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Digital Technologies and Maternal Healthcare Service Delivery in Rural Communities of Bayelsa State, Nigeria

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Abstract
Poor maternal healthcare service delivery is a major challenge that heightens the rate of maternal mortality among rural women in Bayelsa State. The study explores the role of digital technologies through computer utilisation and ultrasound scanner accessibility in hospitals have improved and contributed to maternal healthcare service delivery in rural communities in Bayelsa State. Survey research design was adopted and the instruments for data collection were in-depth interview and questionnaire. Data from the questionnaire were analyzed using the Statistics for Social Sciences (SPSS), presented in tables. Findings revealed that digital equipment improve maternal healthcare service delivery in rural community by using computers in the management of patients' file in terms of electronic record keeping and ultrasound scanner in providing pregnancy scan results and enable early determination for cesarean section. It is recommended among others that local government council and Bayelsa State government to jointly provide digital equipment like computers and ultrasound scanners in rural communities.

Keywords: *Digital technologies and Maternal healthcare*

Introduction

This research examines the role of digital technologies through computer utilisation and ultrasound scanner accessibility in hospitals have contributed or improved maternal healthcare delivery service in rural communities in Bayelsa State. Access to quality information on ante-natal healthcare is essential towards successful delivery by pregnant women, who undergo check-ups in a hospital. These check-ups are called antenatal care or antenatal visits (Iyaniwura & Yusuf, 2009). The World Health Organisation (2012) stated that each year, about six million women become pregnant, and five million of these pregnancies result in childbirth. The WHO (2007) further reported that about 16 million girls, aged 15-19, and some one million girls, under 15, give birth every year, most of them in low-and-middle-income countries. According to the US Government poster on teen pregnancy, over 1100 teenagers, mostly aged 18-19, give birth every day in the United States alone (Hamilton, Brady, Ventura & Stephanie, 2012). A significant number of these pregnancies are not successfully delivered, especially in developing countries.

In Nigeria, for instance, approximately more than 500 women each day die of maternal-related complications or face critical and lasting health consequences (Kamal, 2018). In Bayelsa State, pregnant women die each day from preventable causes related to pregnancy and child-birth. For instance, the year 2015 witnessed the highest maternal mortality ratio in Bayelsa State (Ochieng & Gichoya, 2013). For each death, there are also an estimated 30 to 50 women who will experience life-long conditions and disabilities such as obstetric fistula. However, most of these health consequences and maternal healthcare challenges are preventable using digital technologies through the level of computer usability and the utility of ultrasound scanner utilisation by pregnant women in hospitals, as this will aid efficient maternal health delivery service.
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Digital technologies have significantly contributed to and played a role in revolutionising various industries, especially in the health sector. Technologies in the health sector allow pregnant women to have safe delivery, better health delivery services, healthier life, a longer life expectancy and a more productive life (Maiurova & Kurniawan, 2022). According to Tortorella and Fogliatto (2022), technology has empowered patients and pregnant women, even in remote areas, to access quality health services. Thus, digital technologies through computers and ultrasound scanners can be employed to improve maternal health delivery service in rural communities in Bayelsa State where there are hard-to-reach areas occasioned by the extensive riverine terrain and poor social mobilisation.

This research is divided into five sections. The first section is the introduction, which discussed the background to the research. The second section discussed concepts like digital technologies and maternal healthcare, which are related and relevant to the research. The third section articulated the description of the methodology adopted for the collection of data and analysis for the research. The fourth section presented the results and discussion of findings from. The fifth, which is the final section encapsulate the conclusion and recommendations of the research.

Conceptual Premise

The following concepts form the conceptual thrust of this paper. These concepts are digital technologies and maternal healthcare. This section therefore explores these concepts with a view to providing their contextual meanings and understanding in this discourse.

Digital Technologies

Digital technologies refer to the application of digital means for service delivery. Digital technologies enable the storage, processing, transmission, capturing, and display of information by digital means for effective service delivery (Doron & Jeffrey, 2018). In modern societies, digital technologies are incorporated into almost every activity, including public health, societal planning and political organisations, such as civil society (Jain, 2014). Development and communication theorists have always observed that an increase in technological leap by adopting modern technological techniques would not only modernise the traditional societies but also reform the bureaucracies, including maternal healthcare (Jain, 2014).

In Nigeria, the infrastructure concerns are a severe obstacle. However, the country has drastically improved in telecommunications infrastructure beyond urban centres, with broadband connections and the setting up of fibre optic networks. Over 70 percent of the Nigerian population, including those in rural areas, for instance, have access to mobile phones, and only a limited percent of the people, again especially rural dwellers, do not have mobile phones and access to broadband connections (Spencer & Smith, 2010; Bhatnagar, 2014). All these point to the fact that the application of digital technologies in providing services to pregnant mothers in rural communities is feasible and will go a long way to improve maternal healthcare service delivery.

Digital technologies have become the most supportive economic and extensive medium for service delivery and outreach across the world. Digital technologies have become more all-encompassing than the most essential infrastructure across the world. The widespread use of digital technologies has reached an efficient dissemination of maternal healthcare information to even rural communities (Patrick, Griswold, Raab, & Instille, 2008). The use and application of digital technologies and mHealth for service delivery now constitute the primary form of access and exchange of information and contribute to personal and social relationships (De Costa, 2019). Nations where mHealth and the application of digital equipment constitute the primary form of access, increased exchange of information on commercial or social services is contributing to developmental goals are changing social relations. Information awareness and user-friendliness through the use of digital technologies have reduced transaction costs in terms of time and money. Digital technologies have transformed daily lives and influenced every sector of public administration and development. In Africa and Nigeria, for instance, the growth of digital technologies has been associated with accessing economic services for poor households, creating opportunities for employment, entertainment and education, and toward social, political, and economic transformation (WHO, UNICEF, UNFPA, & World Bank, 2008). Consequently, digital technologies have become the ears and eyes for the public to identify gaps in the delivery of public

services. Thus, digital technologies can also be applied in developing countries like Nigeria to improve maternal healthcare service delivery in rural communities.

Maternal Healthcare

Maternal healthcare is the overall well-being of women at the stage of pregnancy and children below age 5 years (Aluko & Ademiluyi, 2015). It is comprehensive as it includes educational, social, nutritional services as well as medical care during and post pregnancy. A number of reasons have been attributed to why many pregnant and nursing mothers choose not to make use of appropriate antenatal and postnatal care. Some of these are family, cultural, or hereditarily related to the social, economic and political developments. This implies that the natural environment performs critical and powerful functions in healthcare utilisation behaviour of women across African societies. However, family and cultural factors majorly determine healthcare utilisation behaviour of pregnant women in Nigeria in general and Bayelsa State in particular (Aluko & Ademiluyi, 2015).

One of the SDGs' major goal risks is the advancement of the health of pregnant and nursing mothers (maternal health) and reducing maternal and child death by 2030 (Elem & Nyeche, 2016). Inspite of this global devotion, the loss of women's lives as a result of complications during pregnancy has been on the increase in most Sub-Saharan African countries (Nwokocha, 2008). In Nigeria, for example, maternal mortality is responsible for about 59, 000 deaths of women annually (WHO, 2009). Nigerian women are 500 times prone to lose their lives in childbirth when compared to some of the advanced countries of the world (Owumi, Isiugo-Abanihe, Isamah, & Adeshina, 2002). In addition, Nigeria is rated second after India in global maternal incident rate and the worst in Africa (WHO, 2007). Thus, the occurrence of maternal mortality in Nigeria has become very worrying as every birth procedure becomes a potential incidence, leading to at least one case of maternal mortality in every 20 live births. This confrontation is directly connected to the nation's poor maternal healthcare service delivery system.

The state has an essential role to play in maternal healthcare service delivery. Ladipo (2008) observed that the Nigerian health sector is confronted with the most daunting crisis of maternal mortality, during pregnancy and post-delivery. Ladipo further noted that the Bayelsa State Government, for instance, claims to be spending about 30% to 40% of the state's available resources for healthcare at the point of need of all citizens. The social system therefore cannot function effectively in a different and better way to deliver better healthcare outcomes. It is the duty of the state to effectively address the healthcare needs, including maternal mortality, by adequately utilising the funds allocated for healthcare delivery at all cost. The state is supposed to focus on the key indicators of maternal healthcare, which is primary healthcare. However, despite the allocation of money by the federal government to state governments to tackle maternal healthcare, the reality remains that these funds are not used for the purpose for which they are meant, and as such the pending challenges with the healthcare system are still lingering (Harrison, 2009). It is therefore essential that the healthcare service delivery system at the state level should be devoid of corruption. Money budgeted for maternal healthcare service delivery is siphoned, as

well as resources that are meant to lead to effective and efficient delivery of maternal healthcare become illusive in the sector (Harrison, 2009). Primary, secondary and tertiary healthcare therefore should be replicated, most especially in the rural areas of Nigeria, to allow pregnant mothers to have access to digital technologies that will provide quality and affordable healthcare services. In Nigeria in general and Bayelsa State in particular have achieved major successes in reducing maternal mortality, emphasises child health and strengthening control of other pregnancy-related complications. These successes in some states demonstrate that goal 3 of SDGs is indeed achievable with the right application of digital technologies and adequate level of investment.

Methodology

This research employed a survey research design address the purposes of the research. Collection and analysis of primary and secondary data related to maternal health delivery service in rural communities in Bayelsa State were carried out for this research. Secondary data were collected from information available in the public domain, such as books, journals, internet, etc. The primary data were collected from key informant interview (KII) and the instrument of the questionnaire administered to rural women in the four LGAs. The research interviewed stakeholders, ranging from doctors, nurses, government officials from the Bayelsa State Ministry of Health and pregnant women. The study further collected data through the instrument of questionnaire that was administered to rural women only. The population and location of this research were women in rural areas who have experienced pregnancy or child-birth in four local government areas of Bayelsa State, because the four (4) LGAs have the highest recorded cases of maternal mortality. The data collected from the field were presented using tables and simple percentages. Descriptive statistics was used to explain and analyse the research prepositions regarding whether computer utilisation and ultrasound scanner accessibility in hospitals have contributed to maternal health delivery service.

Theoretical Framework: Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) is adopted in this research in order to understand the subject under investigation. The UTAUT according to the writings of Davit (2023), examines the acceptance of technology, determined by the effects of performance expectancy, effort expectancy, social influence and facilitating conditions.

The growth of emerging digital technologies and equipment, such as big data, Artificial Intelligence, cloud computing, robotics, computers, ultrasound scanner, blood pressure apparatus, among others, drives the implementation of new technologies in organisations including the healthcare sector (Verhoef, Broekhuizen, Bart, Bhattachanya, Fabian & Haenlein, 2021). The application of information communication technology (ICT) has drastically improved the way institutions and organisations deliver public services to consumers. The use of digital technologies in the workplace has redefined inter-and intra-organisational communication and rationalised business processes to ensure benefits, such as higher productivity, the well-being of employees and improved service delivery and the satisfaction of consumers (Venkatesh, and Davis, 2009). In order to yield such result, institutions and organisations make enormous spendings on

technologies. Digital equipment like computers and ultrasound utilisation and adoption in rural communities for maternal health service delivery are one of the core tenets of the Unified Theory of Acceptance and Use of Technology. The application of such digital equipment for healthcare service deliveries will improve service delivery and reduce/stop maternal mortality in rural Bayelsa State.

The major assumptions of UTAUT, were derived by Venkatesh et al. (2003), represents a contemporary model for understanding technology adoption. The model amalgamates key elements from eight prominent technology acceptance theories into a singular framework (however, the focus is on four assumptions). These encompass the theory of reasoned action (TRA), technology acceptance model (TAM), motivation model (MM), theory of planned behaviour (TPB), the combined TAM and TPB approach, model of PC utilisation (NPTU), innovation diffusion theory (IDT), and social cognitive theory (SCT). Through UTAUT, not only can the acceptance of information technology and systems be comprehended, but also the actual patterns of their utilisation. The UTAUT model's notable strength lies in its capacity to integrate diverse TAMs, which significantly enhances the study of technology acceptance and employment (Venkatesh et al., 2003).

UTAUT has been utilised in diverse geographical contexts to understand the role of culture in technology adoption and solidify the generalisability of the theory tenets (Gupta, Dasgupta & Gupta, 2008). The majority of the findings showed that the role of UTAUT constructs was significant, irrespective of the different in cultures. For instance, the adoption of the model in a comparative study on technology acceptance in the USA and China demonstrated the high explanatory power to the model across the two geographical settings. Thus, the application of digital technologies using the tenets of UTAUT in rural Bayelsa State will demonstrate the insight into the conditions associated with the culture which is required, such as nations' socio-economic status or norms.

In addition, UTAUT has a number of practical applications to the study. UTAUT can be used to know whether the application of digital technologies for service delivery in rural communities will yield the desired result and also to know the level of acceptance by rural women over the years. Evidence that the model can be used by healthcare providers to design a more user-oriented mechanism as well as providing the adequate and necessary equipment for maternal health delivery service.

Results and Analysis

The results and summary of the findings from the instrument of the questionnaire administered to rural women of reproductive age in four (4) local government areas and the data collected using semi-structured interviews with stakeholders in the health sector ranging from doctors, nurses, pregnant women and government officials from the Bayelsa State Ministry of Health are presented.

To establish or refute the relationship between digitisation and maternal health service delivery in rural communities, respondents were asked to respond to twelve (12) questions based on their knowledge of how the accessibility and utilisation of digital technologies in hospitals have improved maternal health service delivery in rural communities. The analysis presented key issues related to the well-being of pregnant women in rural communities. These issues include regular antenatal visits by pregnant women to a healthcare facility, the availability of computers for emergencies like caesarean sections and as well as how computer utilisation reduce time spent in hospitals for antenatal care. Other issues include whether the availability and utilisation of ultrasound scanner by pregnant women in rural communities has improve maternal healthcare service delivery. The summary of respondents' reactions is shown in table 1 and 2.

Table 1: How Computer Utilisation is associated with Maternal Health Delivery Service

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree n=367

Variables	SD (*f*-%)	D (*f*-%)	U (*f*-%)	A (*f*-%)	SA (*f*-%)	Mean	Std. Deviation
Pregnant women regularly go to a hospital for their antenatal care	1(3%)	18(4.9%)	18(4.9%)	231(62.9%)	99(27.0%)	4.114	72653
There are computers in the hospital where you go for your maternal health	4(1.1%)	4(1.1%)	12(3.3%)	159(43.3%)	188(51.2%)	4.4251	71228
Computers help to store appointments and bookings of pregnant women	0(0%)	3(8%)	5(1.4%)	165(45.0%)	194(52.9%)	4.4986	47200
Use of computers in a hospital support caesarean section for pregnant women	0(0%)	0(0%)	1(3%)	209(56.9%)	157(42.8%)	4.4251	50052
Use of computers in a hospital reduce queues for antenatal check-ups	0(0%)	1(3%)	15(4.1%)	268(73.0%)	83(22.6%)	7.1798	49624
Computers save the results of maternal health care diagnoses and medication	0(0%)	0(0%)	5(1.4%)	138(37.6%)	223(60.8%)	4.7330	2.68157
Computers reduce time spent for maternal healthcare delivery service	0(0%)	0(0%)	7(1.9%)	233(63.5%)	127(34.6%)	4.3270	50884

Computers makes maternal service delivery more effective and efficient	0(0%)	15(4.1%)	24(6.5%)	236(64.3%)	92(25.1%)	4.1035	68566
Computers aid drug prescriptions for pregnant women	0(0%)	0(0%)	19(5.2%)	139(37.9%)	209(56.9%)	4.5177	51519
Computers provide accurate pregnant women medical record	0(0%)	0(0%)	2(5%)	128(34.9%)	237(64.6%)	4.6403	49180
Computers help to store pregnancy scan and images of pregnant women	0(0%)	0(0%)	1(3%)	124(33.8%)	242(65.9%)	4.6567	48118
Computers help to save pregnant women previous medical record	0(0%)	0(0%)	1(3%)	126(34.3%)	240(65.4%)	4.6512	48292

Table 1 clearly reveals the frequency, percentage, mean, and standard deviation in order to find out how the level of computer usability in hospitals is associated with maternal health service delivery in rural communities in Bayelsa State. The result of the study shows that the majority of the respondents, 231(62.9%) agreed, and 99(27.0%) strongly agreed that pregnant women in rural communities regularly go to hospitals for their antenatal care (mean = 4.1144, std = 72653). However, 18(4.9%) of the respondents disagreed and 1(3%) strongly disagreed, and only 18(4.9%) of the respondents were not sure of their opinion. It was also revealed that most of the respondents, 188(51.2%) strongly agreed and 159(43.3%) agreed that there are computers in the hospital where they go for their maternal health delivery service (mean = 4.4251, std = 71228). On the other hand, 4(1.1%) strongly disagreed, 4(1.1%) agreed that there are no computers where they go for their maternal health delivery service; only few respondents, 12(3.3%) were not sure of their opinion.

The result of the study also revealed the that majority of the respondents, 193(52.9%), strongly agreed that the level of computer utilisation in hospitals helps to store appointments and bookings of pregnant women (mean = 4.4988, std = 47200). In addition, 165(45.0%) of the respondents also agreed with the view. However, 5(1.4%) were not sure of their opinion, 3(8%) disagreed, and none of the respondents 0(0%) strongly disagreed.

On caesarean services in hospitals, most of the respondents, 209(56.9%) agreed, and 157(42.8%) strongly agreed that the use of computers in hospitals supports caesarean service provision for pregnant women. However, while only 1(3%) of the respondents never took a decision on the opinion, none 0(0%) of the respondents either disagreed or strongly disagreed with the view. Furthermore, the result of the study also revealed that the majority of the respondents, 268(73.0%) agreed that the use of computers in hospitals reduces queues for antenatal check-ups (mean = 7.1798, std = 49624). Also, 83(22.6%) strongly agreed with the opinion. However, 15(4.1%) were not sure of the views and only 1(3%) disagreed, and none 0(0%) of the respondents strongly disagreed.

Besides, the study showed that most of the respondents, 223(60.8%), strongly agreed, corroborated by 138(37.6%), that computers in hospitals save the results of maternal health care diagnoses and medication (mean = 4.7330, std = 2.68157). While none of the respondents 0(0%) either disagreed or strongly disagreed with the view, only 5(1.4%) were not sure of the view. In terms of time spent in hospitals, most of the respondents, 233(68.5%), agreed and 127(34.6%) strongly agreed that computer usability in hospitals reduces time spent for maternal healthcare service delivery (mean = 4.43270, std = 50884). While 7(1.9%) were not certain of the view, none of the respondents 0(0%) neither disagreed nor strongly disagreed with the view. In terms of effectiveness and efficiency, 236(64.3%) which is most of the respondents, agreed that computer usability in hospitals makes maternal health service delivery more effective and efficient (mean = 4.1035, std = 68566). Similarly, 92(25.1%) of the respondents also supported the earlier view. While few of the respondents 24(6.5%) were not certain of the opinion, 15(4.1%) disagreed, and none of the respondents 0(0%) strongly disagreed.

Further results of the study clearly showed that the majority of the respondents, 209(56.9%), strongly agreed, and 139(64.3%) agreed that computer usability in hospitals aids drug prescriptions for pregnant women. While none of the respondents disagreed or strongly disagreed with the view, only 19(5.2%) of the respondents were not sure of their opinion. In terms of the accuracy of pregnant women's medical records, most of the respondents, 237(64.6%), strongly agreed and 128(34.9) also agreed of the opinion that computer usability in hospitals provides accurate pregnant womens' medical records (mean = 4.6403, std = 49180). While none of the respondents disagreed nor strongly disagreed with the view, only 2(5%) of the respondents were not sure of their opinion.

The result of the study also revealed that most of the respondents, 242(65.9%), strongly agreed that computer usability in hospitals helps to store pregnancy scans and images of pregnant women (mean = 4.6567, std = 48118). In addition, 124(33.8%) also agreed with the opinion. However, while only 1(3%) of the respondents were not sure of the view, none 0(0%) of the respondents either disagreed or strongly disagreed with the observation. Finally, on pregnant women's previous medical records, the result shows that most of the respondents, 240(56.4%), strongly agreed that computer usability in hospital helps to save pregnant women's previous medical records. Also, a number of respondents 126(34.3%) agreed with the view. Nevertheless, none of the respondents strongly disagreed or disagreed with the view, and only 1(3%) of the respondents was not certain of their opinion.

Qualitative data on the usefulness of computers in maternal health delivery are informing. One of the interviewees Ezekiel Churchill, who is a medical doctor at General Hospital Amassoma in Southern Ijaw LGA stated that:

> As a surgeon in this facility, the monitors help doctors to monitor pregnant women during surgery and labour. It will enable the doctor to know whether the patient or a pregnant woman is losing more blood as well as to know the progress of the labour. With computers, pregnant women undergoing caesarean section are properly monitored, making maternal healthcare services more effective and reliable (Ezekiel, male, 32 years).

Another respondent, Ombufa Amos, who is a nurse in the Comprehensive Primary Health Centre, Oporoma, in Southern Ijaw LGA, posited that:

> The use of computers enables healthcare providers to track pregnancy complications and recognise dangers more quickly in order to have quick interventions. Also, pregnant women can have quick access to their data. Even though there are still queues, the waiting period for pregnant women for their antenatal care has reduced drastically. Generally, with computers, healthcare services have improved (Ombufa, male, 36 years).

In addition to the above interviews and experiences of pregnant women, personal observation in the field shows that in most health care facilities visited, some medical staff have to come to the

office with their personal computers (laptops) for services. Also, staff complained that even though there are computers, they are simply not sufficient for the office, but the services provided by the available computers cannot be overemphasised. It is therefore clear that computer utilisation in hospitals is capable of improving maternal health delivery service in terms of record keeping, caesarean sections, as well as tracking pregnancy complications.

Table 2: The Nexus between Ultrasound Scanner and Maternal Health Service Delivery

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree n=367

Variables	SD (*f*-%)	D (*f*-%)	U (*f*-%)	A (*f*-%)	SA (*f*-%)	Mean	Std. Deviation
Ultrasound scanner help to check for multiple pregnancy (e.g. twins or triplets)	0(0%)	0(0%)	1(3%)	96(26.2%)	270(73.6%)	4.7330	0.44914
Use of ultrasound scanner in a hospital confirm pregnant women baby's age	0(0%)	0(0%)	1(3%)	124(33.8%)	242(65.9%)	4.6567	0.48118
Ultrasound scanner in a hospital estimate pregnant women due date of delivery	0(0%)	0(0%)	1(3%)	136(37.1%)	230(62.7%)	4.6240	0.49065
Ultrasound scanner help to check your baby's organs and other structures are developing normally	0(0%)	0(0%)	1(3%)	96(26.2%)	270(73.6%)	4.7330	0.44914
Ultrasound scanner help to confirms your baby's position in your uterus	0(0%)	0(0%)	3(8%)	84(22.9%)	380(76.3%)	4.7548	0.44944
Use of ultrasound scanner in a hospital help to check the length of your cervix	0(0%)	0(0%)	3(8%)	97(26.4%)	267(72.8%)	4.7193	0.46780
Ultrasound scanner in a hospital help to locate the location of your placenta	0(0%)	0(0%)	3(8%)	94(25.6%)	270(73.6%)	4.7275	0.46386

Use of ultrasound scanner in a hospital help to check your baby wellbeing	0(0%)	0(0%)	1(3%)	128(34.9%)	238(64.9%)	4.6458	0.48460
Use of ultrasound scanner in a hospital help to check your baby's size	0(0%)	0(0%)	1(3%)	110(30.0%)	255(69.5%)	4.7984	2.05331
Use of ultrasound scanner in a hospital help to check your baby's growth	0(0%)	0(0%)	1(3%)	94(25.6%)	272(74.1%)	4.7384	0.44626
Ultrasound scanner help to check if the pregnancy is viable i.e. to know if the baby heart is beating	0(0%)	0(0%)	1(3%)	103(26.1%)	263(71.7%)	4.7139	0.45855
Ultrasound scanner help in pregnancy complication that require caesarean section	0(0%)	0(0%)	1(3%)	92(25.1%)	274(74.7%)	4.7439	0.44330

Source: Field Work, 2023

Table 2 showed the frequency, percentage and mean to explain the relationship between ultrasound scanner utilisation in hospitals and maternal health service delivery in rural communities in Bayelsa State. The result of the study revealed that the majority of the respondents, 270(73.6), strongly agreed that ultrasound scanners help to check for multiple pregnancies e.g., twins or triplets (mean = 4.7330, std = 0.44914). In addition, 96(26.2) also agreed with the opinion. While none of the respondents 0(0%) either disagreed or strongly disagreed, only 1(3%) of the respondents was not sure about the view. In terms of the baby's age, most of the respondents, 242(65.9%), strongly agreed, and 124(33.8%) agreed that ultrasound scanner utilisation in a hospital confirms pregnant women baby's age (mean = 4.6567, std = 0.48118). However, 1(3%) was not sure of the opinion, and none neither disagreed nor strongly disagreed. On pregnant women's due date of delivery, the result showed that the majority of the respondents, 230(62.7%) strongly agreed that ultrasound scanner utilisation in hospitals estimates accurately pregnant women's due date of delivery (mean = 4.6240, std = 0.49065). Also, 136(37.1%) agreed, but 1(3%) were not sure of the view, and none either disagreed or strongly disagreed.

In terms of the pregnant women's babies' organs and other structures, the result showed that the majority of the respondents, 270(73.6), strongly agreed, corroborated by 96(26.2%) who also agreed that ultrasound scanner helps to check pregnant women's babies' organs and other structures to determine whether they are developing normally (mean = 4.7330, std = 0.44914). While none 0(0%) either disagreed or strongly disagreed, only 1(3%) was not sure of the view. The results of the study further showed that the majority of the respondents, 380(76.3%) strongly agreed, and 84(22.9%) agreed that ultrasound scanner utilisation in hospitals helps to confirm a baby's position in the uterus (mean = 4.7548, std = 0.44944). However, while none of the respondents disagreed or strongly disagreed with the view, only 3(8%) were not sure of the opinion. In terms of the length of the cervix of a pregnant woman, the results showed that most of the respondents, 267(72.8%) strongly agreed that the use of ultrasound scanner in hospitals helps to check the length of a pregnant woman's cervix (mean = 4.7193, std = 0.46780). In addition, 97(26.4%) agreed, but 3(8%) were not sure, and none of the respondents disagreed or strongly disagreed with the view.

The result of the study further revealed that the majority of the respondents, 270(73.6%), strongly agreed that the use of ultrasound scanners in hospitals helps to detect the location of the placenta in pregnant women (mean = 4.7275, std = 0.46386). This view was corroborated by some respondents, 94(25.6%), who also agreed with the opinion. While none of the respondents either agreed or strongly disagreed with the view, only 3(8%) were not sure of the view. On the baby's well-being, most of the respondents, 238(64.9%), strongly agreed, and 128(34.9%) agreed that ultrasound scanner utilisation in hospital helps to check the baby's well-being (mean = 4.6458, std = 0.48460). Yet, none disagreed nor strongly disagreed with the view, and only 1(3%) was not sure of the opinion. Also, the results of the study further revealed that most of the respondents, 255(69.5%) strongly agreed, supported by 110(30.0%) who agreed that the use of ultrasound scanners in hospitals helps to check the baby's size (mean = 4.7984, std = 2.5331). While none of the respondents 0(0%) disagreed with the view, only 1(3%) was not certain of the opinion.

In terms of the baby's growth, the results of the study further showed that most of the respondents, 272(74.1%) strongly agreed that the use of ultrasound scanners in hospitals helps to check the baby's growth (mean = 4.7384, std = 0.44626). While this was buttressed by 94(25.6%), 1(3%) was not sure, and none disagreed with the opinion. Finally, in terms of whether Caesarean section is required or not, the result of the study shows that the majority of the respondents, 274(74.7%) strongly agreed that ultrasound scanner utilisation in hospitals helps in determining pregnancy complications that require Caesarean section (mean = 4.7439, std = 0.44330). This was also supported by 92(25.1%) who also agreed with the view. While 1(3%) was not certain of the view, none disagreed or strongly disagreed with the view.

Quantitative data generated through interviews strongly complemented the results from quantitative data. For example, one of the respondents Ebi Tariere, a pregnant woman in Kolokuma LGA, in her experience, stressed that:

> Ultrasound scanners have really helped me as a pregnant mother, and they have helped my maternal health care services. For example, when I was pregnant, I did not know that I had a pregnancy with multiple babies until six (6) months later when I had a scan in the hospital. I have seen cases in this village where some women have multiple pregnancies and during delivery, the first baby will come, and the TBA will not know that there is another baby, and this has caused a lot of mother and child deaths in this community. Before now, pregnant women faced a lot of issues, but as women are enlightened with the scanner, most of those issues are not there anymore (Sinclair, female, 38 years).

Isaac Nathan, staff of the Bayelsa State Ministry of Health, further stated that:

> It is true that ultrasound scanners are not available in most of our health care facilities, especially primary health care facilities. But in some general hospitals, the scanner is provided. Also, a number of private hospitals have the scanners but it is more expensive to utilise such services. Changes in government policies also affect the availability of the machine. Like when a new government emerge, it is like going back to square one. We know the ministry has a lot to do, but the politicians are sometimes not supporting our plight. I can say that the ultrasound scanner in the available hospitals has saved so many lives (Nathaniel, male, 37 years).

Personal experience in the field also shows that in hospitals where there are no ultrasound scanners, referrals are made for such services. It was also found that when some medical doctors are posted to rural communities, they will refuse to go because of the hostile environment occasioned by activities of militants or claims that they cannot swim, and the unavailability of the necessary equipment. Thus, both qualitative and quantitative data have affirmed that usability of ultrasound scanners in hospitals has improved maternal healthcare services delivery in rural communities in Bayelsa State. It clearly shows that before the installation of ultrasound scanners, it was difficult for pregnant women to know if they had complications while pregnant; the growth and sex of the

baby were unknown, as well as whether a caesarean section was required. The ultrasound scanner, therefore, has completely changed the mode of maternal healthcare services delivery for pregnant women.

Discussion of Findings

This section mainly focuses on the discussion of findings of the research. This is done based on the objectives of this research.

Computer availability and level of utilisation

This research set to find out the level of computer usability in facilities undertaking maternal health service delivery in rural communities in Bayelsa State. Findings from this research revealed that there are computers available and being utilised in both tertiary and primary health care facilities undertaking maternal health service delivery in rural communities in Bayelsa State. However, it was noticed that even though computers have been provided, the epileptic public power supply has reduced the level of utilisation in these health centres, compared to tertiary healthcare facilities that have alternative power supply such as standby generators. But if there is an emergency, they usually put on the generator for such service. Though mini-generators are available at primary and secondary health care facilities, they are resorted to only when there are emergency cases due to cost of running these generators. Despite this limitation, computer availability and utilisation have proved critical in enhancing service delivery in rural communities. The study also revealed that most of the respondents demonstrated good knowledge of computer utilisation. However, in some primary healthcare centres, computer knowledge and utilisation were low; this was as a result of poor training of staff. Thus, providing training and continuous follow-up are necessary measures to increase the likelihood of the success of maternal health service delivery.

Electronic record keeping in hospitals for patients or pregnant women supports and improves maternal health service delivery in rural communities. The study revealed that computer utilisation in hospitals for record keeping is associated with maternal healthcare service delivery. The research revealed that when pregnant women visit the hospital for their antenatal check-ups, the movement of manual files from one place to another is a barrier to the success of maternal health service delivery. Patients' files are the principal repository for information concerning a patient's healthcare. Findings revealed that improvement in patients' record management could make major contributions to improving the healthcare system. Overall, electronic records of pregnant women have improved maternal health service delivery by providing medical personnel with accessible data, faster retrieval, higher quality, and more versatility in data display. It is pertinent at this juncture to state that electronic record keeping increases hospital efficiency by reducing costs and improving staff productivity, and this typifies improvement in maternal health service delivery in rural communities.

Findings in this study also revealed that computer utilisation in hospitals reduces queues for antenatal check-ups by pregnant women in rural communities, and this has improved maternal health service delivery. Time spent as a patient waits in the clinic before being attended to by one of the hospital medical staffs for antenatal check-ups is a major disincentive for pregnant women

and constitutes a barrier to the utilisation of antenatal care. It is therefore necessary to state that computer availability and utilisation in a hospital have improved maternal health service delivery by reducing the waiting time for pregnant women for their antenatal check-ups in rural communities of Bayelsa State.

This finding is also in line with Amanda and Schinkel (2020), who posited that long waiting times in hospitals for pregnant women and poor patients' satisfaction contribute to poor utilisation of antenatal check-ups. It is therefore necessary to state that computer availability and utilisation in a hospital have improved maternal health service delivery by reducing the waiting time for pregnant women for their antenatal check-ups in rural communities of Bayelsa State. In addition, the theory adopted, UTAUT and its application typifies that, the application of digital technologies for maternal healthcare delivery service improve service and reduce maternal mortality, which is one of the core tenets of the UTAUT.

Ultrasound Scanner Availability and Use for Maternal Health Service Delivery

This research in addition was to investigate the effect of ultrasound scanner use on maternal health service delivery in rural communities in Bayelsa State. The study found that in rural communities, especially in the primary healthcare centers, there are no ultrasound scanners. However, they are available only in tertiary and private hospitals in rural Bayelsa, e.g. Federal Medical Centre (FMC) Yenagoa and Niger Delta Teaching Hospital, Okolobiri. Ultrasound scanner utilisation by rural women is only available through referrals in these hospitals. The findings of the study showed that ultrasound scanner use has improved maternal health service delivery in rural communities in Bayelsa State. This is by way of providing scan results related to multiple pregnancies as well as the baby's development. Ultrasound scanner utilisation has also enabled early determination for cesarean sections on pregnant women in Bayelsa State. In Southern Ijaw Local Government Area, over 79% of pregnant women had benefited from these services traced to ultrasound scanner use. All these services exemplify the fact that ultrasound scanner utilisation has improved maternal health service delivery in rural communities in Bayelsa State.

Further findings revealed that inaccurate expected date of delivery has adverse effects on the health and safety of pregnant women and foetuses. This has been addressed with the improved use of ultrasound scanner. Without this service, it was always difficult for pregnant women to plan for delivery when the date is unknown. But when the expected date of delivery is known, it will enable pregnant women to prepare for delivery, including moving close to a healthcare facility. These services are provided in General Hospital Odi, General Hospital Nembe and Redeemer Hospital Sagbama. In the case of referrals, Federal Medical Centre, Yenagoa, General Hospital Okolobiri, and General Hospital Amassoma also provide these services to rural women in Bayelsa State. This also typifies the relevance of ultrasound scanner in the health sector and to pregnant women in the delivery of maternal healthcare.

This research was predicated on two basic assumptions, which are (1) the research presupposes that computer usability in hospitals contributes to maternal healthcare delivery service in rural areas in terms of electronic record keeping for pregnant women and (2) ultrasound sound scanner accessibility in hospital provides pregnancy scan results related to complications. Findings revealed that computers utilisation in hospitals by pregnant women in rural communities contribute significantly to maternal healthcare delivery service. This is in the area of electronic record-keeping, and this has reduced the time spent by pregnant woman to be attended to by a healthcare personnel. Computers (monitors) aid caesarean section for emergencies and this also have reduced maternal mortality by saving the lives of mother and child. On the other hand, pregnancy scan results provided by ultrasound scanners in times of emergencies in hospitals reduced maternal deaths in rural areas. Ultrasound scanners check for multiple pregnancy (e.g. twins or triplets), the age, position, structure and the well-being of the baby in the uterus, as well help to identify pregnancy complications that require caesarean section. All these exemplify the assertion that computers and ultrasound availability and utilisation in hospital contributes to maternal healthcare delivery service in rural areas.

Conclusion and Recommendations

This research aimed to find out how digital technologies through computer utilisation and ultrasound scanner usability in hospitals has improved healthcare delivery service in rural communities in Bayelsa State. Based on the quantitative and qualitative analysis, there is a high possibility that the digitisation of maternal healthcare in rural communities has the capacity to improve and contribute to maternal health care delivery service in rural communities. Despite the difficult, hard-to-reach or riverine terrain, inadequate public power supply, and insufficient health care infrastructures in the state, there is a huge promise that adequate government funding on maternal healthcare will enable or support the provision of digital technologies in rural communities to improve maternal healthcare delivery service and reduce maternal mortality in order to save mothers and children. At this juncture, the following recommendations are essential to deepen the digitisation of maternal healthcare service delivery. Local government councils and the Bayelsa State Government to jointly provide digital equipment like computers in rural healthcare facilities to improve the maternal healthcare services delivery. Health care providers, NGOs, and the Bayelsa State Government are to properly educate and enlighten rural women on the benefits of utilising ultrasound scanner for their regular antenatal check-ups. And finally, the Bayelsa State Government to consider and invest in digitalising maternal healthcare in difficult riverine terrains or hard-to-reach communities for quick and timely accessibility of maternal healthcare services.

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