affecting the use of infomediaries in mHealth interventions: The case of maternal healthcare in rural Malawi*. This version has been revised based on the discussion at the conference and a further review of recent literature.

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APPENDICES

Appendix A. Summary of documents used in the study

Document Title	Document Type	Authors	Document Name
Impact Evaluation of Chipatala cha pa Foni (CCPF), Malawi's Health and Nutrition Hotline	Project information and CCPF use	(Jimat Development Consultants, 2018)	Project document 1
Chipatala Cha Pa Foni: Healthcare through mobile phone	Project Information	(Innovation Working Group, 2016)	Project document 2
Evaluation of the Information and Communication Technology for Maternal, Newborn and Child Health Project: Improving Access to Reproduction, Maternal and Newborn Health Information and Services in Malawi	CCPF use Report	(Watkins et al., 2013)	Project document 3
Evaluation of the Information and Communications Technology for Maternal Newborn and Child Health Project (Chipatala cha pa Foni)	CCPF evaluation report	(VillageReach, 2014)	Project document 4
Where there is no phone: The benefits and limitations of using intermediaries to extend the reach of mHealth to individuals without personal phones in Malawi	Published article	(Larsen-Cooper et al., 2015)	Project document 5
Scaling up a health and nutrition hotline in Malawi: The benefits of multi-sectoral collaboration	Published article	(Blauvelt et al., 2018)	Project document 6
SMS versus voice messaging to deliver MNCH communication in rural Malawi: Assessment of delivery success and user experience	Published article	(Crawford et al., 2014)	Project document 7
Strengthening the home-to-facility continuum of newborn and child health care through mHealth: Evidence from intervention in rural Malawi	Published article	(Fotso et al., 2015)	Project document 8

Appendix B. Summary of demographic characteristics of the maternal healthcare clients in the study

Characteristics	No. of Clients		Characteristics	No. of Clients
Age range: 15-19	2		Months started ANC	
20-25	6		2	7
26-35	8		3	13
36-45	4			
Educational level			No. of ANC visits	
Primary	17		4	9
Junior Secondary	3		5	11
No. of pregnancy used CCPF	13			
1	4			
2	3			
3				

Appendix C. Summary of activities done in data analysis

Phases of Inductive Thematic Analysis	Activities Done
Familiarisation	We translated and transcribed the audio interviews from Chichewa into English. The raw transcribed data (including the notes) was then imported into Nvivo 12 for analysis.
Theme development and coding	We used the concepts that we identified to create themes and subthemes (nodes and sub-nodes) in Nvivo 12. Data from secondary sources and empirical data were then coded in Nvivo 12. Using the whole data set, the researcher finalized coding the data.
Reviewing themes	We reviewed the coded data extracts, where collated data extracts of each theme were read to see if the current theme make a coherent pattern. If the data extract does not fit, they were moved to themes where they fit. The validity of individual themes in relation to the entire data set was also checked. Using Nvivo 12, the researchers developed a thematic map (see Figure 1) to determine whether it accurately reflects the meaning of the whole data set compared to the conceptual framework.
Defining and naming	This phase involves defining and refining the themes that are going to be present in the findings chapter. The researcher identifies what is of interest in the data set and why, and the story that each theme tells. The themes and sample codes are presented in Appendix D.
Writing up	The findings section of this study presents the results and they are interpreted in the discussion section.

Appendix D. Summary of main themes, sub-themes, and sample codes

Main Themes and Sub-Themes	Sample Codes
Perceived value of the intervention	
	"It is a quick hospital service; they help us quickly" [Client 2].
	"CCPF information is very helpful, we were just staying and we were ignorant, we didn't know what to do. Most women were dying because they did not know when to go to the hospital when problems arise, because of lack of proper advice …" [Client 17].
Characteristics of the maternal healthcare client	
Literacy	*"The method that was used to access CCPF was difficult at first. It depended on the level of education to use it comfortably. But now it is easy, they have simplified everything ..."* [Community Volunteer 1]
Social acceptability of pregnancy	*"I remember starting attending antenatal care when I was six months pregnant and registered for CCPF ... it is shameful to approach people on anything"* [Client 1]
Characteristics of the infomediary	
Demographic characteristics	*"I was shy and uncomfortable when I found that the community volunteer was a man, I failed to speak about the problems I was facing"* [Client 10]
Trustworthiness	"*Normally I receive maternal related advice from my older aunt or grandmother because they take my pregnancy serious and they cannot disclose my pregnancy to anyone*" [Client 1].
Likelihood of the availability of mobile phones	*"Most of the times the problem is with the volunteers mobile phone… sometimes the phone is not charged… so she tell us to come again …"* [Client 15].
Relationship between maternal healthcare client and infomediary	*"Other people sometimes do not allow us to use their mobile phones. Most of the times, we used to use our relative's mobile phones ..."* [Client 17]
Socio-environmental factors	
Perceived privacy concerns	*"I used to get messages on my mother's phone... what was happening is that she could open my message, read it first and then give it to me. Sometimes she could tell me that I received a message from CCPF but someone was playing with my phone and it got deleted"* [Client 8]
Availability of infomediaries	*"You know in a village setup, houses are far apart, so to travel to the mobile phone owner who lives far away and find that the mobile phone owner is not at home is disappointing"* [Client 11].
Improved health outcomes	*"There was a time when my unborn child position was not good, so I called CCPF about it, so they helped me with advice on what I should do so that the child can turn properly... it worked and I had a normal delivery"* [Client 9].

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