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mHealth knowledge and usage in maternal healthcare delivery: perspectives and experiences of healthcare practitioners in Ghana

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ABSTRACT

Objectives This study explored the knowledge and experiences of health practitioners regarding the use of mobile health (mHealth) for maternal healthcare delivery.
Design Underpinned by the Unified Theory of Acceptance and Use of Technology, this study was an exploratory qualitative design involving in-depth interviews. Data collection occurred between July 2023 and January 2024.
Setting The study was conducted in three administrative regions in Ghana: Ashanti, Northern and Upper West regions. In each of these regions, one urban and one rural setting were selected to ascertain pertinent data from a wide range of maternity health practitioners and directors of health services operating within these regions.
Participants Purposive sampling technique was used to recruit 32 participants, who fall into two primary groups: directors of health services (n=9) and maternity health practitioners (23).
Results The findings revealed that maternal healthcare providers were familiar with and frequently used mHealth technologies (typically video calls/conferences and text messages). mHealth was considered a useful tool in maternal healthcare as it enhanced the efficiency of service delivery and improved practitioners' performance. mHealth facilities eased access to digital medical information, user-friendly interfaces and the ability to facilitate remote consultations. The willingness and ability of health professionals to use mHealth were conditioned by the nature of organisational and infrastructural support they received, including technical guidance and equipment availability. Thus, mHealth knowledge and use among maternal healthcare providers are predicated on personal, social and institutional conditions.
Conclusions Maternal healthcare providers are generally aware of the benefits of mHealth and are ready to use it when available. Thus, it is imperative that the Government of Ghana prioritise incorporation of mHealth into the existing and future maternal healthcare model to enhance care delivery and increase the prospects of achieving the first and second targets of the third Sustainable Development Goals. To ascertain greater gains from mHealth, it is worth acknowledging the varying factors that drive the adoption and effective use of mHealth, such as performance expectancy, ease of use, social influences and organisational support. Interventions aimed

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The Unified Theory of Acceptance and Use of Technology aided in contextualising the findings and enhanced the rigour of the study by reinforcing its credibility and trustworthiness.
⇒ The in-depth interviews offered deeper insights and reflections on our research participants' experiential knowledge and perceptions about integrating mHealth and maternal healthcare delivery.
⇒ The study did not include the perspectives of women seeking maternity care.

at enhancing mHealth integration should address these factors in a context-specific manner.

INTRODUCTION

Improving maternal health is a critical global health priority as high rates of maternal mortality continue to pose a serious threat to the well-being of women. Despite the universal progress towards achieving Sustainable Development Goal 3, maternal mortality ratio (MMR) and neonatal mortality rate remain unacceptably high in low- and middle-income countries (LMICs) as 95% of global MMR occur in these countries.[1] Sub-Saharan Africa (SSA), including Ghana, accounts for about 70% of the global MMR.[2] Ghana was unable to achieve any of the maternal health-related Millennium Development Goals and currently has 263 MMR, far exceeding the global threshold.[3 4] This cast doubts about the ability of Ghana and other LMICs to achieve the first and second targets of SDG 3, thus reducing the global MMR to less than 70 per 100 000 live births and neonatal mortality to at least 12 per 1000 live births, respectively.[3] The existing maternal health systems in SSA are wrought with numerous challenges, such as inadequate financing, limited access to information and a scarcity

of human resources.[5] These obstacles impede the provision of quality maternal healthcare services, leading to preventable deaths and complications.[6] To address these challenges and safeguard the holistic well-being of mothers and their newborns, innovative approaches have emerged, one of which is the efficient integration of mobile health (mHealth) into maternal healthcare in LMICs such as Ghana, in spite of the resource constraints.

mHealth has been conceived by the WHO as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices".[7] Leveraging the widespread availability and use of mobile devices, especially mobile phones, mHealth has helped overcome barriers to delivering essential maternal health information and services.[8] mHealth addresses the shortage of healthcare professionals by providing technology-driven support for healthcare diagnosis, treatment adherence, health worker training, patient education and other critical areas.[9] It has become an important mechanism to improve maternal, neonatal and child health (MNCH) globally.[10] Through targeted client communication, mobile phones enable pregnant women to access and receive information that can lead to improved uptake of MNCH services and health outcomes.[11] Additionally, mHealth helps reach individuals who do not normally engage with the health system, overcoming geographical barriers to accessing healthcare.[12] These benefits substantiate the need for effective integration of mHealth into maternal health services in Ghana and other LMICs, where inadequate financing, limited access to information and a shortage of healthcare professionals impede the delivery of comprehensive maternal healthcare.[13]

In spite of the fast-paced technological advancements in all facets of human endeavours, mHealth has not been formalised as a conventional practice in Ghana in spite of the aforementioned benefits and the unpleasant statistics characterising Ghana's maternal health situation. As of 2022, Ghana had a mobile-cellular telephone subscription rate of 119.6 per every 100 inhabitants,[14] with 24.06 million internet users and 38.95 million active cellular mobile connections at the beginning of 2024.[15] This significant surge in internet use inspires a critical reflection on how best mHealth could be well integrated into the current model of maternal healthcare in Ghana, particularly from the perspective of maternal healthcare providers. Thus, it is crucial and timely to understand the perspectives, experiences and potential barriers faced by healthcare providers in implementing or using mHealth interventions and applications to gain a comprehensive understanding of their experiences field. So far, some scholars have noted that mHealth is already informally used by healthcare providers in Ghana typified by healthcare providers using their mobile devices.[16 17]

Against this backdrop, this study applies the Unified Theory of Acceptance and Use of Technology (UTAUT) framework to gain a deeper, practitioner-centric understanding of mHealth's role and potential in enhancing maternal health outcomes. This represents a key theoretical and methodological advancement as existing research on mHealth in the Global South has rarely employed such robust technology adoption models. In this regard, this study aims to explore the knowledge, experiences and challenges faced by healthcare providers in the Global South regarding the utilisation of mHealth technologies in maternal healthcare delivery. Specifically, the objectives are to:

1. Explore the mHealth knowledge among healthcare providers, focusing on their experience with mHealth tools, knowledge of safe delivery applications, preferred mediums for using mHealth and challenges encountered.
2. Assess the current usage patterns of mHealth technologies among healthcare providers, including their roles in assisting others with mHealth, competency, frequency of use and instances where assistance is sought.
3. Identify the phases of maternity care that critically need mHealth application, spanning across antenatal care (ANC), labour/birth and postnatal care.

Theoretical background

The UTAUT, developed by Venkatesh et al,[18] is a widely recognised model in technology adoption research. It integrates key concepts from eight preceding theories of user acceptance, providing a comprehensive framework to understand technology usage behaviour.[19 20] The central premise of UTAUT is that behavioural intention to use technology is influenced by four core constructs: performance expectancy, effort expectancy, social influence and facilitating conditions, while the actual usage behaviour is directly determined by these intentions.[18] Additionally, the model proposes that these relationships are moderated by factors such as age, gender, experience, and voluntariness of use.

The UTAUT model was selected for this study because it provides a comprehensive and holistic framework for understanding technology adoption. By integrating multiple theoretical perspectives, UTAUT offers a robust method for exploring the complex dynamics governing mHealth technology acceptance and use. Its core constructs—performance expectancy, effort expectancy, social influence and facilitating conditions—are directly relevant to assessing how healthcare practitioners perceive and use mHealth tools. These constructs capture both individual perceptions (eg, the perceived benefits and ease of use of mHealth) and external enablers (eg, technical support and infrastructure), making the model highly suitable for investigating the adoption process in healthcare settings. Moreover, UTAUT's inclusion of moderating factors such as age, gender, experience and voluntariness of use allows for a more nuanced understanding of how different demographic groups may adopt mHealth solutions. This is particularly valuable in the healthcare context, where practitioners' adoption of technology may vary significantly based on these

individual differences. By accounting for these factors, UTAUT provides insight into knowledge, perception and utilisation and helps identify potential barriers and facilitators specific to various user groups.

Literature review on key predictors of intention to use mHealth services

Performance expectancy and mHealth use

The concept of performance expectancy captures an individual's belief that technology will enhance their daily activities.[18] Numerous extant studies on technology adoption and acceptance have consistently demonstrated that performance expectancy serves as a significant driver of technology adoption, whereas users' sustained engagement with technology is strongly influenced by their perception of the associated benefits.[21] Within the specific context of mHealth usage, studies have consistently found that the expectation of a technology's problem-solving capabilities is the most influential factor in shaping users' behavioural intentions to adopt new health technologies.[22]

Performance expectancy denotes that the utilisation of technology allows medical personnel to monitor users' health and provide comprehensive information effectively.[23] Moreover, performance expectancy represents the primary factor influencing individuals' long-term willingness to adopt health technologies as users are more inclined to embrace and sustain the usage of technologies when they perceive the associated benefits.[24] This pattern extends beyond the healthcare domain as studies focused on promoting healthy lifestyles have also corroborated the significant influence of performance expectancy on individuals' intention to adopt technology-based solutions.[25] These findings underscore the pivotal role of users' perceptions of the usefulness and problem-solving capabilities of technology in driving its long-term acceptance and usage across various applications.

Effort expectancy and mHealth adoption

Effort expectancy refers to how easy or difficult a person perceives using a technology to be. Numerous studies consistently highlight the significance of perceived ease of use as a technological factor influencing practitioners' acceptance of mHealth.[26 27] User-friendly interfaces, intuitive design and minimal technical complexity contribute to this perceived ease of use as tools that minimise cognitive effort are preferred by users, facilitating adoption and engagement.[24 28] It is argued that when technology is easy to use, practitioners perceive it as beneficial and are more likely to integrate it into their workflow. Healthcare practitioners, especially those with limited technological proficiency, prefer mHealth tools that are accessible and easy to use.[27 29] Hence, the extant literature suggests that the design and usability of mHealth tools should prioritise simplicity, technical compatibility, culturally appropriate layouts and customisation options to promote acceptance and adoption among users.[30]

Social influence and mHealth use

Social influence plays a pivotal role in shaping the acceptance and adoption of mHealth technology by healthcare practitioners, as evidenced by a growing body of literature. Numerous studies have consistently demonstrated that the perceptions and beliefs of influential individuals significantly impact professionals' intentions to adopt and use mHealth apps.[31 32] Specifically, recommendations and encouragement from trusted colleagues and respected peers have been found to influence healthcare providers' decisions to embrace mHealth tools profoundly.[32 33] This influence emanates from the social dynamics within professional networks, where practitioners rely on the experiences and opinions of their peers to guide their behaviour.[31] Moreover, the support and endorsement of authority figures within the healthcare system, such as senior physicians or hospital administrators, have been identified as significant drivers of the adoption of mHealth apps by healthcare practitioners.[34] This form of social influence carries substantial weight due to the hierarchical structure of healthcare organisations and the influence that superiors' opinions exert on shaping practitioners' attitudes and behaviours. Research also suggests that when patients express a strong preference for using mHealth tools for communication, monitoring or self-management, practitioners are more inclined to incorporate these apps into their practice.[35]

Enablers and mHealth use

Facilitating conditions or enablers are crucial determinants in the adoption and use of mHealth technology by healthcare practitioners. Extensive research has identified key facilitating conditions that significantly influence mHealth usage. The availability of comprehensive technical support services, including helplines, device maintenance and replacement, is paramount for the effective utilisation of mHealth solutions.[26 36] Dedicated technical support units specifically focused on mHealth devices streamline the adoption process.[8 32] Additionally, organisational and multisectoral engagement among institutions creates a supportive environment through collaborative efforts and information sharing.[26 36]

Moreover, appropriate training is another central facilitating condition for healthcare practitioners to effectively employ mHealth systems. Comprehensive educational programmes, specific technological instructions and awareness campaigns equip practitioners with the necessary knowledge and skills.[26] Regular refresher training is essential to maintain proficiency and prevent skill depletion.[37] Infrastructure provisions, such as secure resources, reliable communication systems and robust internet infrastructure, are also critical enablers for mHealth utilisation.[38] These encompass the physical and organisational structures necessary for the optimal deployment and operation of mHealth initiatives. Access to mobile devices, both wired and wireless networks, and reliable power grids are also highlighted as critical enabling factors.[24 39] Without these foundational elements, the

successful implementation of mHealth interventions becomes challenging as even other issues, such as the availability of specific mobile phone models, can pose significant barriers to mHealth adoption in certain contexts.

METHODS

Study design

Given the paucity of research on the experiences and perspectives of maternal healthcare providers regarding the incorporation of mHealth into maternal healthcare services in Ghana, this study employed an exploratory qualitative design to capture the intricate and nuanced perspectives of medical professionals thoroughly regarding the integration of mHealth.[40] This was done through an in-depth interview (IDI).

Study setting

The study encompassed three administrative regions in Ghana: Ashanti, Northern and Upper West. These regions were purposefully selected due to their distinctive maternal healthcare and health service delivery characteristics.[40] Notably, the Northern and Upper West Regions have been identified as having relatively low rates of mHealth interventions for maternal and neonatal care compared with other regions in the country.[40] This has been attributed to their higher levels of rurality in contrast to the more urbanised southern regions.[41] Hence, in contrast, the Ashanti region, located in the southern part of Ghana, stands out for its cosmopolitan nature and densely populated areas, as well as its diversity and more advanced healthcare services, and is used in complement to offer a unique opportunity to gather a diverse range of perspectives and insights on maternal healthcare. Within each region, one urban area (denoted as 'u') and one rural area (denoted as 'r'), including metropolitan areas, municipalities or districts, were carefully chosen to ensure the inclusion of varied and rich perspectives from both urban and rural maternal healthcare providers. The specific locations selected for data collection were as follows: Ashanti Region (Kumasi Metropolis (u) and Kwabre East District (r)), Northern Region (Tamale Metropolis (u) and Tolon District (r)) and Upper West Region (Wa Municipality (u) and Nandom District (r)) (see table 1). These specific study sites were strategically chosen to facilitate the collection of pertinent data from a wide range of maternity healthcare providers and directors of health services operating within these regions.

Sampling strategy

The study used a purposive sampling technique to enlist a total of 32 participants, comprising two primary groups: 9 directors of health services and 23 maternity healthcare providers. The directors included District, Municipal and Metropolitan Directors of Health Services, as well as Regional Directors of Health Services. The maternity healthcare providers consisted of midwives and in-charges

Table 1 Distribution of sample size

Designation	Sample
Regional Director	
Ashanti Region	1
Northern Region	1
Upper West Region	1
District/Municipal/Metropolitan Director (two per region)	
Kumasi Metropolis (u)	1
Kwabre East District (r)	1
Tamale Metropolis (u)	1
Tolon District (r)	1
Wa Municipality (u)	1
Nandom District(r)	1
Maternity healthcare in-charge	
Kumasi Metropolis (u)	2
Kwabre East District (r)	2
Tamale Metropolis (u)	2
Tolon District (r)	2
Wa Municipality (u)	2
Nandom District (r)	2
Maternal healthcare providers: one per urban and rural hospital in each district//municipality/metro)	
Kumasi Metropolis (u)	2
Kwabre East District (r)	2
Tamale Metropolis (u)	2
Tolon District (r)	2
Wa Municipality (u)	1
Nandom District (r)	2
Total	32

r, rural; u, urban.

of maternal healthcare departments working in rural and urban health facilities. Given that the research is qualitative and seeks to comprehend issues at a deeper level rather than generalise them,[42] the sample size was determined to be suitable for thoroughly examining the main issues under investigation and achieving saturation.[43]

Data collection instrument and process

The data collection was done using two distinct semi-structured IDI guides to enable discussion of the topical issues in the research from a wide range of participants' experiences while remaining focused on the study. One IDI was designated for the Directors of Health Services (see online supplemental file 1), while the other was for the health practitioners interviewed at the respective health facilities (see online supplemental file 2). The topics discussed included sociodemographic characteristics, past experiences in using mHealth, the benefits and perceived advantages of mHealth technology and the ease with which its use affects their everyday

Table 2 Sociodemographic characteristics

Participant	Sex	Age range	Educational status	Marital status	Designation	Years of experience	Knowledge of mHealth
R1	Female	31–40	Tertiary	Married	Midwifery Officer	11	Yes
R2	Female	UD	Tertiary		Senior Midwifery Officer	13	No
R3	Female	20–30	Tertiary	Single	Staff Midwife	1	Yes
R4	Female	41–50	Tertiary	Married	Metropolitan Director of Health Services	17	Yes
R5	Female	41–50	Tertiary	Married	Municipal Director of Health Services	28	Yes
R6	Female	41–50	Tertiary	Married	Midwifery Officer	12	No
R7	Female	31–40	Tertiary	Single	Senior Staff Midwife	10	Yes
R8	Female	31–40	Tertiary	Married	In-Charge of Maternity/Midwifery Officer	9	No
R9	Female	20–30	Tertiary	Married	Staff Midwife	6	Yes
R10	Female	31–40	Tertiary	Single	Midwifery Officer	10	Yes
R11	Female	31–40	Tertiary	Married	Senior Staff Midwife	11	Yes
R12	Female	31–40	Tertiary	Married	Midwifery Officer	12	Yes
R13	Female	Above 50	Secondary (O' level)	Married	Midwife	25	No
R14	Male	41–50	Tertiary	Married	Municipal Director of Health Services	19	Yes
R15	Female	31–40	Tertiary	Married	Midwifery Officer	–	Yes
R16	Female	31–40	Tertiary	Married	Midwifery Officer	13	Yes
R17	Male	41–50	Tertiary	Married	Regional Director of Health Services	19	Yes
R18	Female	UD	Tertiary	Married	Midwifery Officer	10	No
R19	Female	31–40	Tertiary	Married	Senior Midwifery Officer	16	No
R20	Female	31–40	Tertiary	Married	Senior Staff Midwife	3	Yes
R21	Female	31–40	Tertiary	Married	Senior Staff Midwife	11	Yes
R22	Female	41–50	Tertiary	Married	Senior Midwifery Officer	13	Yes
R23	Male	31–40	Tertiary	Married	District Director of Health Services	9	Yes
R24	Female	31–40	Tertiary	Married	Municipal Director of Health Service	10	Yes
R25	Male	41–50	Tertiary	Married	Deputy Regional Director of Health Services	15	Yes
R26	Female	31–40	Tertiary	Married	Midwifery Officer	15	Yes
R27	Male	41–50	Tertiary	Married	Medical Superintendent		Yes
R28	Female	41–50	Tertiary	Married	Deputy Chief Midwife Officer	19	Yes
R29	Female	41–50	Tertiary	Married	Senior Midwifery Officer	12	No
R30	Female	31–40	Tertiary	Married	Senior Staff Midwife	7	Yes
R31	Female	41–50	Tertiary	Married	Midwifery Officer	9	Yes
R32	Female	31–40	Tertiary	Married	Midwifery Officer	15	Yes

mHealth, mobile health; UD, undisclosed; UWR, Upper West Region.

routine. Additionally, participants were asked about how the perception and beliefs of significant others and the availability of facilitating conditions influence their usage of mHealth technology. The data collection process spanned from July 2023 to January 2024. Given the qualitative nature of this study, the lengthened timeframe for data gathering was necessary to accommodate the busy schedules of healthcare providers and ensure thorough participation. This approach allowed us to gather rich, detailed insights from the participants.

The research team conducted face-to-face interviews with the maternal healthcare providers during regular business hours after obtaining their permission. The practitioners also provided letters of introduction to help the team engage with other practitioners in their jurisdictions. The interviews with the maternal healthcare practitioners took place in private rooms or other quiet areas within their healthcare facilities. For the directors, the interviews were conducted in their offices. The research team ensured that each participant had ample time,

typically 40 min, to share their perspectives and experiences. Participants were encouraged to express their thoughts openly and honestly throughout the interviews. They communicated the study's purpose, assured confidentiality and explained the audio-recording process.

Before data collection, the interview guide underwent rigorous vetting by subject matter experts to uphold content validity. This expert review process bolstered the face validity of the instrument, ensuring that questions effectively measured the intended constructs. Pilot interviews with a small sample group were conducted to refine the interview guide for clarity and relevance, further bolstering the validity of the data collection instrument. Thorough documentation of the data collection process, including interviewers' training protocols, interview settings and participant consent procedures, was maintained to ensure transparency and reproducibility. Data analysis followed a systematic approach, incorporating coding schemes and engaging multiple researchers in the analysis process to enhance the reliability of the findings. By implementing these measures, the research team fortified the validity and reliability of the data collection process, enhancing the credibility and robustness of the research outcomes.

Patient and public involvement

The public and patients were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Data analysis

The study adopted the framework analysis approach, which is renowned for its systematic and rigorous nature, and gained widespread acceptance across diverse academic domains, including the healthcare sector.[44] This robust approach helped the research team unearth profound insights that contribute to a comprehensive understanding of the research topic, with the help of NVivo V.14 to manage the data. The framework analysis approach encompassed multiple methodical stages, including familiarisation, theme framework identification, indexing, charting, mapping and interpretation.[45] During the familiarisation phase, the research team immersed themselves in the data, diligently making astute observations and capturing insightful notes. Recurring themes emerged organically, forming the fundamental basis of the preliminary thematic framework.

With meticulous attention to detail, the team indexed the data, precisely extracting pertinent sections aligned with specific topics and themes (see online supplemental file 3). This meticulous indexing process facilitated the subsequent charting phase, wherein the data were visually organised into coherent thematic charts, enabling a comprehensive overview of the inter-related information. As the exploration of the data deepened, the mapping and interpretation unfolded. The team delved into the intricacies of the data, unravelling subtle nuances and assigning profound interpretations to the identified themes. This analytical stage provided critical insights into the participants' experiences and perspectives. The study has been reported following the Standards for Reporting Qualitative Research.[46]

RESULTS

Sociodemographic characteristics of participants

The sociodemographic characteristics of the research participants are presented in table 2. Of the 32 participants, only 5 were males (n=5; 15.6%). They were health personnel in three administrative regions: Ashanti (n=11; 34.4%), Northern (n=10;31.3%) and Upper West (n=11; 34.4%). Predominantly, the research participants had tertiary education (n=31; 96.9%), with one having secondary (formerly O'-level education) (n=1; 3.1%). In a similar vein, nearly all of them were married (n=29; 90.6%). They were dominated by midwives of varied ranks (n=23; 71.9%), and their work experience spanned 3–28 years. A greater number of them indicated that they possessed knowledge about mHealth (n=25; 78.1%) as shown in table 2.

Knowledge and usage of mHealth

The study asked healthcare providers about their familiarity with mHealth and the frequency of using this technology in their daily routines at the workplace. The practitioners narrated that, although not universal, many are knowledgeable and experienced with mHealth, using it frequently in their day-to-day delivery of maternal healthcare, such as general consultation, calculating gestation period, record-keeping, case management and antenatal, among others. Some of the narratives were:

> I use it every day when I come to work. Those who come will want to know the number of weeks before you will attend to them, so you calculate the age. If the person has her first menstrual period or the person has the first scan that gives the EDD [expected delivery date], You just key in and get your results. I use it every day. (R12, Midwifery Officer, 31–40 years, female)

> I can say almost every day when I am on duty, and I am currently in the labour ward, so I use it often. (R15, Midwifery Officer, 31–40 years, female)

The healthcare providers explained that there were two primary ways mHealth had been adopted into maternal healthcare: it had helped address geographical limitations and enabled online collaboration. In such cases, mHealth allowed patients and nurses to communicate with nearby health centres through voice or video calls, text messages and other means for diagnoses and prescriptions. Some healthcare providers have asserted:

> For the remote areas, sometimes they call for patient management. They send the lab tests on WhatsApp for us to see; these are the labs we have, what are the next steps? Then we can coach them on some

interventions to take. (R5, Municipal Director of Health Services, 40–41 years, female)

Because we don't have doctors at our health centre, we use mHealth. We narrate clients' condition to a doctor [through mobile phone calls], and per the complaints, the doctor will direct us to know what to do. (R9, Staff Midwife, 20–30 years, female)

Another use of mHealth involved online platforms (such as WhatsApp, Facebook and Zoom) where practitioners and physicians from around the globe, within countries and between different health facilities are able to come together to discuss, diagnose and analyse health issues, providing solutions or prescriptions.

We have a platform where cases are sent, especially from other regions. We have other consultants in other countries who are also on the platform and will also give inputs to cases people are managing. (R5, Municipal Director of Health Services, 41–50 years, female)

Adoption of mHealth through the lens of UTAUT

The familiarity and adoption of mHealth technology in daily maternal health delivery in Ghana can also be better understood through the UTAUT's framework. The core idea behind UTAUT is that the actual utilisation of information technology is directly predicted by one's desire to use it. These desires can be explained by four main factors that determine the behavioural intention and the use of mobile phones in healthcare. The narratives provided by the participants were themed around these factors, highlighting the practical advantages, ease of use, views of superiors and support systems that had facilitated the integration of mHealth into maternal healthcare.

Performance expectancy and use of mHealth

The participants' narratives highlighted the significant influence of the mHealth technology's performance expectancy, specifically its usefulness in maternal healthcare delivery in Ghana. According to healthcare providers, technology was acknowledged as a profound and efficient tool that has become indispensable in their daily work. It integrated all the critical medical information and eligibility criteria into easily accessible digital formats, enhancing the efficiency and accuracy of maternal healthcare delivery services. This has made use of mHealth technology an essential tool. Some of the physicians had emphasised this by stating:

… I can't work without that. I am a physician. So, we do have a lot of Apps that we use when working with patients. When you need to confirm information, [to check] the dosages, [or] medications and all those things, you just need to open the app and type. (R25, Deputy Regional Director of Health Services, 41–50 years, male)

We downloaded the criteria onto our phones. So, when we educate a person, we also inquire to know whether the person has a medical condition. Through that, we can detect whether the method the person is going in for will be favourable for the woman's condition. (R4, Metropolitan Director of Health Services, 41–50 years, female)

Also, the mHealth technology app's unique function of sending instant prompts or notifications to the maternal unit on receiving a referral has been particularly valued. These alerts provided prompt notifications even before the patient arrived at their unit. One participant noted:

Any time a referral is coming, they send an alert on the platform or if you are also sending a referral, you also send an alert. Sometimes they show a picture of the referral form that shows that it is coming. (R1, Midwifery Officer, 31–40 years, female)

Beyond alerts and notifications, the mHealth technology has also assisted in organising patients' folders alphabetically and electronically, making work easier and more efficient. Unlike manual systems, it offered the fastest way to retrieve data and provided accurate results and information, where obtaining prompt information could have been nearly impossible or take several hours or days to find a patient's records.

Its use is helpful and, as I said earlier, it even makes the work faster. Like somebody did the scan in December and no EDD was found but the day was provided, you just input it, and it will come. … It is accurate too. (R15, Midwifery Officer, 31–40 years, female)

You see, if you want general information on drugs, it will come in alphabetical order, or conditions. So, I can't work with my phone off because the paper can't give you this kind of information. After all, it won't be quick [manual]. (R3, Staff Midwife, 20–30 years, female)

Effort expectancy and ease of use of mHealth among healthcare providers

The healthcare provider had expressed confidence in using mHealth applications, citing their ease of use and efficiency in speeding up their work. They had specifically mentioned that the apps and interventions had been user-friendly and did not pose significant difficulties. Additionally, the practitioners highlighted the accuracy of the technology, further bolstering their confidence in its effectiveness. By enabling remote monitoring and providing access to valuable data, mHealth has contributed to improved maternal and infant outcomes, ultimately leading to a reduction in maternal and infant mortality rates. A practitioner had explained:

It is easy to use, and as I said earlier, it even makes the work faster. So, at least it has, and I am confident in using those apps; I don't have much difficulty. It is accurate, too. (R15, Midwifery Officer, 31–40 years, female)

The practitioners, however, expressed that several external factors affected the user-friendly attributes of the mHealth technology. They elucidated that the continuous occurrence of pop-up advertisements impeded the seamless user experience of the application. This concern escalated in emergency situations when practitioners necessitated prompt access to crucial information via the mHealth app. At such critical junctures, an advertisement could unexpectedly appear, persisting for several seconds or even minutes, consequently leading to time wastage and disruption in the efficient functioning of the application. A practitioner remarked:

Sometimes the ads. When you click [the app], the advertisement plays, and you must listen to it; it is just [long]. (R12, Midwifery Officer, 31–40 years, female)

Moreover, the healthcare providers emphasised the existence of intricate procedures inherent in the mHealth system, which they had to navigate to accomplish their desired objectives. They acknowledged that a lack of familiarity with these processes presented significant challenges. Specifically, they frequently encountered the need to follow specific phone-based procedures for tasks including app downloads and email access. The unfamiliarity with these steps further compounded the difficulties and impeded the efficient utilisation of mHealth technology. A Midwifery Officer expressed:

Like some of the places you must go and touch before you get to other places, we are not conversant with those places. … it is always a problem for us. (R16, Midwifery Officer, 31–40 years, female)

Social influence and mHealth adoption and use
Social influence has played a significant role in the adoption of mHealth technology among healthcare practitioners, as expounded through diverse shared by practitioners. This influence has been categorised into three primary subthemes: observing superiors or colleagues using mHealth, receiving recommendations from superiors or colleagues and responding to requests from or meeting the needs of patients.

Practitioners indicated that their interest in adopting mHealth technology often stemmed from observing their more experienced superiors or colleagues using it effectively in their clinical practice. The practitioners had witnessed successful utilisation by respected and knowledgeable staff members, which boosted their confidence and inspired them to integrate these digital tools into their work.

The first time, it was a medical officer who was using it, and a rotational midwife in the maternity unit was here; it was through that we started using it. (R26, Midwifery Officer, 31–40 years, female)

The practitioners also emphasised the pivotal role of recommendations from their superiors or trusted colleagues in facilitating the adoption of mHealth

technology. Positive endorsements and suggestions from respected sources significantly increased the practitioners' willingness and motivation to incorporate these applications into their routine clinical practice.

At times, it can also be a recommendation from superiors. He mentioned the app name, and then we just went to the Google Store and downloaded it. (R2, Senior Midwifery Officer, UD, female)

Another critical factor that influenced the adoption of mHealth technology was the necessity to meet the evolving needs of patients. Practitioners had often felt compelled to use these applications when they had recognised the potential benefits of providing timely updates, information or improved care to their patients.

That patient I said I wanted to educate, and by then I didn't have the App, so that time I downloaded the App. (R12, Midwifery Officer, 31–40 years, female)

Conditions that facilitate mHealth adoption and use
A supportive environment for education and training
As per the narratives, a supportive environment had been put in place to assist maternal healthcare providers in integrating the app into their daily work and simplifying their tasks. The participants reported that being in a supportive environment with technical guidance had facilitated the adoption of mHealth for maternal healthcare delivery. Some of the narratives provided by the participants had been as follows:

Well, we are four in a group; we have management, RCH, public health, and clinical. So, if you are locked somewhere, you just call a colleague to help you out. (R19, Senior Midwifery Officer, 31–40 years, female)

Initially, when I was about to start it, I didn't understand it that much. I sought support from my regional public health nurse. … I ask her questions, and she tells me, do it this way, don't do it this way. (R28, Deputy Chief Midwife Officer, 41–50 years)

The maternal healthcare providers also hinted that there had been built-in support in mHealth, where designated staff had been responsible for addressing patient queries, which made mHealth highly effective in maternal healthcare delivery. When patients had called or sent a text, they had been promptly directed to the appropriate unit. According to the maternal healthcare providers, this support has made adopting or using maternal mHealth highly commendable and effective for maternal health delivery. A practitioner had narrated:

When patients have a case at the health centre, they call [or send a text to] the centre, and they will be linked to a midwife, a doctor, or any other person depending on the condition that they called in. (R1, Midwifery Officer, 31–40 years, female)

There had been another aspect where mHealth also provided a platform for maternal healthcare providers

to remotely transmit patient information. This offered a crucial educational information system through which texts or voice notes were sent to patients for later review, especially when patients were unavailable or inaccessible. For instance, the maternal healthcare providers had informed:

> We send voice messages and texts to patients. On phone calls, we educate them and allow them to also ask questions. (R3, Staff Midwife, 20–30 years, female)

> We send them WhatsApp messages, phone calls, and text messages, that is S.M.S. Text messages through SMS and WhatsApp are sent to those who are educated, and phone calls are made to the less educated. (R27, Medical Superintendent, 41–50, male)

Support to staff who are not familiar with mHealth
Some maternal health providers were not familiar with the use of mHealth. The participants indicated that these had been their worries. Hence, systems were created to provide support for those who had not been privy to this technical advancement. Most maternal healthcare providers had still been adopting the orthodox methods of counting the days of pregnancy. Given this, those who had been conversant with the scientific approach had offered a helping hand to the 'newcomers'. Additionally, there were instances where others had even helped their peers download the apps on their phones. Some of the responses had been as follows:

> I can say some people do not know that there are mobile apps like this; so, they use manual calculation. … Yesterday I helped someone, she is not a midwife here, she works in the village. So, I helped her to download it for her on her phone. (R12, Midwifery Officer, 31–40 years, female)

> Yes. A colleague in the ward couldn't also download it. … she wanted to use the WHEEL and couldn't download it., … I helped her to download it on her phone. (R16, Midwifery Officer, 31–40 years, female)

Provision of infrastructure
Maternal healthcare providers had also been provided with compatible tools and accoutrements that had necessitated the adoption of the app in maternal health. Apparatus such as laptops, desktops, tablets, smartphones, iPads and flash drives had served as mediums through which they had familiarised themselves with the mHealth app and technology, stored information and communicated with patients. Some of the provided submissions by the maternal healthcare providers had been as follows:

> They gave us mobile phones and there were Apps on the mobile phones; that could help us register a pregnant woman on ANC to educate them according to her gestational age; and even how to mHcare for herself and the baby, delivered. (R10, Midwifery Officer, 31–40 years, female)

> we have computers, we have tablets, phones, iPads and then those are the various mediums that they can be used. (R14, Municipal Director of Health Services, 41–50 years, male)

The compatibility and integration of mHealth
To make mHealth more suitable for maternal health delivery, some maternal healthcare providers had indicated that, although all aspects of maternal health had been important, ANC had been of the highest priority. They believed that mHealth needed to start with the antenatal phase. The practitioners emphasised the significance of providing information on what pregnant women should eat, identifying danger signs, knowing when to report to the facility and understanding the medications that need to be administered. They considered these aspects vital for ensuring good health and well-being. The practitioners had expressed the belief that if ANC had been initiated accurately, issues related to delivery, postnatal/postpartum care and other related concerns would not pose significant challenges.

> … we must begin from the ANC. If we get the ANC right, we are more likely to improve on the standard of outcomes and then at birth. So, if you ask me, I will say we will need to begin or start from the ANC. (R14, Municipal Director of Health Services, 41–50 years, male)

> The app is very useful at the ANC. Good ANC prevents complications. Pregnancy starts from the antenatal, so the antenatal needs to be very effective. (R12, Midwifery Officer, 31–40 years, female)

However, despite the facilitating conditions in major healthcare deliveries, the experienced maternal healthcare practitioners who had participated in the study had lamented that no specific maternal healthcare aspect had been more important than the others, and all divisions under healthcare in Ghana had to be treated fairly when it came to mHealth. They had appealed for the health and well-being of pregnant women, the unborn and the safe delivery of babies, emphasising the need for all sections or units of maternal health to collaborate and work together. It had been evident in the narratives that priorities had been given to certain units while others had been slightly or outrightly neglected. Some of the lamentations had been as follows:

> All of them because the pregnant woman will need care …. Also, after delivery, sometimes complications set in … So, I think we need a mobile application in all the stages. From pregnancy, labour and delivery. (R15, Midwifery Officer, 31–40 years, female)

> All the units are equally important. So, for me, I don't see the inequality because we are doing the work together, ANC, Postnatal and Labour, and even the family planning. (R23, District Director of Health Services, 31–40, male)

DISCUSSION

The overarching focus of this study was to examine the knowledge and utilisation of mHealth among healthcare providers in Ghana. Though not universally adopted, the narratives indicate a significant level of familiarity and frequent usage of mHealth technologies among practitioners. One of the key drivers for the adoption and use of mHealth applications and interventions by practitioners in Ghana is its ability to facilitate remote consultations, enable collaboration between healthcare providers across different facilities and overcome geographical barriers to healthcare access.[47] It is noteworthy for practitioners as they emphasised the use of online platforms like WhatsApp and Zoom for case discussions, virtual meetings and real-time data sharing, which affirms the potential of mHealth to foster collaborative learning, decision-making and timely interventions—even in rural resource-limited settings.[26 36 38] The ability to digitally transmit laboratory results and other medical information from rural areas to the urban centres while receiving guidance from distant healthcare providers demonstrates the usefulness of mHealth interventions, particularly in regions with limited access to well-equipped healthcare facilities, such as parts of the Global South, including Ghana.[48] Such quality and characteristics bridge some healthcare access and improve the quality and accessibility of maternal and child healthcare services in Ghana, as corroborated by previous research.[49 50]

The accounts of healthcare providers underscore the high-performance expectancy of mHealth technologies, particularly their usefulness and efficiency in maternal healthcare delivery, as corroborated by other studies.[24 25] The ease of accessing medical information digitally enhances the accuracy and efficiency of healthcare services. Consistent with existing empirical research,[26 27] practitioners in our study highlighted the critical role of mHealth's usefulness in its adoption. Maternal health delivery is interconnected with various departments, such as obstetrics and gynaecology, neonatal intensive care, paediatrics, emergency, anaesthesiology, radiology and laboratory services. This interconnection affirms that mHealth interventions should not be department-specific but facilitate coordination and integration across multiple departments. Effective communication and collaboration are essential for providing comprehensive and high-quality maternal healthcare. The ability to send instant alerts, organise patient records electronically and enhance efficiency, accuracy and convenience across these departments further demonstrates the practical advantages of mHealth. These benefits support its indispensable role in the daily healthcare routines of practitioners and their willingness to adopt it, particularly among Ghanaian healthcare providers.[24 28]

The findings further highlight the critical role that social influence plays in driving the adoption and use of mHealth tools among Ghanaian healthcare practitioners. Observing respected colleagues and superiors using these mobile applications in their clinical practice inspires other practitioners to follow suit successfully.[31 32] Not only that but also the endorsements and recommendations from trusted sources further amplify this influence as practitioners are more willing to integrate mHealth when it is positively advocated by those they hold in high regard.[32 33] Beyond the influence of peers and leadership, the study also identifies the patient-centric motivations that spur mHealth adoption and usage.[35] Practitioners recognise the potential benefits these technologies offer in improving care delivery and meeting the evolving needs of their patients. As they became aware of how mHealth can enable them to provide timely updates, information sharing and enhanced patient support, this became one of the primary drivers for incorporating these tools into their workflows and into their practice. Furthermore, the study found that practitioners view mHealth as providing better access to care and services and improving patient engagement and satisfaction. This further reinforces their motivation to adopt and leverage mHealth technologies.

It is also important to establish that organisational and infrastructural support plays a critical role in facilitating the adoption and usage of mHealth technologies among maternal healthcare providers. The practitioners explained that certain valuable conditions and enabling factors must be in place before mHealth can be fully used in their clinical practice. Specifically, the importance of providing a supportive environment that addresses both the technical and operational aspects of mHealth integration is emphasised. This supportive environment includes the availability of technical guidance, helplines and peer-to-peer support mechanisms, which enable practitioners—even those who are unfamiliar with the technology—to navigate the integration process effectively.[36] Equipping healthcare providers with the necessary infrastructure, such as smartphones, tablets, iPads and laptops, further reinforces this supportive ecosystem and removes potential barriers to mHealth adoption. Additionally, providing regular training and establishing dedicated units responsible for updating and upgrading these mHealth facilities are crucial. These measures ensured that the technology keeps pace with the ever-changing demands of the healthcare landscape, allowing practitioners to leverage the full capabilities of mHealth in their maternal care delivery. Without these foundational elements in place, the practitioners noted,[37] the full utilisation and widespread usage of mHealth tools cannot be reliably ascertained.

Implications for practice

Practitioners recommend mHealth applications with user-friendly interfaces and readable font sizes as most of these interventions require some level of technology literacy. It would be beneficial to provide training programmes to practitioners to enhance their familiarity with mHealth applications and procedures. Moreover, while ANC is seen as a priority area, practitioners emphasise the importance of integrating mHealth across all aspects of maternal healthcare, including antenatal, labour/delivery, postnatal and postpartum care. They express concerns about

the current imbalance, with some areas receiving more attention and resources than others in terms of mHealth initiatives. To ensure the health and well-being of pregnant women and newborns, practitioners advocate for a holistic and collaborative approach, where all maternal healthcare units seamlessly work together through mHealth integration.

Strengths and limitations of the study

Methodological rigour was maintained throughout the research, ensuring the credibility of the findings. The in-depth exploration through detailed interviews provided rich insights into healthcare providers' perspectives and experiences with mHealth. The study's practical implications for healthcare settings, contribution to existing knowledge and potential for guiding future research are key strengths that enhance the study's overall value and significance. The selection of the UTAUT model further strengthens the study by providing a comprehensive framework for understanding technology adoption, particularly in healthcare contexts.

Despite the valuable insights and policy implications derived from this study, it is important to acknowledge several limitations. One limitation is the scope of the study population as it did not include the perspectives of women seeking maternity care. Including patient perspectives could have provided a more comprehensive understanding of the dynamics of academic support and collaborative learning environments. Another limitation is the absence of a real-life-controlled intervention within this formative inquiry on healthcare workers' perspectives regarding mHealth utilisation. The findings might have differed if participants had experienced a controlled intervention scenario. This limitation underscores the potential impact of practical interventions on the observed outcomes and should be noted. To address this limitation and further expand on the findings, future research should consider including the perspectives of healthcare receivers and other stakeholders to gain a more holistic understanding of the subject matter. Also, to enhance the robustness of the findings, future studies should consider employing a mixed-methods approach that combines qualitative insights with quantitative data. This would validate the observed trends and patterns statistically, adding a more comprehensive perspective to the study. This would also help gather a wider range of information and ensure a more in-depth exploration of the research topic.

CONCLUSION

The study provides empirical evidence on the knowledge, usage and adoption of mHealth technologies in maternal healthcare in Ghana, as perceived and experienced by healthcare practitioners. The findings highlight the increasing adoption and utilisation of these technologies among the practitioners. The key drivers identified include the ability of mHealth to facilitate remote consultations, enable cross-facility collaboration and overcome geographic barriers to access care. The study also emphasises how mHealth enhances the efficiency, convenience and timeliness of healthcare services, including the comfort of sending alerts and managing records electronically. Notably, the study underscores the critical role of social influence, with peers and leadership serving as inspirations for other providers to adopt these technologies. Furthermore, the study identifies the need for organisational and infrastructural support to fully realise the benefits of mHealth, such as technical guidance, necessary equipment and dedicated units for updates. Importantly, the findings support the analysis through the UTAUT model. It establishes that performance expectancy, effort expectancy, social influence and facilitating conditions are all important factors influencing the adoption and use of mHealth technologies in maternal healthcare. This suggests that interventions aiming to enhance mHealth integration in maternal health services should take a comprehensive approach. Such efforts would benefit from a thorough understanding of the key issues across these UTAUT factors, accounting for the specific contexts and needs within different settings.

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