

EFFECTS OF A NURSING INTERVENTION USING A MOBILE PHONE APPLICATION ON UPTAKE OF ANTENATAL CARE, TETANUS TOXOIDS AND MALARIA PREVENTION AMONG PREGNANT WOMEN IN NIGERIA

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Abstract

Maternal mortality is high in Nigeria especially in the rural areas due to knowledge deficit about expected care and labour process, socio-cultural belief, healthcare workers' attitude, and physical and financial barriers to quality healthcare access. Mobile health (mhealth) technology which is the use of mobile communication devices in healthcare delivery, is intended to reduce costs, improve care access, remove time and distance barriers, and facilitate patient- provider communications needed to make appropriate health decisions. Globally, the effect of mhealth on health outcomes has been explored but there exists a literature dearth about its use on maternal health issues in Nigeria. **Methods:** This comparison study carried out in four randomly selected Local Government Areas across Oyo South Senatorial district involved pregnant women in comparison groups. One group of pregnant women (191 women) had a mobile health nursing intervention in which mobile telephones were given to nurses and pregnant women to facilitate communication (intervention group) while the control group of 192 women continued with the regular traditional care. Over an 8-month period, women in the intervention group received free voice calls and health promotion text messages from nurses. Uptake of antenatal care attendance, Intermittent Preventive Treatment of malaria in Pregnancy (IPTp) and Tetanus Toxoids (TT) was monitored throughout the follow-up period in both groups. An outcome evaluation checklist was used to document utilisation and completion of the three indices among pregnant women. **Results:** The study revealed a statistically significant difference in antenatal clinic (ANC) attendance (66.8% versus 53.1%, $p=0.006$) and uptake of IPTp (47.6% versus

18.4%, $p<0.001$); although there was an improved uptake of Tetanus Toxoids (TT) between intervention (64.5%) and control groups (54.1%) this was not significant. Significantly more women in the intervention group who completed ANC had IPTp (OR: 14.9, CI: 6.3-35.7) and TT (OR: 8.2, CI: 1.7-39.9) than those who did not complete the ANC. **Conclusion:** Improved uptake of Antenatal Care Attendance, Intermittent Preventive Treatment of malaria in pregnancy, and tetanus toxoids occurs as a result of mHealth, and is beneficial for health promotion, and prevention and early identification of diseases resulting in maternal and child mortality reduction in Nigeria.

Keywords: mHealth; nursing intervention; maternal mortality; pregnancy; maternal health services.

Introduction

Every two minutes, one woman dies somewhere in the world from complications of pregnancy or childbirth. One third of these maternal deaths take place in just two countries, India with 20% of the global total (56,000 deaths) and Nigeria with about 14% (40,000 deaths). Globally, the maternal mortality ratio is 400 per 100,000 live births, however in Nigeria, the figure was about 1,500 per 100,000 in 2006¹ and is currently 804 per 100,000. By implication, one woman dies approximately every 3 minutes in childbirth in Nigeria.

This is significantly related to poverty, ignorance about expected care and the labour process, socio-cultural beliefs, transportation problems, and healthcare workers' attitude.² In Nigeria, 58% of women receive some Antenatal Care (ANC) from a skilled provider, most commonly from a nurse or

midwife (30%), or a doctor (23%). Forty-five percent of women had the recommended four or more ANC visits, but only 16% of women had an antenatal care visit by their fourth month of pregnancy, as recommended. More than one-third of women (36%) received no ANC.³ Despite their importance, just 54% of women took iron tablets or syrup during their last pregnancy while only 10% took intestinal parasite drugs. Six in ten women (60%) who received antenatal care were informed of the signs of pregnancy complications. About 50% of the most recent births were protected against neonatal tetanus. All of these factors contribute greatly to high mortality in Nigeria.⁴

ANC is defined as care received by a pregnant woman throughout the period of pregnancy to ensure that the woman and unborn child survive pregnancy and childbirth. ANC provides a chance to interact with a pregnant woman so that the woman can make appropriate choices and decisions that will contribute to optimal pregnancy outcome and care of the newborn.¹

Early commencement of ANC and regular visits have the potential to affect maternal and foetal outcome positively.^{5,6} ANC has the potential to reduce maternal morbidity and improve newborns' health.^{7,8} It provides pregnant women with a broad range of health promotion and preventive health services and is important in identifying risk factors for adverse pregnancy outcomes. Inadequate antenatal care is related to poor pregnancy outcome and women who seek antenatal care late with few visits are less likely to have a complete protective dose of Intermittent Preventive Treatment of malaria in pregnancy (IPTp), Tetanus Toxoids (TT), attend postnatal care, and have assisted delivery by a skilled attendant.⁹

The World Health Organization (WHO) recommends a minimum of four antenatal visits per pregnancy (with the first occurring during the first trimester), but according to WHO figures, between 2005 and 2010 only 53% of pregnant women worldwide attended the recommended four antenatal visits and in low-income countries, this figure was a disappointing 36%.¹⁰

Although Nigeria, like most developing countries of the world, does not have national guidelines on antenatal care, commencement of antenatal care within the first 14 weeks of gestation is widely accepted and previous research has defined booking after the 14th week of pregnancy as late.¹¹⁻¹⁵

The care a woman receives before, during and immediately after pregnancy is beneficial in ensuring the survival and development of a healthy baby and mother. Utilisation of modern healthcare services is important in determining pregnancy outcome. To avoid complications during and after delivery, essential obstetric care provided within the healthcare facilities and by a skilled provider is needed.

Pregnant women, especially primigravida and secundigravida, are more vulnerable to malaria than non-pregnant women from the same area.¹⁶ Maternal anaemia and low birth weight babies (LBW) are two important consequences of malaria. In sub-Saharan Africa, malaria is a major contributory cause of anaemia, especially among primigravida living in holo-endemic areas or perennially exposed to malaria.¹⁷ Malaria-associated anaemia puts pregnant women at greater risk of other morbidities including placental abruption, placenta praevia, premature labour, and maternal death. In addition, LBW babies are at increased risk of early childhood mortality. The WHO recommends that IPTp should be taken at least twice during pregnancy and research has shown the efficacy of IPTp.¹⁸ However, data from 2004 to 2009 suggest that, in spite of national policies for prevention and control of Malaria in Pregnancy (MiP) (and the limitations and scarcity of available nationally representative survey data), insufficient progress has been made towards the targets for coverage of IPTp and Insecticide Treated Net use during pregnancy.¹⁹

The WHO states that more than 180,000 newborns and over 30,000 women die each year from tetanus, some of which occur during pregnancy. The International Congress of Obstetrics and Gynaecologists (ICOG) recommend that pregnant women should have (a) three doses at childbirth, 4, and 6-12 months if they have never been immunised before, (b) at least two doses in the late second or third trimester if the woman's immunisation history is unknown, and (c) a dose in the postpartum period if there is no record of any TT administered during pregnancy. Immunisation of pregnant women or women of childbearing age with two doses of tetanus toxoids was estimated to reduce mortality from neonatal tetanus by 94%.²⁰

Adequate antenatal care attendance is mainly the responsibility of the pregnant woman. Pregnant women need more access to basic information on safe motherhood and the right to decent quality healthcare based on their identified need and not their ability to

pay. A woman's education is one of the most important determinants of neonatal mortality and mortality levels decline as the mother's education increases. One of the most important responsibilities of skilled health providers is to provide detailed, concise and appropriate information to women before, during and after pregnancy. This is because information can help empower women to claim their rights and protect their health and that of their unborn child. Studies have suggested four dimensions to the support that women want in pregnancy: emotional support, informational support, physical support, and advocacy. Concise information for mothers during pregnancy is lacking especially at the rural level in Nigeria because of the serious shortage of facilities and skilled health workers like nurses and midwives predisposing women to the risk of not adopting healthy behaviours. A mobile health (mHealth) nursing intervention may overcome this and be beneficial.

The nursing intervention may promote a reliable, time-saving and cost effective approach to the delivery of quality healthcare at the primary care level in Nigeria. mHealth has been used in healthcare delivery and research across Nigeria. Only Ondo State government has used it to address maternal health issues, but there is currently limited evidence of its efficiency and effectiveness.

This study assessed the effects of an mHealth nursing intervention on the complete uptake of antenatal care attendance, IPTp and TT among pregnant women attending antenatal clinics in Primary Health Care (PHC) centres in the Oyo South Senatorial District.

Methods

This comparison study involved four out of nine local government areas (LGA) randomly selected and allocated to an mHealth technology intervention group (IG) and a control or usual care (CG) group made up of a semi-urban and an urban group. Also, all the forty-eight nurses who work in the selected LGA (IG: 21 nurses; CG: 27 nurses) and 383 literate pregnant women (IG:191 women; CG:192 women) at gestational age of 4-6 months, registered at the primary health clinic (PHC) who had mobile phones and were willing to participate in the study were recruited for inclusion consecutively. The selection period lasted for four weeks (February, 2013)

The general objective of the research was to account for variance in the dependent variables (antenatal care, TT vaccination and IPTp), and by comparing findings in the intervention and control groups to see how the independent variable (mobile health nursing intervention) contributed to accounting for that variance.

Approval to conduct the study was obtained from Oyo State Ethical Review Board, the Local Government Chairmen and Directors for Health. Written and informed consent was obtained from nurses and participating women after having explained the purpose, methods, duration and potential benefits of the study to policy formulation and implementation.

Nurse participants were provided with mobile phones for the duration of the study, pre-loaded with the clients' antenatal care and telephone numbers, and health promoting messages. An "All Purpose Medical Information System" (APMIS) tool was designed for this purpose, consisting of 365 gestational age appropriate health-promoting and disease-preventing messages categorised under five major sub-themes: general messages on foetal development, danger signs in pregnancy, signs of labour, signs of complications in labour, reminders of antenatal appointments, and drugs. All the health messages were also translated back-to-back and available in both English and Yoruba languages and delivered in clients' preferred language and time of the day.

The pregnant women could also contact their primary care nurses on a regular basis or whenever the need arose for emergencies, education, information or enquiries at no cost to either the nurses or the pregnant women.

Researcher-led mobile phone educational training was carried out with the nurse midwives who were in the intervention group. It empowered nurses with the knowledge and skills of using mHealth technology in educating and meeting the biological, psychological and informational health needs of clients throughout pregnancy with the aim of improving health seeking behaviours and reducing maternal morbidity and mortality. The training also equipped nurses with the recently adopted Focussed Antenatal Care model which aims at promoting the health of mothers and their babies through targeted assessments of pregnant women to facilitate early identification and treatment of already established disease, early detection of complications and other potential problems that can affect the outcomes of pregnancy, and prophylactic

treatment for anaemia, malaria, and sexually transmitted infections (STIs) including HIV, urinary tract infections and tetanus.²¹

Nurses at the PHC centres who had received training in the mobile health application, used their mobile phones to call and send text messages to the women in the intervention group at least once a week. These nursing interventions, free voice call and health promotion text messages lasted for eight months from selection to six weeks after delivery or termination of pregnancy.

Using direct observation by trained research assistants and hospital records, an outcome evaluation checklist was used to document utilisation and completion of the three indices among pregnant women over the eight month period. For antenatal care attendance, a total of at least four visits was considered as complete and less than four as incomplete. Similarly, an uptake of at least two doses of tetanus toxoid vaccines during pregnancy at least two doses of intermittent preventive treatment for malaria during pregnancy was considered as complete. Less than this was considered to be incomplete). Data were analysed using Chi-square and multiple logistic regression, with alpha set at 5%.

Results

The average age of the women was 25.5 ± 4.5 years, range (18 - 40 y). Most were married (82.5%). Two respondents were widowed during the course of their present pregnancy. The majority of women had completed secondary education (64.2%). Most of the respondents were Yoruba (90.1%). Less than half of the women were self-employed (41.8%). (Table 1)

Table 1. Socio-demographic data (n=383).

Age (years)	n (%)	Marital Status	n (%)
< 20	7.3	Single	2.1
21-30	59.3	Married	82.5
31-40	32.4	Divorced	13.3
No response	1.0	Widowed	0.5
		No response	1.6
Education		Employment	
None formal	1.3	Government	3.1
Primary	18.8	Private sector	11.7
Secondary	64.2	Self-employed	41.8
Tertiary	14.4	Unemployed	27.2
No response	1.3	Students	16.2

The outcome measures of the intervention and control groups are shown in Table 2.

Table 2. Analysis of intervention outcome indices in intervention and control groups (Incomp = Incomplete and Comp = Complete).

	mHealth N(%)	Control N(%)	p=	OR
ANC Incomp	62 (33.2)	92 (46.9)	0.006	1.8
ANC Comp	125 (66.8)	104 (53.1)		
IPTp Incomp	98 (52.4)	160 (81.6)	0.001	4.0
IPTp Comp	89 (47.6)	36 (18.4)		
TT Incomp	46 (35.5)	90 (40.9)	0.047	1.0
TT Comp	141 (73.3)	106 (54.1)		

Findings from the study revealed that significantly more women in the intervention group attended antenatal care at least four times (p=0.006), completed uptake of IPTp (p=0.001) and TT (p=0.047). Some women had up to seven ANC attendance which though commendable, was not necessary since especially since further exploration revealed that they were not of high risk. The breakdown of ANC visits is shown in Table 3.

Table 3. Breakdown of antenatal care attendance.

ANC attendance	mHealth. N(%)	Control N(%)	Total N (%)
Once	4 (2.1)	12 (6.1)	16 (4.2)
Twice	30 (16.0)	14 (7.1)	44 (11.5)
Thrice	28 (15.0)	66 (33.7)	94 (24.5)
Four times	40 (21.4)	52 (26.5)	92 (24)
Five times	47 (25.1)	44 (22.4)	91 (21.8)
Six times	26 (13.9)	8 (4.1)	34 (8.9)
Seven times	12 (6.4)	0 (0)	12 (3.1)

The relationship between antenatal care attendance and tetanus toxoids and IPTp receipt is shown in Table 4. Women who attended four or more antenatal appointments, whether they were in the intervention or control groups, were significantly more likely to complete IPTp and receive two or more TT vaccinations (p<0.0001). This relationship was explored further using multiple logistic regression with both indices showing a significant relationship (p<0.05). After adjusting for confounding variables like government policy and coincidence in multivariate analysis, the relationship was still significant in the intervention group (p=0.0001).

Table 4. Relationship between ANC attendance and maternal health seeking behaviour (Incomp = Incomplete and Comp = Complete).

	ANC Attendance		P=	OR
	Incomp	Comp		
Uptake of IPTp				
mHealth Incomp	55 (88.7)	43 (34.4)	0.0001	15.0
mHealth Comp	7 (11.3)	82 (65.6)		
Control Incomp	90 (97.8)	70 (67.3)	0.0001	21.9
Control Comp	2 (2.2)	34 (32.7)		
Uptake of TT				
mHealth Incomp	50 (82.0)	16 (12.8)	0.0001	8.2
mHealth Comp	11 (18.0)	109 (87.2)		
Control Incomp	58 (63.0)	32 (30.8)	0.0001	3.8
Control Comp	34 (37.0)	72 (69.2)		

Of women who completed four or more ANC visits, those in the intervention group were more likely to complete their IPTp doses, although this was not significant, (OR = 2.54, 95%CI: 0.80-8.07, p=0.114), but were significantly more likely to complete their TT doses, (OR = 15.70, 95%CI: 5.46-45.21, p=0.0001). In contrast, those in the control group were significantly more likely to complete their IPTp doses, (OR = 15.28, 95%CI: 3.38-69.15, p=0.0001) than their TT doses, (OR 1.77, 95%CI: 0.91-3.45, p=0.094).

Discussion

The nursing intervention using mobile phones improved uptake of maternal health services among pregnant women. Significantly more women in the intervention group had the minimum of the four ANC clinic attendances (66.8% vs 53.1%), completed the IPTp course (47.6% vs 18.4%) and the TT vaccinations (73.3% vs 54.1%). This is in agreement with Lund who found that 44% of the women in an mHealth intervention group attended four or more ANC visits versus 31% in the control group.²² On occasions when messages were delivered late or not made because of public holidays, women called their primary care nurses to make enquiries about their appointments. In the intervention group, 4% of intervention women attended antenatal care only once versus 12% of women in the control group, suggesting more appropriate healthcare seeking behaviour.

The mHealth intervention group showed significant improvement in IPTp and TT uptake over the control group. Women in the control group who attended antenatal clinic four of more times were also

significantly more likely to complete IPTp and TT treatment. After adjusting for other factors like coincidence, logistic regression showed that women in the control group who attended ANC four or more times were more likely to complete their doses of IPTp (p=0.0001) and those in the mHealth group were significantly more likely to complete their TT vaccination.(p=0.0001). This would suggest that the major benefit of the mHealth intervention is in improving ANC attendance. Various studies support these findings. The use of mHealth interventions are effective in improving clinic attendances and modifying health seeking behaviours like increased adherence to anti retroviral therapy and smoking cessation programmes.²³

Further findings revealed that more women in the intervention group (47.6%) as against the control group (18.4%) had two doses of IPT in pregnancy. Though statistically significant, there is a need to worry about this trend, considering that a higher percentage of women attended their ANC more than twice. The reported knowledge of clients about IPTp was low as revealed in other studies (8.1%).^{19,20} It is reported elsewhere that respondents, although unsure and unclear about drugs used for IPTp, were willing to take them when administered by health workers based on trust.^{16,19,24,25} This calls for a high level of sensitisation by all stakeholders to educate pregnant women about the need to be fully protected in pregnancy. While the results are promising an unintended limitation of this study is the possible confounding effect of the recently adopted Focussed Antenatal Care model.

Conflict of Interest. The authors declare no conflicts of interest.

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