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Assessing mobile phone use by pregnant women in Nigeria: A capability perspective

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Abstract

This paper explores the use of mobile phones to access maternal health care in sub-Saharan Africa and whether it enhances capability and human development. Analysing focus groups and interviews on mobile phone uses by pregnant women in Nigeria based on the Technology Augmented Capability Approach, we show that the mobile phone as a technical object facilitates three broad capabilities for pregnant women, namely, (a) enhances their voice and choice to push for health care quality, (b) enhances their access to emergency services while maintaining entrepreneurial activities, and (c) enhances their health literacy and social connectedness. However, personal, social, and environmental factors influence the conversion of the use of the mobile phone into capabilities by the pregnant women.

KEYWORDS

capability approach, case study, mobile phones, pregnant women

1 | INTRODUCTION

Information and communication technologies (ICTs) play a vital role in addressing many of the challenges in community-based health care systems and enhance quality of life (Cohen, Coleman, & Abrahams, 2015). One popular example of such interventions is the Health Information Systems Project (HISP) that started in 1994 in South Africa and has now been scaled up in many developing countries (Braa, Monteiro, & Sahay, 2004). In addition, the increasing penetration and use of mobile phones in developing countries have given rise to the field of mobile health (mHealth) where mobile technologies are used to support health practices (Sondaal et al., 2016). One of the major domains addressed by mHealth interventions is the support of pregnant women in order to reduce the high rate of neonatal and maternal mortality (Chib, van Velthoven, & Car, 2015). According to the World Health Organization (WHO, 2018), 830 women die daily from pregnancy or childbirth-related complications in sub-Saharan Africa.

To date, many studies have focused on the effectiveness of mHealth interventions for maternal health care in developing countries (eg, Chib et al., 2015; Ilozumba et al., 2018; Lee et al., 2016). However, despite the considerable amount of research conducted within the global domain of mobile technologies and health in developing countries, Nyemba-Mudenda and Chigona (2018) state that the literature on mHealth tends to focus mainly on the design and implementation of mHealth projects, with limited focus on assessing how mHealth interventions contribute to developmental outcomes. The lack of evidence on the impact of ICTs on maternal health care delivery has continued to hinder efforts to strengthen the delivery of primary health care in developing countries (Cohen et al., 2015).

Furthermore, Sahay and Walsham (2017) note the challenges in theorizing on the link between ICTs and their contribution to health care delivery in developing countries. Specifically, studies within the domain of Information and Communication Technology for Development (ICT4D) have been criticised for neglecting sound methodological foundations, which has led to a call for more theory-based and responsive approaches to understand the relation between ICTs and human development (Heeks, 2010).

Against this background, the research question of our study is "What are the impact of mobile phones on the lives of pregnant women accessing maternal health in Nigeria." We build on Haenssgen and Ariana (2018) technology-augment capability approach (CA) to adopt a wider theoretical-driven approach to help foreground the complex linkage between ICTs and human development. Using interviews and focus groups with pregnant women from the city of Jos, Plateau State, Nigeria, this study provides a case narrative through which we can understand how mobile phones support more than just efficiency but real freedom for pregnant women accessing maternal health care.

The paper is organised as follows. In the next section, we discuss the relevant literature on the use of mobile phones in developing countries. We then present our theoretical framework and the key concepts we use for analysing our case study. The fourth section presents the context of our case study and the fifth our research methods. This is followed by the presentation and discussion of findings. The paper concludes with the implications for research and practice.

2 | MOBILE HEALTH IN DEVELOPING COUNTRIES

Mobile health technologies have been implemented in many developing countries to address challenges in relation to maternal and child health. The rapid adoption of mHealth interventions in addressing maternal health could be due to the increasing access and use of mobile phones by women (Al Dahdah, Du Loû, & Méadel, 2015). Several studies have shown results on projects that have used mobile technologies. For example, the voice and message features have been used in maternal health care delivery to increase access to family planning information (Corker, 2010), to tackle emergencies and complications during pregnancy (Ivatury, Moore, & Bloch, 2009), to support the presence of skilled individuals during the delivery (Lund et al., 2012), to collect health-related information from pregnant women (Van Heerden, Norris, Tollman, Richter, & Rotheram-Borus, 2013), and to improve prenatal and postnatal care (Cormick et al., 2012). Other studies have highlighted the challenges in the adoption and use of mobile phones in the maternal health care sector in developing countries. Leon, Schneider, and Daviaud (2012) noted that there are weaknesses in key health systems areas, such as finance, organisational culture, capacity for health information management, and the poor availability and use of technologies in primary health care. They also identify technological challenges, such as the complexity of ensuring integration of information systems and interoperability and securing privacy of information.

Other studies with similar findings have been conducted in different settings to understand the opportunities and challenges of mHealth adoption in developing countries (eg, Källander et al., 2013; Leon, Schneider, & Daviaud, 2012; Tamrat & Kachnowski, 2012). However, there is little evidence available on the impact of mHealth in empowering women to seek better health care (Noordam, Kuepper, Stekelenburg, & Milen, 2011). Nyemba-Mudenda and Chigona (2018) argue that the literature is yet to effectively assess mHealth based on one's capabilities and how it contributes towards social change and human development. Along these lines, in their study (Nyemba-Mudenda & Chigona, 2018), they draw upon Sen's (1999) CA to evaluate intended and unintended outcomes of mobile phone use in maternal health in Malawi and how pregnant mothers appropriate the capability inputs to their specific context and call for further research in the sub-Saharan Africa to gain additional insights into mHealth's impact on maternal health outcomes and development.

In Nigeria, which is the focus of this study, the maternal health context is similar to other sub-Saharan countries with many of these deliveries taking place at home. There is a one in 13 chance of a woman dying during pregnancy (Egharevba, Pharr, van Wyk, & Ezeanolue, 2017), primarily due to the use of unskilled traditional birth attendants who assist during delivery (Austin, Fapohunda, Langer, & Orobaton, 2015). Maternity mortality is also a concern during labour or within the first 24 hours after birth, mostly due to preventable causes, such as obstructed labour, haemorrhage, eclampsia, unsafe abortions, and infections (Ahmed, Creanga, Gillespie, & Tsui, 2010; Pfeiffer & Mwaipopo, 2013). The use of antenatal care in Nigeria is quite low; approximately only 61% of pregnant women visit a skilled provider at least once during their pregnancy, while the documented average for developing countries is 79% (Onyeajam, Xirasagar, Khan, Hardin, & Odutolu, 2018). With the widespread coverage and ownership of mobile phones in Nigeria particularly among women, there have been several interventions, designed around the use of mobile phones, to strengthen the health care system and improve health outcomes in developing countries.

This study focuses on the use of mobile phones by pregnant women in Nigeria and draws upon the technology augmented CA framework to understand the developmental outcomes achieved as well as the impediments that hinder the developmental impact. This is discussed next.

3 | THEORETICAL PERSPECTIVE

The domain of ICT4D has witnessed the application of a wide range of conceptual frameworks from diverse disciplines depending on the purpose of the research. The frameworks and theories that have been adopted and applied by various ICT4D researchers include the Unified Theory of Acceptance and Use of Technology (UTAUT) (Bawack & Kamdjoug, 2018), Actor Network Theory (ANT) (Chaudhuri, Dasgupta, Hoysala, Kendall,

& Janaka, 2017), Structuration Theory (Bernardi (2017), and Institutional Theory Effah (2016). While these various frameworks and theories can help us understand the social implications of ICTs in developing countries, they tend to ignore the development outcomes despite their promise of providing a developmental perspective at the individual level of study (Grunfeld, Hak, & Pin, 2011).

As a result, we turn to Sen's CA to development, also known as the human centred development, to theorise around ICT interventions in developing countries. CA focuses on the expansion of human freedom both as the primary end and as the primary means of development (Sen, 1999). CA is multidisciplinary, flexible, and focused on the long-term global goals of human right, equity, and sustainable development (Jolly, 2010), and it critiques the economic theories of development such as modernisation that concentrate on income, gross domestic product, and expenditure (Sahay & Walsham, 2017). Two key elements of CA are the notions of *functionings* and *capabilities*. Functionings are beings and doings, for example, being literate or employed, and capabilities refer to an individual's freedom to achieve valuable functionings (eg, the freedom to pursue and secure employment).

Sen (1999) argues that freedom involves both the processes that allow freedom of actions and decisions and the actual opportunities that people have, given their personal and social circumstances. In summary, functionings are simply actual or realised achievements while capabilities refer to the effective opportunities for actualising these achievements (Zheng, 2007). A crucial distinction made by CA, and which is pertinent to our study, is the distinction made between commodities (goods and services), functionings (beings and doings), and capabilities. The approach recognises the significant importance of commodities to well-being. Individual conversion factors are thought to influence the extent to which a person can utilise commodities to generate capabilities. Three categories are identified: personal, social, and environmental conversion factors (Robeyns, 2005).

To date, several studies have focused around the implications of CA to further understand the role of ICTs in society. Even Sen (2010) himself takes up the topic of ICTs to discuss the contribution of mobile technologies as commodities in enhancing people's freedom. Literature applying the CA to ICTs contains a mixture of theoretical reflections and some empirical applications. Existing research at the intersection of CA and ICTs can be loosely classified into two groups: those that look at how CA overlaps or intersects with the discourse around equality and social justice in ICTs (Stillman & Denison, 2014; Zheng & Stahl, 2011) and those that adopt the terminology of CA (capabilities, functionings, and conversion factors) to empirically investigate ICTs for development and shed new light on old discussions regarding the value and evaluation of ICTs (Abubakar, Dasuki, & Quaye, 2017; Hatakka & Lagsten, 2012; Sahay & Walsham, 2017).

Heeks (2010) notes that understanding how ICTs can facilitate the realisation of "development as freedom [is] a yet unfulfilled task" (p. 23). This could be due to a lack of agreement on how technologies can be situated in the CA framework (Andersson, Grönlund, & Wicander, 2012). Fairly recently, Haenssgen and Ariana (2018) have contributed towards the theoretical development of the CA by formally incorporating technology within the framework, putting forth the concepts of technical objects and technological conversions (Figure 1).

In more detail, Haenssgen and Ariana (2018) propose that technical objects have a "generative" and a "transformative" element through which they directly enable capabilities and affect other objects in the enhancement of valued capabilities. The objects acquire the transformative dimension from the broader technological context, which includes a new class of conversion factors, ie, the technological factors. The technology augmented CA framework harmonises the different notions of technology in the literature on capability and explicitly highlights the position and role of technical objects and technological factors.

In the next section, we present the context of our case study in Nigeria, and we draw upon the technology-augmented CA to ascertain the developmental contribution of mobile phones to the capabilities of pregnant women in Nigeria within the specific maternal health care context.

4 | CASE STUDY: CONTEXT

The research took place in Anguwar Rogo ward of Jos North Local government, Plateau State, Nigeria. Nigeria, and particularly Anguwar Rogo, is in dire need of improved maternal health care delivery systems. In 2015, the maternal mortality rate in Nigeria was 814 deaths per 100 000 live births (CIA, 2017). According to the 2016 UNICEF report on maternal and child health in Nigeria, the country loses about 2300 five-year-olds or younger and 145 women of childbearing age daily, ranking Nigeria as the second globally in under-five and maternal mortality rates (UNICEF, 2016). The population of Anguwar Rogo is approximately 160 000, and the majority of the dwellers are petty traders and farmers. It is the most
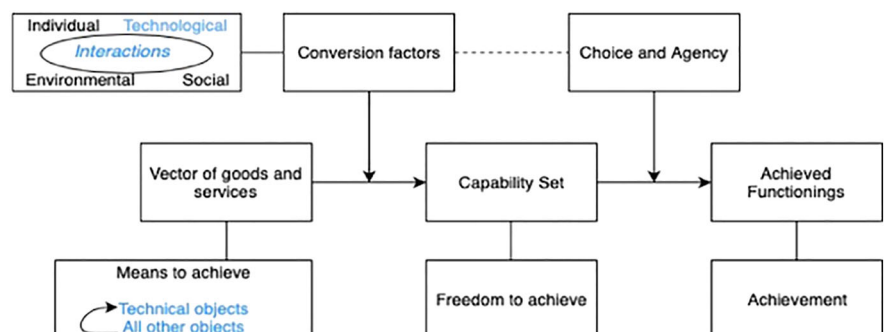

FIGURE 1 Technology augmented capability approach (CA) framework (Haenssgen & Ariana, 2018)

populous among all 20 wards in Jos North local government. There has been an increase in maternal deaths in this ward due to deteriorating living conditions, poor access to health care, and poverty. Alagboso (2015) noted that 64% of women in this ward give birth at home while only about 36% deliver at either public or private hospitals thus resulting in more maternal deaths.

There is a single maternity clinic with four nurses, two midwives, and a junior doctor who provide maternal care services. The clinic is not fully equipped for full-scale emergency services; hence, when there is an emergency case that cannot be handled at the maternity clinic, the patient is transferred to the general hospital in Jos town, which is a short distance from the clinic. Currently, there is no emergency ambulance at the clinic, resulting in patients usually organising their own transportation when the need arises. Jos-North local government has been faced with numerous religious crises dating from 2008. Also, it has suffered from major telecommunication services breakdown that lasted for several months due to the bombing of network facilities in the Northern Nigeria by Boko Haram terrorists. During a crisis, a curfew was usually imposed between 6 PM to 6 AM in the affected areas. The process of communication between the maternity clinic, the patients, and the general hospital was adversely affected by the lack of network services and ethno-religious crisis. In general, the overall provision of antenatal services as well as attendance by expecting mothers declined significantly during the period of crisis.

However, with the return of normalcy and peace and the restoration of telecommunication services, the delivery of maternal health care services has thrived and tremendous improvements have been recorded. Furthermore, the government of Plateau state has introduced a state programme to improve maternal health care delivery in the state. Specifically, the state government in 2010 launched the Maternal New-born and Child Health Strategy aimed at advancing the health of women and children in the state. One key element of this programme is the use of mobile phones to improve health outcomes while at the same time enhancing citizen engagement and accountability. Against this background, mobile phones are predominantly used for two major reasons. First, the pregnant women can use their mobile phone to call a toll free number and talk to a midwife concerning health issues in terms of emergency or when they are out of reach of a community health centre. Second, the community health centres can send to the pregnant women pregnancy-related health messages and reminders for their appointments. To date, however, there has been little evaluation of the impact of this intervention since its launch.

5 | RESEARCH DESIGN

The research question of our study is the following: "What are the impact of mobile phones on the lives of pregnant women accessing maternal health in Nigeria." To address our research question, we adopted the interpretivism paradigm (Walsham, 2006) in order to empirically investigate the impact of mobile phone usage on the capabilities of pregnant women. Our study took place in a community health centre in Anguwan Rogo, a community ward in Jos-North local government, Plateau State, Nigeria, during July 2017. The first author originates from Jos and has worked on several maternal health community projects in the community. This provided us with insider information, a well-rounded understanding of the context, and access to the particular community health centre.

We collected data via focus group sessions and interviews. In line with a qualitative methodology, we used purposeful sampling technique to identify participants who could readily express their experience with the investigated project. We conducted three sets of focus group sessions, and six face-to-face interviews at the district health centres. The first session of the focus group comprised four women and lasted about 45 minutes. The second session comprised three women and lasted for about an hour and a half. The last focus group session was made up of four women and lasted about an hour. The interviews were conducted to probe follow-up questions on new and emerging topics. Questions used for both the interviews and focus group sessions were guided by the technological augmented CA and were broadly focused on whether and how mobile phones and nontechnical objects contribute to their capabilities as perceived by pregnant women while accessing maternal health care. We also asked question on the factors that enable and restrict their capabilities.

The interview sessions were conducted with six pregnant women, and their duration ranged between 40 minutes to an hour. The interviewers explained the objectives of the study, its voluntary nature, and sought consent from each of the women prior to commencing the interviews and focus group sessions. Participants were informed that the reports resulting from the study would not contain any information that could be used to identify them. For this purpose, in our study, we use pseudonyms to preserve the participants: confidentiality and anonymity. In total, approximately 4.3 hours of interviews and 4.5 hours of focus group discussions were collected and analysed. Both the interviews and the focus group sessions were conducted in Hausa language, recorded, and later translated into English by one of the authors whose local dialect is Hausa. The issue of reliability and validity of case-study research was tackled by using a triangulation of various sources of data.

The collated data were transcribed and then analysed following the guidelines of thematic analysis (Clarke & Braun, 2014). Firstly, we familiarised ourselves with the data by going through the material multiple times. Next, we started coding our transcript data while revisiting the data as well as the existing literature around the emerging themes in order to clarify any ambiguities and enrich our understanding. After coding was completed, we sorted all the different coded extracts into themes reflecting the use of mobile phones by the participants (pregnant women), the capabilities afforded by the use of mobile phones and the conversion factors that influence their usage. Finally, we identified three major themes as relevant to the technology augmented CA, but with careful attention given to emergent topics. Relevant themes and quotations from qualitative transcripts are described in Table 1.

TABLE 1 Examples of themes from the focus groups and interview

Sample Theme	Sources	Sample-Coded Excerpts From Transcripts/Field Notes
Enhance their voice and choice to push for health care quality	Pre-reading of transcripts and Theoretical Concepts	"Because of the issue of shortage of mama kits and poor antenatal services, we kept calling the attention of the local government. But their response was so slow as such we decided to call the radio station where we know citizen's views are properly discussed and all government officials will hear our cries as pregnant women. We believe it has been so successful as these issues have gradually been addressed"
Enhance their knowledge literacy and social connectedness	Pre-reading of transcripts and Theoretical Concepts	"Sometimes if I am feeling so much pain that I cannot talk, my husband simply calls the midwife on my behalf seeking any advice on a quick remedy to the problem. He has learned a lot about pregnancy from the midwife due to several calls he has made to her"

6 | FINDINGS AND ANALYSIS

Our findings show that mobile phones as a technical object interacts with other nontechnical objects, such as midwives, to generate capabilities. These capabilities can be categorised into three broad themes, namely, (a) enhance their voice and choice to push for health care quality, (b) enhance their access to emergency services and entrepreneurial activities, and (c) enhance their knowledge literacy and social connectedness. However, the pregnant women's ability to convert their mobile phones into capabilities is influence by personal, social, and environmental factors. In what follows, we present our findings along the lines of the identified capabilities in relation to these conversion factors.

6.1 | Enhancing voice and choice to push for health care quality

The findings of the study show that mobile phones improve transparency and accountability in the provision of health care services. Women are sent daily SMSs and WhatsApp messages informing them that antenatal services are free in public hospitals and clinics. Normally, during antenatal services shortly before birth, pregnant women are given a "Mama Kit," which is a free all-in-one kit for a clean and safe delivery. The kit contains a baby wrapper, soap, a pair of gloves, cotton wool, cord ligature, polythene sheet, and a small gauze. However, the pregnant women usually have to compete with dishonest midwives who sell these kits to private clinics or demand a bribe before giving the kits to the women. These unethical practices are possible due to the lack of monitoring and reporting of poor antenatal services. Many women experience a pregnancy loss or are faced with childbirth-related complications as a result of unethical practices in maternal health care delivery. On few occasions, there have been reported cases of negligence by midwives. Sometimes, while the pregnant women visit health clinics, there are no midwives on duty, and therefore, they are turned away or advised to visit private clinics for medical attention. To address these issues, the government has provided a toll-free number at all district hospitals where patients can report any case of unethical practices and negligence of duty by health officials. Hafsatu noted the following:

> "They usually send us messages on our phones that all the services in the clinic are free but lately we noticed that we haven't been given mama kits which are supposed to be free. But if you go to some little pharmacy, you see people selling it and if you pay a bribe you can get it … But thank God we mobilised ourselves and kept calling the government number that was provided to report any irregularities until we were listened to."
>
> [Hafsatu, 8 months pregnant, Aged 32]

Other women noted that they used their mobile phones to send messages to and call a popular local radio station complaining about the new forms of corruption being faced by many pregnant women in the community in order to raise awareness. Their voices were heard, and this led to an improvement in the distribution of mama kits and the delivery of antenatal services in the district clinics:

> "Because of the issue of shortage of mama kits and poor antenatal services, we kept calling the attention of the local government. But their response was so slow as such we decided to call the radio station where we know citizen's views are properly discussed and all government officials will hear our cries as pregnant women. We believe it has been so successful as these issues have gradually been addressed."
>
> [Karima, 7 months pregnant, Aged 27]

Some participants in the focus group discussion also mentioned how a WhatsApp group comprising of both the pregnant women and the midwives has allowed them to voice out their concerns:

"Sometimes we usually also send in our complaints on the WhatsApp group to the midwives who are also part of the group. So many of these concerns are gathered by the midwives and reported to the senior health officials. Last time in the chat a lady complained that the location of the class was too small to accommodate the women and to our surprise, when we came for the next class, we noticed a bigger room was provided with more benches for us to sit."

[Bintu, 4 months pregnant, Aged 24]

The mobile phone has empowered pregnant women to be fearless and given them the ability to voice out their opinions and expose unlawful practices. This opened up a new chapter of improved antenatal services within the community that allows pregnant women to demand better health care services. Hence, mobile phones have allowed the women to play a crucial role in setting the agenda for better health care delivery by becoming active participants rather than passive recipients. On the other hand, this has contributed to transparency guarantees for the pregnant women by providing them with a platform through which they are able to demand and experience greater transparency in the provision of antenatal health care services.

6.2 | Enhancing access to emergency services while maintaining entrepreneurial activities

In addition to enhanced voice and choice, the use of mobile phones brought about economic benefits. For example, one of the pregnant women is an entrepreneur who sells baby products. She has been able to market her products in the WhatsApp's group of the pregnant women, which has resulted in an increase in her income. Bilkisu stated the following:

"You know during pregnancy; you must shop for your baby …. your baby needs the right products to grow well. With our WhatsApp group I have been able to market cheap and quality products by posting pictures and prices. Many members are patronising because I am part of them and if they order from me I will deliver to their homes because I know the stress of going to the market when you are pregnant."

[Bilkisu, 4 months pregnant, Aged 21]

Also, the pregnant women noted that the mobile phone has helped them have easier access to the midwives. In the past, for every discomfort or pain, they had to go to the hospital and then make another trip back. Sometimes, if they got to the hospital, they were sent back home as they were told that their discomfort or pain were normal pregnancy symptoms and all they needed was rest. However, with the mobile phone, they can easily call the midwives and if there is need, they are then advised to visit the hospital. Hence, consultation via the mobile phone helps them save time and reduces the physical burden and the financial costs that the pregnant women would incur had they travelled to the community health clinic using public transport. These are very significant savings with many of the women complaining about the distance and the cost of travelling to access antenatal care services at the district hospital.

However, our findings of the study show that, while on the one hand, the mobile phone facilitates consultation; on the other hand, it distorts the interaction and information exchange between the midwives and the pregnant women. One of the pregnant women, Hauwa, noted the following:

"For me, I prefer visiting the midwives than calling them for emergency services. Last time I was pregnant, I called the midwife and told her my symptoms and she told me they were minor pains and I should just rest my body. For two days I was in so much pain that I kept calling the midwife who got angry with me and asked I stop acting like a baby. On the third day, my husband rushed me to the hospital and immediately I had a C-Section, so you see sometimes the mobile phone can never really replace the face to face consultation and diagnosis because with that at least the midwives can see you and understand the problem."

[Hauwa, 6 months pregnant, Aged 24]

In addition to economic opportunities, which are important to the pregnant women, another relevant theme is that of preventive care in the context of pregnancy emergencies. During pregnancy, women may experience a number of complications, ranging from mild and severe discomfort to life-threatening illnesses. Other problems may include mental and physical conditions that can adversely impact both the mother and the child. The health care districts provided preventive care through SMS-based information, which is also shared in the WhatsApp group. Fatima noted the following:

"We get messages on our phones on pregnancy complications and any outbreak of disease in the community from the district hospital. This has helped a lot of us to make adequate advance preparations in case of any emergency. We also share the information amongst ourselves just in case some people didn't receive the messages due to network issues in their locations."

[Aishatu, 5 months pregnant, Aged 29]

For the pregnant women, the mobile phones have served as an effective and practical tool for planning and initiating rapid interventions during any emergency. Calls were also made to arrange transportation and communicate with midwives who usually call the doctors informing them about inbound patients:

"When we had a breakdown of the communication network due to the Boko Haram attacks, there were cases of either the death of a mother or the baby due to the inability to make calls for emergency situations. But now that communication lines have been restored there has been a reduction in maternal mortality."

[Fatima, 4 months pregnant, Aged 24]

6.3 | Enhancing knowledge and social connectedness

The mobile phones allowed the pregnant women to increase their knowledge on preparing for childbirth. Daily SMS and WhatsApp messages in both English and Hausa were sent to pregnant women about healthy diet, stress, exercising, and keeping fit during pregnancy. The aim was not only to help pregnant women be and feel healthy during pregnancy but also to boost their confidence and increase their knowledge base. Our findings show that the pregnant women formed an informal virtual antenatal class where they share information on how to prepare for their babies' birth and how to look after and feed their babies. This informal class helped those women who were unable to attend antenatal classes to catch up, which in turn allowed them to share information and seek advice from their peers:

"Usually I have morning sickness and I am unable to attend the antenatal class which usually starts at 8 am. So, what I do is I usually check our antenatal class group on WhatsApp for the updates of the class activities and see what I have missed."

[Baturiya, 2 months pregnant, Aged 21]

These informal virtual classes, coupled with the peer interaction, were of significant help for first-time mothers, because they helped them know more about their pregnancy and what to expect in general. In this part of the country, a pregnant woman, and especially a first-time mother, is expected to exhibit some shyness with regard to her pregnancy. Asking a lot of questions or complaining about discomfort is associated with being immodest. Therefore, the mobile phone allowed them to seek information and advice without breaking societal norms. It also provided them with instant access to midwives for expert advice when needed.

"Sometimes if I am feeling so much pain that I cannot talk, my husband simply calls the midwife on my behalf seeking any advice on a quick remedy to the problem. He has learnt a lot about pregnancy from the midwife due to several calls he has made to her."

[Baturiya, 2 months pregnant, Aged 21]

This easy access afforded by mobile phones has facilitated private consultation between pregnant women and the midwives. Asabe noted the following:

"With my mobile phone, I can now discuss freely with midwives either by calling or personal chat on WhatsApp especially when it has to do with personal discussion such as fertility issues."

[Asabe, 5 months Pregnant, Aged 20]

Therefore, our findings illustrate that, as a result of mobile phone use, not only there is increased male support during pregnancy but also improved monitoring of the pregnant woman. After any antenatal treatment is administered to pregnant women, they are usually called by the midwives to check their health status and any side effects. According to one of the participants, the midwives call her regularly, and messages are always posted on their WhatsApp group asking if they are all doing fine. In pregnancy, patient monitoring is a vital component for reducing complications and for acquiring essential medical advice from midwives. Even though the majority of the women said they preferred meeting with the midwives for consultation, they still found the mobile phone very suitable for discussing sensitive issues.

6.4 | Impediments hindering the conversion of mobile phone use into freedom

While the findings of the study show that mobile phones can contribute towards empowering pregnant women in different ways when accessing maternal health care, they also highlight the associated challenges hindering the capabilities enabled by the functions of mobile phones. These challenges are discussed in the section below.

6.4.1 | Personal factors

Illiteracy

Despite that the majority of the participants noted that they could call the midwives and receive calls using their phones, many of them suggested that they lacked the technical know-how on how to use the mobile phone properly, discussing that they could not send read or send SMS on their phones:

> *"It is easy to make calls and receive calls from the health officials but my problem is with regards to the SMS services. I cannot read and write so whenever they send an SMS to my phone in Hausa or English and my children are not at home to read and translate it to me, then I find it hard to understand the messages … I missed an appointment once because I did not understand the message on the phone informing me of a change in time until my children came back home to inform me."*
>
> [Saudatu, 8 months pregnant, 38]

The dominance of Hausa and English language as the medium of communication in using ICT means that pregnant women who can neither speak nor understand Hausa and English are significantly challenged in using their mobile phones for accessing the provided health care services. As a result, illiteracy and the lack of localised content are factors that impact negatively on the conversion of mobile phones into capabilities.

Financial impediments

Another barrier towards accessing better health care services is the cost of a mobile phone. One of the participating pregnant women noted the following:

> *"I do not have a personal phone; all information relevant to the antenatal services is sent to my husband's phone. When he goes to work and returns, he explains to me whatever SMS he might have received from the health officials. However, if he travels, then I do not even have access to any information until he returns. At the moment we cannot afford another phone, so when he is not around I do not have access to this information."*
>
> [Jamila, 2 months, Aged 19]

Others noted that they did have a phone and were receiving the relevant information; however, they were not using a smartphone, which was more expensive, and as a result, they did not have access to the very active WhatsApp group. This means that they were missing a lot of information that could have been useful to them. Other women noted that while they had the phones, they still struggled to top-up their phones with credit due to financial challenges:

> *"I have not topped up my phone since last month because my husband has not yet harvested the crop in the farm, so until he does that I will not be able put credit on my phone. Last time, I was facing a lot of pains in the middle of the night but neither me nor my husband had credit to call the midwives for advice but by God's grace the pain subsided."*
>
> [Hauwa, 6 months pregnant, 24]

These financial impediments adversely affect the pregnant women and constrain them from using their mobile phones to not only discuss with midwives their concerns but also voice out their opinions for better health care delivery.

6.4.2 | Environmental factors

Infrastructural issues

Poor telecommunication infrastructure is a major barrier, hindering the pregnant women from converting mobiles phones to freedom. The network in the wider area of Anguwan Rogo has not improved over the recent years, and many of the pregnant women have shown dismay over the poor telecommunication infrastructure, as they can be severely affected:

> *"The network coverage is very poor, last month a mother lost her unborn baby because the network was so bad and they couldn't contact the midwives that were responsible for her care."*
>
> [Asabe, 5 months Pregnant, Aged 20]

Currently in Nigeria, nondelivery of SMS, drop calls and the inability to make calls are frequently experienced by citizens even after been charged by the network. Even though the Nigeria Communication Commission, ie, the independent regulatory authority for the telecommunications industry in Nigeria, has mandated telecommunication providers to be efficient and effective, not much improvement has been achieved. Other infrastructural issues include the lack of electricity. Many of the women noted that they have to go for weeks without electricity in their homes. This suggests that they have their mobile phones switched off as they are unable to charge the battery. Although there are small business entrepreneurs that have electricity generators and charge as much as $0.24 to get a phone charged, due to their financial circumstances, many women cannot afford to pay the said amount and therefore are unable to access this service.

6.4.3 | Social factors

Health and domestic issues

Occasionally, the condition of their health affects the women's capacity to make full use of their mobile phones for accessing health care. For example, Lami stated the following:

"Due to the recurring sickness and discomfort in pregnancy, I become so weak and tired that I forget to check my mobile phone for any message from the health officials. Sometimes I even forget to charge the phone moreover there is electricity failure within the community."

[Lami, 1 month pregnant, 35]

Other women, despite being pregnant, are required to spend a significant amount of time caring for their families, such as in preparing meals, going to the market, and taking care of their other children. These activities tend to restrict the women's time and engagement with their mobile phones:

"In our culture, while the man is charge of the house, the wife must take care of the house, this is very important. In some instances, I will have some little discomfort and may want to call the midwife seeking for advice but once I remember that I haven't finished preparing the food that would be eaten by the kids and my husband, I completely ignore calling and focus on my home duties. This is our culture."

[Bintu, 4 months pregnant, Aged 24]

In summary, not only does the poor health condition of the pregnant women affect their use of mobile phones but also their culture where women are expected to undertake the majority of the household responsibilities.

Table 2 below shows a summary of the case study findings using the concepts of the technology augmented CA.

7 | DISCUSSION

In this study, we have looked into how pregnant women in the city of Jos, Plateau State, Nigeria, use the mobile phone in order to understand "the developmental impacts of the use of mobile phones in maternal health by pregnant women in Nigeria." Building on the technology-augment CA (Haenssgen & Ariana, 2018), our findings indicate that mobile phones have development outcomes and implications. Mobile phones go beyond just being a tool to access maternal health care, but rather they can indeed help improve the pregnant women's maternal health literacy and information capabilities. The awareness regarding the benefits of prenatal services encourage the women to maintain a healthy lifestyle and manage minor health illness during pregnancy. This has an advantage of reducing pregnancy risks and symptoms associated with maternal morbidity and mortality (Lori & Boyle, 2011). At the same time, the pregnant women experience better health care also during emergencies, as they can contact their midwives in a more timely fashion. This confirms previous studies that have found that the use of mobile phones enhances both the capabilities and the overall well-being of pregnant women (Noordam et al., 2011; Nyemba-Mudenda & Chigona, 2018), and in our study, we illustrate clearly how this can be done through the prompt access of maternal care.

Furthermore, the use of mobile phones provides the pregnant women with a platform to interact with each other and talk more freely about their health issues with the midwives. Hence, this has enhanced their confidence, self-esteem as well as the adoption of maternal best practices, confirming previous studies (Oyeyemi & Wynn, 2014). In addition, using the mobile phone as a platform, the women formed informal virtual antenatal classes, which gave to many of them the opportunity to stay up to date with information about their pregnancy and avoid complications. A novel finding of our study within the mHealth field is that, aside social connectedness and peer support that help build social capabilities, pregnant women use the mobile phone as a platform for seeking out business opportunities, as well, among their network, which echoes the findings of Masika and Bailur on female street vendors in Uganda (Masika & Bailur, 2015). At the same time, the use of mobile phones helps them with cost savings that relate to their transportation back and forth to the clinic in case of minor conditions.

TABLE 2 Summary of findings

Commodity	Conversion Factors	Capabilities
Technical objects Mobile Phone	Personal Illiteracy Financial impediment	Enhance their voice and choice to push for health care quality Giving women a voice in deciding the care they would like to receive.
Nontechnical objects Midwives		Provides an accountability mechanism for services by ensuring the women's experiences of the health system are heard.
	Environmental Infrastructural issues	Supports the government's commitment to decreasing maternal mortality rates in Nigeria.
	Social Health and domestic issues	Enhance their access to emergency services while maintaining entrepreneurial activities. Increased earnings through access to more customers. Savings in transportation costs associated with visits to the clinic. Opportunity to plan for rapid interventions in emergency cases. Opportunity to prevent and control disease outbreak and pregnancy related complications.
		Enhance their Knowledge Literacy and Social Connectedness Opportunities for learning. Opportunities for seeking information on good health practices. Increased interaction with health personnel and fellow pregnant women. Opportunities for effective monitoring of pregnant women by health personnel.

Our study shows that the mobile phones can help improve transparency and accountability in the provision of health care services. The pregnant women receive information about health policies and practices in the health care sector through messages to their mobile phones, and they are also able to engage directly or indirectly with health officials. These opportunities enhance social accountability as well as the women's agency to voice their opinions and concerns. Along these lines, previous findings have showed that enhancing one's agency can significantly help towards helping individuals feel less marginalised (Lodenstein et al., 2017). Further, Nyemba-Mudenda and Chigona (2018), while studying the mHealth in Malawi, discuss that mobile phones can lead to positive outcomes for pregnant women, by enhancing their information capabilities such as IT literacy, their engagement and their financial capabilities in terms of savings. In our study, however, we show that pregnant women use these mobile phones as a platform to mobilise themselves, voice their concerns, demand better services and persevere until they are listened to by the relevant authorities. As a result, in this case, the use of mobile can ensure transparency and accountability within the health system.

Despite the potential of mobile use to support the pregnant women's capabilities and improve the relevant health outcomes, our findings show that there are several socio-cultural factors that impede the pregnant women from effectively converting the technical (mobile phone) and non-technical (midwives) objects into freedom (Table 2). First of all, through the theoretical lens of the technology augmented CA, we show that mobile phones can function as a commodity that facilitates and enhances three broad capabilities, namely: enhance their voice and choice to push for health care quality; enhance their access to emergency services while maintaining entrepreneurial activities; and enhance their health literary and social connectedness. As a technical commodity, the mobile phone can influence the interaction between the pregnant women, and other, non-technical commodities, ie, the midwives. For example, some pregnant women would communicate poorly their symptoms over the mobile phone, which inadvertently leads to wrong consultation and prescriptions. As a result, the midwives prefer that the pregnant women, instead of using their mobile phone to contact them, they travel to the hospital and be checked up. Therefore, in this case, our findings highlight that the freedom of improved access to emergency services is on the one hand the result of owning or being able to use a mobile phone, but on the other hand, it can equally be halted due to how midwives prefer to interact with the pregnant women.

Other impediments have to do with personal factors. Some pregnant women lack basic literacy skills and therefore are unable to access basic maternal health care information. Many of them don't read or cannot understand the health care-related text messages they receive. However, literacy and the ability to understand and interpret the communicated information is of paramount importance for the effectiveness of mHealth services (Nyemba-Mudenda & Chigona, 2018). For this reason, Alam, D'Este, Banwell, and Lokuge (2017) calls for the use of voice messaging rather than text messaging for mHealth initiatives, because voice messages do not necessitate that participants are literate.

The cost of owning a mobile phone and accessing several of its features had adverse effects on the impact of mHealth on maternal health services. As a result, many of the pregnant women have to share their mobile phones with family members. Naturally, sharing a mobile phone among household members is often associated with the lack of or very low income (Lesitaokana, 2016), which is often the case in the region where we conducted our case study. Furthermore, like in other developing countries, there is a number of environmental factors that hinder access to mHealth services in Nigeria (Nyemba-Mudenda & Chigona, 2018). Our study shows that lack of electricity and poor telecommunication infrastructure are the two major factors that prohibit pregnant women to access the provided mHealth services via their mobile phones. Their status within the traditional African society and the overarching sociocultural beliefs further detrimentally affects their ability to convert the mobile phone into real freedom. The traditional African man believes that women are solely responsible for all the household chores (Soyingbe, 2015), which suggests that irrespective of the circumstances, women need to take care of their family and the household. Indeed, our findings indicate that many of the pregnant women are so much preoccupied with their household duties that they end up forgetting to access maternal health services.

The previously discussed sociocultural factors (personal, social, and environmental) are critical conversion factors that either facilitate or hinder pregnant women from converting the commodity (mobile phone) into one or more of three identified capabilities (cf Table 2). While the mobile phone can be seen as a commodity, its features and functions, as well as its prerequisites, can be seen also as conversion factors. For example, while some women have access to a mobile phone, it is not necessarily the case that it can support the WhatsApp application. As a result, without access to a smartphone, their freedom to participate in the WhatsApp-enabled antenatal class are severely limited. Furthermore, the identified conversion factors interact with each other and influence the role of mobile phones in enhancing the capabilities of women to receive improved maternal health outcomes. For example, even though some of the women owned mobiles phones (financial factor), their illiteracy (personal factors) impedes their ability to read and understand health-related text messages; as a result, their freedom of building maternal health awareness is adversely affected.

In other words, our findings both confirm and extend the work of Nyemba-Mudenda and Chigona (2018) work on mHealth services for pregnant women in a developing country context. Specifically, we show that mobile phones, as a technical commodity, can indeed enhance women's capabilities. On the other hand, however, their technological nature interacts with other conversion factors and enhances or impedes the pregnant women capabilities.

8 | CONCLUSION

Addressing the call for more research into understanding the impact and challenges of using mobile phones for the delivery of maternal health care, in this paper, we have presented a case study of pregnant women in the city of Jos, Nigeria, to theorise on the relationship ICTs and human

development. We employed the technology augmented CA (Haenssgen & Ariana, 2018) as our theoretical lens in order to understand how the use of mobile phones by pregnant women within the maternal health care system of a developing country contributes towards human development. Our findings indicate that mobile phones have the capacity to support and contribute to the improved delivery of maternal health care services and to human development. We illustrate how the use of mobile phones lead to increased social, economic, and political opportunities for pregnant women against the backdrop of maternal health care services, which are not always available in many parts of Nigeria. While discussing the positive outcomes, we have also identified the social, economic, and infrastructural constraints that hinder the full conversion of mobile phones into freedom in this particular context.

Our findings have implications for researchers and policy makers concerned with the use of ICTs in maternal health care delivery, especially in developing countries. First, our study demonstrates an alternative way of evaluating mHealth services through the lens of the technology augmented CA, by drawing attention both to the technical objects (mobile phones in our case) and the nontechnical objects, (the mid-wives). In addition, we have identified the sociotechnological factors that facilitate or impede valuable capabilities, and our findings can inform policy-making with regard to alleviating the negative influence of these factors. Along these lines, our findings echo existing discussions within the ICT4D literature that research and policy makers need to address the sociocultural context in order to ensure the appropriate utilisation of mobile phones for improved maternal health outcomes.

Furthermore, we posit that our theoretical lens together with our participatory approach to communicating with the pregnant women in Nigeria, allowed them to define themselves the capabilities they valued. Yim and Gomez (2018) note that identifying important themes that reflect valued capabilities that result from the use of mobile phones allows researchers to develop an overview of the individual's capabilities in various contexts, without forcing any capabilities that might be considered as research bias. In our study, the participating pregnant women proffered the capabilities they consider important while accessing maternal health care, and we believe that this democratic process of identifying capabilities is well aligned to Sen's (1999) conceptualisation of human development.

Our study has some limitations. In this study, we have presented a single case study focused around the use of mobile phones by pregnant women in Jos, Nigeria, for accessing mHealth services. As a result, it is difficult to generalise to other contexts and regions that most likely present an entirely different sociocultural character. In addition, future studies should focus on a longitudinal research design, which allows for a deeper understanding and for assessing human development empowerment and capability enhancement through the use of mobile phones in the long term.

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