

Information, Communication and Technology Intervention on Utilization of Maternal and Child Health Care in Okigwe Health District Imo State, Nigeria.

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Abstract:

This study examined (ICT) intervention effects on improving pregnant and nursing women's use of maternal and child health care in Okigwe Health District, Imo State. This is a quasi-experimental study, 276 pregnant and nursing women were enrolled in this study. Participants were assigned to the treatment and control groups. Participants in the intervention/treatment group (T-group) received the ICT intervention provided by public health experts and nurses and participants in the control group (C-group) received health talk on visiting days without the intervention. A questionnaire based on the literature titled maternal and child health service utilization questionnaire (MCHUQ) was used to collect data on participants' demographic characteristics (age, occupation, and level of education), and measure the utilization of MCH among pregnant and nursing women. A pilot study was conducted to assess the construct validity of the 20-items questionnaire and a reliability index of 0.78 was obtained using Cronbach Alpha statistics. Data collected at baseline (before intervention) and 12 weeks (3rd month) included demographic variables, use of antenatal care (ANC), post natal (PNC), immunization (IMM), and family planning (FPLAN) services. Pretest was given using the questionnaire before the commencement of the experiment. At the end of 3 months, a post test was given to ascertain the effects of ICT intervention on Utilization of MCH in Okigwe, Imo State. Frequency, percentages, means, ANOVA, Chi-square test, McNemars statistics and paired t-test were used for data analyses. The results showed that the use of ANC, PNC, IMM, and FPLAN increased in the T-group between baseline and (3rd month) post-intervention compared to those in the C-group among others. A significant difference exists in the use of MCH services based on education and occupation while no significant difference exists based on age of the women. Further findings revealed that certain challenges constrained the use of ICT devices which include Network problems/connectivity (70.7%), High cost of ICT devices (52.4%), high cost of data (83.5%), Low level of awareness (60.4%), and Poor saving ability (61.9%) among others. This study thus recommended that there should be reduction of the service tariff and the cost of cell phone, and ICT centers should be established in these areas for women to acquire practical computer training for the enhancement of mobile phone use among others.

Background:

Pregnancy and childbirth has been the leading cause of maternal and neonatal/child death worldwide especially in Sub-Saharan Africa. World Health Organization [WHO] (2014) estimated that about 250 million pregnancies occurred worldwide and this has resulted in millions of death of women and children. Therefore, to improve the health of women, sources through which they receive information on the important and urgency of using health care services should be improved. Hence, the introduction of ICT in health service delivery becomes imperative. However, evidence shows that there is low use of antenatal care, postnatal, care immunization services and family planning services among pregnant and nursing mothers. It is therefore imperative to analyze the effectiveness of ICT intervention in improving the use of maternal and child health care (MCH) services among pregnant and nursing women in Okigwe Health District in Imo State.

Materials and Methods: This study was a quasi-experimental conducted from April to July 2020 in Okigwe, Imo State. The estimated population was 2,275 pregnant and nursing women registered at the health centers in Okigwe Health District. The local government has 9 health wards. This quasi-experimental study was aimed at assessing the effectiveness of ICT intervention in increasing the utilization of MCH among pregnant and nursing women. The sample comprised 276 pregnant and nursing women. Convenience sampling was used to select the study subjects. A questionnaire based on the literature titled maternal and child health service utilization questionnaire was used to collect data on participants' demographic characteristics (age, occupation, and level

of education), and measure the utilization of MCH among pregnant and nursing women. A pilot study was conducted to assess the construct validity of the 20-item questionnaire and a reliability index of 0.78 was obtained. The analyses were performed with the use of Special Package for Social Sciences (SPSS) 20.0. At the end of post intervention, data were collected for the post test, 273 respondents were used for data analyses. Data were analyzed according to the test measure. The use of ANC was measured using mean, standard deviation and paired t-test while the use of PNC, Immunization, Family Planning were analyzed using frequency and percentages and McNemars statistics. Challenges of use of ICT was measured using frequency and percentages. The demographic characteristics were tested using ANOVA for continuous variables and chi-square for categorical variables at 0.05 level of significance.

Results: The use of ANC, PNC, IMM, and FPLAN increased in the T-group between baseline and (3rd month) post-intervention compared to those in the C-group among others. A significant difference exists in the use of MCH services based on education and occupation while no significant difference exists based on age of the women. Further findings revealed that certain challenges constrained the use of ICT devices which include Network problems/connectivity (70.7%), High cost of ICT devices (52.4%), high cost of data (83.5%), Low level of awareness (60.4%), and Poor saving ability(61.9%) among others. (10)

Conclusion: Generally, findings of this study provided evidence for the efficacy of m-Health intervention in pregnant and nursing women use of MCH. Hence, the following recommendations were made that more ICT or m-health intervention/programme targeted at others should be organized to increase use of some other health services and research is needed to develop m-health interventions and increase knowledge about health protection, prevention and promotion behaviours among Nigerian women.

Key Word: Information and Communication Technology ICT, m-Health, Maternal and child health care, Ante-natal care, Post natal care, Immunization, Family planning.

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I. Introduction

Pregnancy and childbirth has been the leading cause of maternal and neonatal/child death worldwide especially in Sub-Saharan Africa. World Health Organization [WHO] (2014) estimated that about 250 million pregnancies occurred worldwide and this has resulted in millions of death of women and children. WHO (2014) also estimated that approximately 830 women die every day due to pregnancy related conditions and child birth. United Nations Children Fund [UNICEF] (2015) estimate showed that Nigeria loses about 145 childbearing mothers' every single day due to pregnancy and pregnancy related conditions. Adewole (2017) lamented that while Nigeria contributed only 2.4 percent to the global population, it also contributes 14 per cent of the global burden of maternal mortality. Mortality in women and neonate has shown little decline due to the progress of Millennium Development Goals (MDGs) 4 and 5 (United Nation, 2015). However, this little progress falls short of expectation because it still account for 97 per cent maternal and 94 per cent neonatal mortality (UNICEF, 2015). This situation could be attributed to the availability, quality and utilization of Maternal and child health care (MCH). Say and Raine (2007), and Wolf, Joh and Lorzonem (2013) reported that unavailability and low use of MCH have contributed to women's death from preventable causes. Azubuike (2014) reported that low use of MCH is attributed to the unavailability and inaccessibility of these services. Ransom and Graham (2006) opined that the death of women is compounded by limited resources and lack of information which acts as barrier to access and use of health services. Azubuike (2019) stated that lack of health education or health information is among the barriers to effective utilization of family planning services. Therefore, to improve the health of women, sources through which they receive information on the important and urgency of using health care services should be improved. Hence, the introduction of ICT in health service delivery is imperative.

The application of Information and Communication Technology (ICT) in health services is a welcome phenomenon in the health care system. ICT is a diverse set of technological tools and resources to create, disseminate, store, bring value addition and manage information (Urwin, 2009). The use of ICT to facilitate health service use is widely accepted in developing countries and Nigeria too has also engaged in adopting ICT in health care facilities (Oyeyemi & Wynn, 2014). WHO and Federal Ministry of Health (FMH) in Nigeria (2011a) recommended the use of ICT in MCH information to improve health outcomes in Nigeria and other developing countries. Hence, use of ICT to deliver health education information can help to mitigate the problems accruing from low use of MCH (Anyoha, Chikaire, Godson, Ogueri, & Utazi, 2018).

Studies on the use of ICT to improve health care showed that it has the potential to overcome inadequacies of health infrastructure, improve access to quality information and services (Atnafu, Otto, & Herbst, 2017; Murthy et al., 2019; Obasola, & Mabawonku, 2016). These studies have shown that ICT has positive impacts on rural livelihoods through vital health information or education. UN Women (2002) stated that ICT do play important roles in disseminating a wide range of information and advice leading to health knowledge and

attitude change among rural communities. Anyaoha et al. (2018) stated that ICT helps in supporting rural communities to acquire new skills and also in creating new job opportunities in the community. This therefore implies that ICT helps to disseminate health information or education. Health information or education is a critical factor that has mattered in healthcare practices and in use of health services. These can be done on a mobile ICT otherwise called mobile health or mHealth.

mHealth refers to the use of wireless, portable information, communication and technology to support health care (Isterparus, 2005). It refers to the use of ICT to support all health and health related field including healthcare services, health surveillance, health literature, and health education, knowledge and research (United Nation Foundation, 2014; WHO, 2016; International Communication Union, 2016). This therefore means that mHealth can be used in all health care service delivery for every population. Numerous mHealth interventions are used to support mothers through safe delivery and to facilitate neonatal and infant health (Lee et al., 2016). WHO (2016) recognized that mHealth is playing important role in the light of continuing health needs and growing global penetration of mobile technologies. mHealth has created an avenue to collaborate, interact and disseminate information in a fast pace which has brought a greater impact on the society. mHealth helps pregnant and nursing mother to access and receive information through hotlines direct messages or smart phone application to improve uptake of MCH (Lund et al., 2014). It has also enabled individuals who do not normally engage in health activities to do so. These mobile deliveries include calling, voice over internet protocol (VoIP), text messaging via short message services (SMS), transfer of still or moving vision/images through multimedia messages services (mms), multimedia download, and live video. These are used to send health information, messages or alerts on maternal and child health care services, text messages, antenatal alert, reminder for taking routine drugs and personal cleanliness, health messages through Whatsapp and FaceBook. However, recently, this technology has emerged for use in the maternal and child health (MCH) program with different feelings and attitude towards it (Aleke, Ekine & Nkwoka, 2018; Olok, Yogas, & Ovuga, 2015), but the available evidence on its effect on MCH are very limited especially in Nigeria and Imo State in particular. Hence, this study assessed the effects of ICT/mhealth intervention delivered through mobile or smart phone on the use of MCH among pregnant and nursing women. Hence, in this study, mHealth and ICT are used interchangeably.

Maternal and Child Health (MCH) care is the most cost effective intervention of the primary health care to prevent maternal and child mortality and to improve the health of mothers and their children. Pregnancy and childbearing is a joyful thing in the society which every woman is expected to go through, though it is associated with a lot of complications which may cause morbidities and mortalities. MCH is one of the greatest achievements of public health care in Nigeria which provides dramatic improvement in the health of mothers and children and also improves their standard of living generally. Society for Family Health (SFH, 2015) stated that MCH is a human right and since its inception in 1990, it has recorded some progress at reducing maternal and child mortality. Through MCH, Nigerian maternal mortality ratio has dropped from 1200 deaths in 1990 to 540 deaths in 2013 per 100,000 live births, similarly child mortality ratio dropped from 191 deaths in 1990 to 94 deaths in 2012 per 100 live births (SFH, 2015). However, despite these achievements, Nigeria is still ranked as one of the highest in maternal and child mortality (Family Care International, 2001; Society for Family Health, 2015). Children all over the world also experience some childhood diseases and complications immediately after birth and through the period of their lives especially the under five children. These complications according to Ayele, Aleyihun, Teji, and Ayana (2014) are very dangerous to their health and wellbeing. For the mothers, these complications range from hemorrhage complications, infections, unsafe abortions, hypertension to obstructed labour, and for the children of under 5 age are diarrhea and acute respiratory infections. Chronic malnutrition among all children under five is still very high (39%) and micronutrient deficiency is widespread (WHO, 2017b). These complications can come anytime hence immediate care and attention should be given to these women to ward off these emergencies, this is why MCH has come to stay to save life and to improve both the health of mothers and children. WHO (2011b) defined MCH as an aspect of modern health services specifically designed for women of childbearing age and children especially the under-five years for the promotion of their health. Azubuike (2014) in a study on the extent of utilization of maternal and child health care services in Okigwe local government areas revealed that most of these services being available are not accessible to the communities especially the rural area and hence not effectively utilized. This is attributed to the distance to the health facilities, bad road network and transportation fare as well as lack of availability of the necessary materials and equipment needed. Hence, this study wants to find out if the use of mobile phone will increase or improve the use of these MCH services. Some MCH services investigated in this study are antenatal care, post-natal care, immunization service and family planning services.

Antenatal care (ANC) is a health service rendered to women during the period of pregnancy (Azubuike, 2014). Every pregnant woman is expected to attend antenatal care in order to benefit from the services. National Population Commission (NPC, 2004) asserted that it is a care for effective prevention of negative pregnancy outcomes when it is sought early in pregnancy and continued to time of delivery. ANC has been found to be relatively effective in reducing maternal and child mortality and morbidity. Babalola and Fatusi (2009) affirmed

that ANC gives opportunity for providing health care services such as prophylactic treatment of malaria and immunization against neonatal tetanus. It is during ANC that a pregnant woman is given adequate care, attention and education needed throughout the period of pregnancy. Yet there is poor access and use these services. Post natal care (PNC) is the service rendered from the moment a baby is born till after six weeks when the woman and the child is strong enough. Adamu (2011) defined post-natal care as a care given to mothers during post partum period (from the first day after delivery up to six weeks). Adamu (2011) asserted that most of the maternal complications occur during the period after delivery therefore women should be given proper attention immediately after delivery. Such complications are hemorrhage, infections, and hypertensive disorders. During this period mothers are closely watched for early dictation of signs of complications. Advice is also given on their hygiene, exclusive breastfeeding, food preparation and weaning. Immunization service is an activity aimed at protecting the mother and child against infectious diseases. Onuzulike (2008) defined immunization as a deliberate stimulation of the body against specific harmful germs and bacteria. This activity is very important because it guides the body of the baby and the mother against diseases. WHO (2007) defined immunization as a process whereby a persons immune system is made to be resistant to an infectious disease by administration of a vaccine. These vaccines stimulate the body's immune system to protect the person against subsequent infections and diseases. Hence, the children at this stage needs to be immunized against mumps, polio, hepatitis, diphtheria, cerebrospinal meningitis among others. Family planning is aimed at preventing and reducing pregnancy. WHO (2016) defined family planning as an aspect of maternal health services aimed at reducing maternal morbidity and mortality associated with unwanted pregnancies and unsafe abortions. The author stated that unwanted pregnancies and unsafe abortion have continued to be major reproductive health problems globally and in Africa. Hence, there is need for mothers to access and utilize family planning effectively. The objectives of these services are to encourage couples to take responsible decision about pregnancy and enable them to achieve their wishes with regards to preventing pregnancies and limiting the size of the family. There are some demographic variables that may affect the use of these services, they include education, occupation and age f pregnant and nursing women. These services according to some researchers have shown significant influence on the use of health care services (Adamu, 2011; Ajaegbu; 2013; Azubuike, 2014; Azubuike, 2019, Magadi, Aqwande & Obare, 2007; Obasola, & Mabawonku, 2016; Felicie et al., 2016) who discovered a significant difference in the level of education on the use of maternal and child care services.

Studies revealed that the effective use of MCH can improve the health of mothers and their children hence will decrease maternal and child mortality (Adamu, 2011; Oyeyemi, & Wynn, 2014). There are poor health outcomes amd complications in not using the MCH services which include unplanned pregnancies, unsafe abortion, induced abortion, miscarriages hemorrhage etc (Adamu, 2011; WHO, 2012. Azubuike, 2014). However, evidence shows that there is low use of antenatal care, postnatal, care Immunization services and family planning services among pregnant and nursing mothers (Navaneetham & Dhamalingam, 2000; Nwogu, 2001; Ajaegbu, 2013; Baba, Kaul & Heena, 2013). Interestingly, it has been proved that effective intervention through the use of ICT/mHealth increased the use of MCH and other health services in developed countries (Jarusheen et al., 2008; Parmar, 2010; Sharma et al., 2011; Mcqueen et al., 2012). The effect of this is still insignificant in Nigeria which could be attributed to some challenges or factors (Ajaegu, 2013. Nigusie, Mokgattle, & Oguntibeji, 2010; Kamal, 2009; Mekonen & Mekonen, 2009). It is therefore imperative to analyze the effectiveness of ICT/mHealth intervention in improving the use of MCH services among pregnant and nursing women in Okigwe Health District in Imo State. To the best of the researchers' knowledge, no related community based ICT intervention work has been done in this part of Imo State, Nigeria. Hence, it is assumed that a well prepared ICT/mHealth intervention exercise can increase the use MCH services among the treatment group. Hence, the following research questions guided the study:

1. What is the effect of ICT intervention on the use of antennal services among pregnant and nursing women?
2. What is the effect of ICT intervention on the use of PNC among pregnant and nursing women?
3. What is the effect of ICT intervention on the use of IMM among pregnant and nursing women?
4. What is the effect of ICT intervention on the use of FPLAN among pregnant and nursing women?
5. What are the challenges facing the use of mHealth among pregnant and nursing women?

Hypotheses

1. There is no significant effect of ICT intervention on the use of MCH services among pregnant and nursing women

2. There is no significant difference in the use of MCH based on educational level of pregnant and nursing women
3. There is no significant difference in the use of MCH based on occupation of pregnant and nursing women
4. There is no significant difference in the use of MCH based on age of pregnant and nursing women

II. Material And Methods

This study was a quasi-experiment conducted from April to July 2020 in Okigwe, Imo State. The estimated population was 2,275 pregnant and nursing women registered at the health centers in Okigwe Health District. The local government has 9 health wards.

Study Design Quasi-experimental research design

Study Location: Health centers in Okigwe Health District, Imo State Nigeria.

Study Duration: April to July 2020.

Sample size: 276 pregnant and nursing women.

Sample size calculation: Women that registered for antenatal and postnatal care services.

Subjects & selection method: Convenience sampling was used to select the study subjects. A consent letter was given to the women in all the wards and 276 consented to partake in the study. For the experimental and control group, the criterion for selection was possession of mobile or smart phone, those in possession of mobile phone were categorized as the experimental or intervention group while those without phone at all were used as the control group. This was done to enhance representativeness and a total of 103 pregnant and 173 nursing women participated in the study. Subsequently, 201 subjects became the experimental group ($n_1=201$), and 75 control group ($n_2=75$). Therefore, the treatment groups were 80 pregnant and 121 nursing women and the control group consisted of 22 pregnant and 53 nursing women.

Procedure methodology

Health personnel and nurses were requested to inform pregnant and nursing women about the study, and the purpose of the study, the date for the onset of the study was agreed upon. They agreed on the antenatal and immunization days. The health personnel that participated in the study were trained by ICT experts on how to use mobile phone and its facilities to disseminate health information like Whatsapp, face book, send messages for two weeks before the commencement of the experiment. The health personnel however agreed to be part of the study especially in the use of mobile or smart phone. For those without mobile or smart phone, were encouraged to get one and supported financially and their data were funded for. A pretest was conducted on the use of MCH using a questionnaire before the onset of the intervention. A questionnaire based on the literature titled maternal and child health service utilization questionnaire was used to collect data on participants' demographic characteristics (age, occupation, and level of education), and measure the utilization of MCH among pregnant and nursing women. A pilot study was conducted to assess the construct validity of the 20-item questionnaire and a reliability index of 0.78 was obtained.

The health education messages were developed by the team of health experts. These health messages and jingles were sent to the health personnel who used it to educate the pregnant and nursing women. The health messages were specific health programmes, antenatal message alert, emergency message alert, taking supplementary drug alert, expected day of delivery alert, health care messages alert. The intervention lasted for 12 weeks. The contents of messages used for the intervention were guided by the previous studies (Oyeyemi, and Wynn, 2014; Simoyan et al., 2013; Lund et al., 2014; Lee et al., 2016). On the day of the antenatal and immunization, participants were given opportunity to ask questions. Also, the control group received health talk during antenatal and immunization visits. Light refreshments (snacks and soft drinks) were given to the participants at the end of each visitation. The utilization of MCH was evaluated at the end of the intervention. Five health education experts with three nurses in Okigwe LGA facilitated the baseline and post-intervention data collection process. The baseline and post-intervention data were collected under the supervision of the investigators. Demographic variables were assessed, these included age (15-25, 26-35, 36-45, 46-above), level of education (primary, secondary, tertiary education or its equivalent) and occupation (civil service, self employed, unemployed). The study investigated the use of antenatal care, post natal care, Immunization care and family service, delivery care was not investigated because those recruited will not be due for delivery within the intervention period.

The antenatal care used was measured using a 6-item scale with a four-point Likert scale of always, frequently, rarely, and often. The 6 options include attending antenatal center, testing blood and urine, checking weight and sugar level, treatment of minor ailments, palpitation, and checking blood pressure (Azubuike, 2014). The extent of use of ANC was determined where mean less than 2.5 indicates low use of ANC at both pre-intervention and post intervention phases.

The post natal care use was measured using a 5-item scale with a Yes/No scale format. The 5 options include attending six weeks checkup, use of contraceptives, treatment of minor ailments, baby examination and immunization, vitamins supplementation. The use of PNC was determined using less than 50% to indicate low use of PNC at both pre-intervention and post intervention phases.

The use of immunization services was measured using an 8-item list of vaccines given at the immunization centers with a Yes and No response format. They include Bacillus Calmatte Guarrine (BCG), Tetanus Toxoid (TT), Diphtheria, Pertusis and Tetanus (DPT), Measles, Cerebrospinal Meningitis (CSM), Hepatitis Vaccine (Hpv), Oral Polio Vaccine (OPV), Yellow Fever Vaccine. 50% and above indicated high use of Immunization services.

The use of family planning was measured using 7-item list of modern contraceptives with a Yes or No response format. They include use of pills, injectable, female condom, male condom, intra uterine devices (IUD), female sterilization, and implants. The 50% response and above indicates high use of contraceptives.

The responses on challenges of use of ICT in MCH using 10-item questions. They include network problems/connectivity, high cost of ICT devices, widespread illiteracy, low level of awareness, poor saving ability, insufficient income, technical/training problems, cultural norms and belief, restricted socialization of women and lack of knowledge of use. The 50% response and above indicated agreement.

Statistical analysis

The analyses were performed with the use of Special Package for Social Science (SPSS) 20.0. At the end of post intervention, data were collected for the post test, 273 respondents were used for data analyses. Data were analyzed according to the test measure. The use of ANC was measured using mean, standard deviation and paired t-test while the use of PNC, Immunization, Family Planning were analyzed using frequency and percentages and McNemars statistics. Challenges of use of ICT were measured using frequency and percentages. The demographic characteristics were tested using ANOVA for continuous variables and chi-square for categorical variables at 0.05 level of significance.

III. Result

I. Effect of ICT/mHealth intervention on use of ANC

Time	ANC	Baseline	After Intervention	df	t	Sig	Decision
Experimental Group n=80	Attendance	1.98±0.59	2.76±0.48	120	14.17	0.000	Sig
	Testing of blood and urine	1.58±0.59	2.67±0.59				
	Checking weight and sugar level	1.60±0.49	2.59±0.59				
	Treatment of minor ailment	2.05±0.74	2.61±0.51				
	Palpitation	2.05±0.67	2.57±0.61				
	Checking blood pressure	1.98±0.64	2.87±0.71				
	Cluster mean	1.87±0.59	2.67±0.61				
Control Group n=21	Attendance	1.16±0.62	1.57±0.71	120	0.535	0.886	Not sig
	testing of blood and urine	2.00±0.00	2.02±0.48				
	checking weight and sugar level	1.52±0.51	1.82±0.70				
	treatment of minor ailment	2.32±0.48	2.14±0.50				
	Palpitation	1.68±0.48	1.28±0.48				
	checking blood pressure	1.97±0.41	2.10±0.40				
	Cluster mean	1.78 ±0.62	1.82±0.54				
Mean gain	Cluster mean	0.80	0.04				

Data in table 1 show that the mean and standard deviation of experimental group is 1.87±0.59 at the baseline, and 2.67±0.61 after the intervention while the control group has 1.78 ±0.62 at the baseline and 1.82±0.54 after the intervention. Hence, at the baseline the mean of the use of ANC was low for both the experimental and the control. However after the intervention, the experimental has a mean of 2.67 which is greater than the criterion mean of 2.5. Table further shows that there is a significant effect (p=0.000>0.05) of the intervention in the experimental group while in the control group, there is no significant effect (p=0.886>0.05) of intervention on the use of ANC among the pregnant women.

Table 2 Effect of ICT/mHealth intervention on the use of PNC

	Postnatal Care	Baseline		After Intervention		Sig	Decision
		Yes f (%)	No f (%)	Yes f (%)	No f (%)		
Experimental n=121	Postpartum Checkup	56(46.3)	65(53.7)	18(35.3)	33(64.7)	0.000	Sig
	Contraceptive use	23(19.0)	98(81.0)	12(23.5)	39(76.5)		
	Treatment of minor ailment	67(55.4)	54(44.6)	27(54.9)	24(45.1)		
	Baby examination	87(71.9)	34(28.1)	29(56.9)	22(43.1)		
	Immunization	68(56.2)	53(43.8)	32(62.8)	19(37.2)		
	Vitamin supplementation	26(21.5)	95(78.5)	13(25.5)	38(74.5)		
	Cluster %	45.1	54.9	44.2	55.8	0.278	Not sig
Control n=51	Postpartum Checkup	96(79.3)	25(20.7)	18(35.3)	33(64.7)		
	Contraceptive use	46(38.0)	75(62.0)	13(25.5)	38(74.5)		
	Treatment of minor ailment	78(64.5)	43(35.5)	27(54.9)	24(45.1)		
	Baby examination	102(84.3)	19(15.7)	29(56.9)	22(43.1)		
	Immunization	118(97.5)	3(2.5)	35(68.6)	16(31.4)		
	Vitamin supplementation	58(47.9)	63(52.1)	13(25.5)	38(74.5)		
		Cluster %	68.6	31.4	44.5	55.5	

Data in table 2 show that the percentage use of the PNC at the base line is 45.1 and 44.2 percent which indicate low utilization for the experimental and the control group respectively. From all indications, the percentage use of PNC both for the experimental and the control group seems the same with little difference. However, after the ICT intervention the percentage use of the experimental group is 68.6 percent which is higher than 50% indicating high utilization while that of the control shows 44.5 per cent low utilization. The table also shows no significant difference ($p=0.278>0.05$) in the control group but a significant difference ($p=0.000<0.05$) in the experimental group. The table therefore shows that ICT intervention has effect on the use of PNC and the effect is significant.

Table 3 Effects of ICT/mHealth intervention on the use of IMM services

	Immunization	Baseline		After Intervention		Sig	Decision	
		Yes f (%)	No f (%)	Yes f (%)	No f (%)			
Experiment n=121	BCG	115(95.0)	6(5.0)	47(92.2)	4(7.8)	0.000	Sig	
	TT	48(39.7)	73(60.3)	23(45.1)	28(54.9)			
	DPT	112(92.6)	9(7.4)	48(94.1)	3(5.9)			
	MEASLE	115(95.0)	6(5.0)	48(94.1)	3(5.9)			
	CSM	46(38.0)	75(62.0)	21(41.2)	30(58.8)			
	HPV	48(39.7)	73(60.3)	23(45.1)	28(54.9)			
	OPV	120(99.2)	1(0.8)	49(96.1)	2(3.9)			
	YFV	87(71.9)	34(28.1)	35(68.6)	16(31.4)			
		Cluster %	71.4	28.6	72.1			27.9
	Control n=51	BCG	121(100.0)	0(0.0)	47(92.2)			4(7.8)
TT		63(52.0)	58(48.0)	25(49.0)	26(51.0)			
DPT		121(100.0)	0(0.0)	48(94.1)	3(5.9)			
MEASLE		120(99.8)	1(0.8)	48(94.1)	3(5.9)			
CSM		67(53.4)	54(46.6)	21(41.2)	30(58.8)			
HPV		56(46.28)	65(53.7)	23(45.1)	28(54.9)			
OPV		121(100.0)	0(0.0)	49(96.1)	2(3.9)			
YFV		98(81.0)	23(19.0)	35(68.6)	16(31.4)			
		Cluster %	79.1	20.9	72.6	27.4		

Data in table 4 shows that the percentage of experimental group is 71.4 percent at the baseline, and 79.1 per cent after the intervention while the control group has 72.1 per cent at the baseline and 72.6 per cent after the intervention. Both groups show high utilization of IMM at the baseline, however after the intervention, there is still increase in the experimental group than in the control group. Table further shows no significant effect ($p=0.732>0.05$) in the control group but a significant effect ($p=0.000<0.05$) exists in the experimental group. Thus indicating that ICT intervention has effect on the use of IMM among women and the effect is significant.

Table 4 Effects of mHealth on the use of FPLAN services

	FPLAN	Baseline		After intervention		Sig	Deci
		Yes f(%)	No f(%)	Yes f(%)	No f(%)		
Experimental n=121	Pills	48(39.7)	7360.3	65(53.7)	5646.3	0.000	Sig
	Injectable	24(19.8)	9780.2	36(29.8)	8570.3		
	Female condom	2(1.7)	11998.3	2(1.7)	11998.3		
	IUD	4(3.3)	11796.7	7(5.7)	11494.3		
	Female sterilization	0(0.0)	1210.0	0(0.0)	1000.0		
	Implant	24(19.8)	9798.3	53(43.8)	6856.2		
	Cluster %	14.1	85.9	22.5	77.5		
Control n=51	Pills	12(23.5)	3976.5	12(23.5)	3976.5	0.086	Not sig
	Injectable	15(29.4)	3670.6	16(31.4)	3568.6		
	Female condom	0(0.0)	1000.0	0(0.0)	1000.0		
	IUD	2(3.9)	4996.1	2(3.9)	4996.1		
	Female sterilization	0(0.0)	1000.0	0(0.0)	1000.0		
	Implant	15(29.4)	3670.6	15(29.4)	3670.6		
	Cluster %	14.4	85.6	14.7	85.3		

Data in table 4 shows that the percentage of experimental group is 14.1 per cent at the baseline, and 22.5 per cent after the intervention while the control group has 14.4 per cent at the baseline and 14.7 per cent after the intervention. The result shows that there is low use of FPLAN for the experimental and control group both at the baseline and after intervention. However after the intervention the experimental group has 22.5 per cent. Table also shows no significant difference ($p=0.086>0.05$) in the control group but a significant difference ($p=0.000<0.05$) in the experimental group. This therefore means that the ICT intervention has significant effect on the use of FPLAN among nursing women.

Table 5 Challenges Facing the Use of mHealth or Mobile Phone for MCH Services

S/N	Items statement	N=273	
		Yes f(%)	No f(%)
1	Network problems/connectivity	193(70.7)	80(29.3)
2	High cost of ICT devices	143(52.4)	130(47.6)
3	High cost of data	228(83.5)	45(16.5)
4	Low level of awareness	165(60.4)	108(39.6)
5	Poor saving ability	169(61.9)	104(38.1)
6	Insufficient income	221(81.0)	52(19.0)
7	Technical/training problems	152(55.7)	121(44.3)
8	Cultural norms and belief	53(19.4)	220(80.6)
9	Restricted socialization of women	101(37.0)	172(63.0)
10	Lack of knowledge of use.	86(31.5)	187(68.5)

Data in table 5 show the challenges hindering the use of ICT in maternal and child care. These challenges are as follows: network problems/connectivity (70.7%), high cost of ICT devices(52.4%), high cost of data (83.5%), low level of awareness(60.4%), poor saving ability(61.9%), insufficient income(81.0%), technical/training problems(55.7%), cultural norms and belief(19.4%), restricted socialization of women (37.0%), and lack of knowledge of use (31.5%).

Table 6 Use of ANC based on Level of Education

		ANOVA Table			F	Sig.
		Sum of Squares	Df	Mean Square		
Attendance	Between Groups	7.769	3	2.590	8.166	.000
	Within Groups	62.151	97	.317		
	Total	69.920	100			
Checking weight and sugar level	Between Groups	7.120	3	2.373	11.226	.000
	Within Groups	41.435	97	.211		
	Total	48.555	100			
Palpitation	Between Groups	5.044	3	1.681	7.637	.000
	Within Groups	43.151	97	.220		
	Total	48.195	100			
Treatment of minor ailment	Between Groups	12.075	3	4.025	8.174	.000
	Within Groups	96.520	97	.492		
	Total	108.595	100			
Testing of blood and urine	Between Groups	.319	3	.106	.236	.871
	Within Groups	88.276	97	.450		
	Total	88.595	100			

	Total	88.595	100			
	Between Groups	15.1	3	5.037	14.996	.000
Checking of blood pressure	Within Groups	65.843	97	.336		
	Total	80.955	100			

Data in table 6 show that a significant difference ($p=0.000<0.05$) exists in the use of all ANC services by the pregnant women but no significant difference ($p=0.871>0.05$) exists in the use of Testing of blood and urine. This implies that level of education of women determines the use of the ANC services.

Table 7 USE of PNC, FPLAN based on Education

MCH	X ² value	df	p-value
PNC			
Checkup	105.018	3	.000
Contraceptive use	28.375	3	.000
Treatment of minor ailment	107.629	3	.000
Baby examination	38.509	3	.000
Immunization	65.494	3	.000
Vitamin supplementation	8.170	3	.043
IMM			
BCG	23.170	3	.000
TT	72.780	3	.000
DPT	31.324	3	.000
MEASLE	24.376	3	.000
CSM	22.054	3	.000
HPV	14.628	3	.002
OPV	71.323	3	.000
YFV	103.776	3	.000
FPLAN			
PILLS	7.619	3	.055
INJ	56.006	3	.000
FEMALE CONDOM	9.432	3	.024
IUD	2.779	3	.427
FEMALE STERIIIZATION	4.729	3	.193
IMPLANT	10.550	3	.014

Data in table 7 show that a significant difference ($p=0.000<0.05$) exists in the use of all PNC, IMM and FPLAN services by the nursing women based on education level. This implies that level of education of women determines the use of the service. However, no significant difference ($p=0.055>0.05$; $p=0.427>0.05$; $p=0.193>0.05$) exist in the use of pills, IUD, and female sterilization respectively. This implies that education do not affect the use of pills, IUD and female sterilization.

Table 8 Use of ANC based on Occupation

		ANOVA Table					
		Sum of Squares	df	Mean Square	F	Sig.	
Attendance	Between Groups	5.954	3	2.977	9.122	.000	
	Within Groups	63.965	97	.326			
	Total	69.920	100				
Checking weight and sugar level	Between Groups	4.109	3	2.055	9.096	.000	
	Within Groups	44.273	97	.226			
	Total	48.382	100				
Palpitation	Between Groups	7.463	3	3.732	18.114	.000	
	Within Groups	40.376	97	.206			
	Total	47.839	100				
Treatment of minor ailment	Between Groups	7.828	3	3.914	7.613	.001	
	Within Groups	100.765	97	.514			
	Total	108.593	100				
Testing of blood and urine	Between Groups	.750	3	.375	.837	.435	
	Within Groups	87.843	97	.448			
	Total	88.593	100				
Checking of blood pressure	Between Groups	3.154	3	1.577	4.027	.019	
	Within Groups	76.765	97	.392			
	Total	79.920	100				

Data in table 8 showthat a significant difference ($p=0.000<0.05$) exists in the use of all ANC services by the pregnant women based on occupation except the use of testing blood and urine ($p=0.435>0.05$) which shows no significant difference. This implies that occupation of women determines the ANC service utilization

Table 9 USE of PNC, IMM, FPLAN based on Occupation

MCH	X ² value	df	p-value
PNC			
Checkup	10.826	2	.004
Contraceptive use	35.089	2	.000
Treatment of minor ailment	133.686	2	.000
Baby examination	47.647	2	.000
Immunization	15.934	2	.000
Vitamin supplementation	6.939	2	.031
IMM			
BCG	28.644	2	.000
TT	10.424	2	.005
DPT	15.092	2	.001
MEASLE	27.667	2	.000
CSM	18.713	2	.000
HPV	18.074	2	.000
OPV	1.298	2	.522
YFV	64.403	2	.000
FPLAN			
PILLS	9.053	2	.011
INJ	.294	2	.863
FEMALE CONDOM	9.432	3	.024
IUD	3.432	2	.180
FEMALE STERILIZATION	5.840	2	.054
IMPLANT	7.711	2	.021

Data in table9 show that a significant difference ($p-0.000<0.05$) exists in the use of all PNC, IMM services by the nursing women based on occupation except in the use of OPV ($p-0.522<0.05$). For FPLAN a significant difference exists in the use of pills ($p-0.011<0.05$), female condom ($p-0.024<0.05$) and implant ($p-0.021<0.05$). This implies that occupation of women affects the use of these services. However, no significant difference exists in the use of INJ ($p-0.863>0.05$), IUD ($p-0.180>0.05$), and female sterilization ($p-0.054>0.05$). This implies that occupation do not affect the use of INJ, IUD and female sterilization

Table 10 Use of ANC based on Age

		ANOVA Table					
		Sum of Squares	df	Mean Square	F	Sig.	
Attendance	Between Groups	1.866	3	.933	2.701	.070	
	Within Groups	68.054	97	.345			
	Total	69.920	100				
checking weight and sugar level	Between Groups	6.736	3	3.368	15.866	.000	
	Within Groups	41.819	97	.212			
	Total	48.555	100				
Palpitation	Between Groups	1.219	3	.610	2.556	.080	
	Within Groups	46.976	97	.238			
	Total	48.195	100				
treatment of minor ailment	Between Groups	1.447	3	.724	1.331	.267	
	Within Groups	107.148	97	.544			
	Total	108.595	100				
Testing of blood and urine	Between Groups	8.104	3	4.052	9.917	.000	
	Within Groups	80.491	97	.409			
	Total	88.595	100				
Checking of blood pressure	Between Groups	11.423	3	5.712	16.182	.000	
	Within Groups	69.532	97	.353			
	Total	80.955	100				

Data in table 10 show that a significant difference exists in the use of checking weight and sugar level, Testing of blood and urine and Checking of blood pressure ($p-0.000<0.05$) while no significant difference exist in the use of Attendance ($p-0.070>0.05$), Palpitation ($p-0.080>0.05$) and treatment of minor ailment ($p-0.267>0.05$). This implies that age of women can influence the use of some ANC services.

Table 11 Use of PNC, IMM, FPLAN based on Age

MCH	X ² value	Df	p-value
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PNC			
Checkup	1.803	2	.406
Contraceptive use	38.838	2	.000
Treatment of minor ailment	52.236	2	.000
Baby examination	61.587	2	.000
Immunization	51.010	2	.000
Vitamin supplementation	30.085	2	.000
IMM			
BCG	26.321	2	.000
TT	42.215	2	.000
DPT	15.813	2	.000
MEASLE	15.853	2	.000
CSM	31.374	2	.000
HPV	118.875	2	.000
OPV	6.687	2	.035
YFV	61.563	2	.000
FPLAN			
PILLS	30.365	2	.000
INJ	10.804	2	.005
FEMALE CONDOM	11.305	2	.004
IUD	22.585	2	.000
FEMALE STERILIZATION	3.137	2	.208
IMPLANT	10.268	2	.006

Data in table 11 show that a significant difference ($p < 0.000 < 0.05$) exists in the use of all PNC except Checkup ($p > 0.406 > 0.05$); IMM services and FPLAN except female sterilization ($p > 0.208 > 0.05$) based on the women age. This implies that age of the women affects the use of these services.

IV. Discussion

Findings of this study revealed that ICT intervention has significant effects on improving the use of MCH. The intervention group showed significant improvement in the use of MCH than the control group. ICT increased the use of ANC. Use of antenatal has proved to help in reducing maternal complications and death (Simoyan et al., 2013; Oyeyemi & Wynn, 2014; Lund et al., 2014; Lee et al., 2016). Further findings revealed that there was increase in the use of PNC, IMM and FPLAN due to ICT intervention. Hence there is a significant effect of the ICT intervention on the use of these services by pregnant and nursing women. These findings are in consistence with those of Anya, Hydera & Jaiteh, 2008; Parmar, 2010; Obasola, & Mabawonku, 2016; Felicie, et al, 2016) which revealed that ICT improves the use of maternal and child care services. These findings also tallies with (Lund et al., 2014; Lee et al., 2016; Urwin, 2009; Mcqueen et al., 2012; Jarusheen et al., 2008; Sharma et al., 2011). The authors revealed that ICT is an effective intervention to boost the use of MCH in order to reduce maternal and child mortality. This finding is very significant because it has provided data on the use of ICT/mHealth on health service utilization especially mobile and smart phone which is in possession of every member of the society in Nigeria and other countries.

More findings also revealed a significant difference in the use of all ANC services, PNC, IMM and FPLAN services by the pregnant and nursing women based on their education level. This implies that level of education of women determines the use of the service. However, no significant difference exists in the use of pills, IUD, and female sterilization respectively. This implies that education do not affect the use of pills, IUD and female sterilization. This agrees with Azubuike (2014) and Azubuike (2019) who discovered a significant difference in the level of education on the use of maternal and child care services. Adamu (2011) also confirmed that education is an important factor to facilitate health care service utilization.

Further findings showed that a significant difference exists in the use of all ANC, PNC, IMM services by the nursing women based on occupation. This is supported by the assertion of Ajaegbu (2013) which stated that occupation is one factor that determines ones time and resources to utilize health services. This therefore means that occupation affects ones use of health services. But occupation does not affect the use of INJ, IUD and female sterilization. The findings also revealed a significant difference ($p < 0.000 < 0.05$) exists in the use of all PNC IMM services and FPLAN based on the women's age. It implies that age of the women affects the use of these services. This could be attributed to the knowledge and use of ICT devices. It seems that the younger women are more conversant with the devices than the older ones hence the significant difference in their use of services. This finding is in consistent with the finding of (Magadi, Aqwande & Obare, 2007; Obasola, & Mabawonku, 2016; Felicie et al., 2016). This implies that ICT intervention has really affected the use of services among women of various age groups.

More findings also revealed a significant difference in the use of all ANC services, PNC, IMM and FPLAN services by the pregnant and nursing women based on their education level. Further findings showed that a significant difference exists in the use of all ANC, PNC, IMM services by the nursing women based on occupation. Findings on the challenges affecting the use of ICT showed that all the factors are challenges that can hinder the use of ICT and also in utilization of MCH services. This agrees with the assertion of Felicie et al.

(2016) which revealed various hindrances to the use of ICT intervention to improve maternal service utilization. Anyoha et al. (2018) supported this finding and revealed that these challenges are mostly common among the low income group and those living in the rural or isolated areas, hence suggested that government should revisit the service charge to enable every one benefit from ICT services.

V. Conclusion

Generally, findings of this study provided evidence for the efficacy of ICT/m-Health intervention in pregnant and nursing women use of MCH. Based on this, the following recommendations were made:

1. More ICT/ m-health intervention/programme targeted at others should be organized to increase use of some other health services.
2. Research is needed to develop ICT/m-health interventions and increase knowledge about health protection, prevention and promotion behaviours among Nigerian women.
3. Training of Health personnel on the effective ways of applying ICT/mHealth to improve service use should be carried out.
4. Government should ensure that service tariff is reduced for easy access to messages and other information;
5. Mobile service providers should reach the grassroots to ensure that services or network is always available at the remote communities.
6. Pregnant and nursing women should be encouraged to at least have a mobile phone to partake in ICT intervention programmes.
7. ICT education should be given to as many that are finding it difficult to operate their mobile or smart phone.
8. Public health educators should continue to reach those in rural or isolated area through ICT devices or physical contact to ensure they are obeying the guidelines.

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