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ORIGINAL RESEARCH

A facility-based survey of maternal anti-tetanus vaccination schedule completion in a Nigerian university community

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Abstract

Background: Maternal anti-tetanus vaccination is required to prevent maternal and neonatal tetanus. In the absence of lifetime protective dosing, repeat vaccination in every new pregnancy is needed to achieve protection of the newborn against tetanus.
Objectives: To determine maternal anti-tetanus vaccination schedule completion rates and the reasons for non-completion of the schedule.
Methods: This cross-sectional survey was conducted among Nigerian antenatal clinic attendees using an interviewee-administered questionnaire.
Results: Most (291/347; 83.9%) respondents had received a TT vaccine in the index pregnancy, and 280/347 (80.7%) received their first TT injection at the booking visit. In comparison, 202/238 (84.9%) of those eligible had received tetanus toxoid protective immunisation (TTPDI) in the index pregnancy. Although a majority (301/347; 86.7%) of the respondents had received at least a dose of TT in a previous pregnancy, only 23/246 (9.3%) eligible pregnant women had received complete vaccination (TT5) Parity ($p<0.001$) and ethnicity (0.013) were the main determinants of the maternal tetanus vaccination schedule (TT5) completion. However, the socio-demographic characteristics were similar for TTPDI. The commonest reason for non-completion was forgetfulness 172/218 (78.9%), and most (287/347; 89.1%) of the respondents wished to receive telephone reminders.
Conclusions: Although neonatal tetanus protective dosing of TT in the current pregnancy was high, a low proportion of mothers completed the five doses recommended by the WHO for lifetime immunity.

Key words: Antenatal care, Communication, Neonatal Tetanus, Tetanus Toxoid, Vaccination.

Introduction

Neonatal mortality continues to be an issue of great concern globally as efforts to improve maternal and child health have produced a slower decline in neonatal mortality rate (NMR) compared to post-neonatal and infant mortality rates; presently, 40% of childhood deaths occur in

the neonatal period. [1] Poorer, less developed countries have the worst neonatal mortality rates. Apart from the limited availability of resources, low uptake of proven health interventions has remained a bane of improving neonatal and maternal health indices in these settings.[2]

Tetanus vaccination in pregnancy is one such intervention that has nearly eliminated neonatal tetanus (NNT) in the developed world. At the same time, developing countries, especially in sub-Saharan Africa, continue to experience a slower decline in neonatal tetanus incidence rates. [3–5] Over 44% of global neonatal deaths due to tetanus in 2015 occurred in sub-Saharan Africa.[6] Tetanus ranks second only to measles among the vaccine-preventable diseases that contribute to mortality in children, and most of these deaths occur in Nigeria and India. [4,6] The high prevalence of neonatal tetanus in many developing countries is partly due to the high proportion of unskilled perinatal care, as most deliveries still occur at home or under unhygienic conditions outside the home. In Nigeria, for instance, 61% of deliveries occurred outside a health facility, as reported in the NDHS 2018. [7] Nigeria ranked among the 12 countries that had not eliminated maternal and neonatal tetanus as of 2020.[9]

The WHO - recommended immunisation schedule for pregnant women involves using the formaldehyde-inactivated, aluminium adsorbed tetanus toxoid (TT), administered as intramuscular injections up to five consecutive doses, and these confer immunity for more than ten years. A booster dose may be administered if the interval after the last dose of the vaccine is more than ten years. [8] However, findings from a recent study based on the antitoxin antibody half-life suggest that a booster dose may not be necessary until 30 years after the tetanus vaccination regimen is completed.[5] The WHO also advocates that a minimum of two doses of TT are required in any pregnancy to confer protection against neonatal tetanus. [9] Although the proportion of children who received all essential childhood vaccinations had gradually increased from 13% in 2003 to 31% in 2018, with a steady decline in the proportion who have received no vaccinations from 29% in 2008 to 19% in 2018, only 48% of pregnant Nigerian women received two or more doses of TT injection as found in the NDHS 2018. [8, 12]

The target for the elimination of neonatal tetanus, defined by the WHO as the occurrence of less than one case per 1000 live births in every district in every country, was postponed thrice from the year 2000 to 2005 and then to 2015 because of slow implementation of the recommended maternal tetanus elimination strategies, mainly in Nigeria and other sub-Saharan African countries. [9]

A woman who strictly complies with the schedule of maternal tetanus vaccination is expected to complete this regimen (five doses), and the time frame in most cases is during her childbearing years.[8] Non-completion automatically means that the woman would take another recommended two doses in a new pregnancy to confer immunity against tetanus for her newborn. These women with non-completion in previous pregnancies risk more doses occasioned by the increasing number of pregnancies. This repeated dosing is capable of causing colossal resource wastage. The cost of three doses of TT vaccine is about $3 per woman, excluding the cost of cold chain maintenance and other personal expenses in getting vaccinated. [11] Therefore, more than a dollar is wasted per woman for every extra dose of TT above the recommended five doses.

Education is crucial in enhancing the use of skilled attendance in pregnancy. Communications involving the use of targeted phone-based reminders are most effective in improving vaccination uptake to prevent childhood vaccine-preventable diseases. [14,15]

Therefore, this study aimed to determine the completion rates of the TT vaccination regimen according to the National Programme on Immunisation (NPI) schedule and the perception of pregnant women concerning communication for improving the completion rates for TT immunisation.

Methods

Study site and design

This cross-sectional study was conducted among women attending the antenatal clinic of the Babcock University Teaching Hospital (BUTH), Ilishan-Remo, Nigeria. The hospital serves neighbouring towns such as Iperu, Ikenne, Ogere and Irolu while receiving referrals from neighbouring states of Lagos and Oyo. [16] The booking clinic in this facility runs Mondays to Fridays, while the follow-up antenatal clinics run on Mondays and Wednesdays.

Materials

An interviewee-administered, semi-structured questionnaire designed by the authors was used to obtain data from the participants. The questionnaire contained sections on socio-demographic profile (which had mainly open-ended questions); other areas focused on tetanus vaccination in the structured, true/false options and open-ended questions to ascertain the number of doses received and intervals from the last received dose. The reasons for non-return/non-completion and suggested communication remedies for the prevention of non-completion were classified into structured groups. An option for 'other responses' was added for easy completion and analysis. The questionnaire was pre-tested on a cross section of 35 women attending the antenatal clinic of BUTH before the study commenced; a Cronbach's alpha reliability coefficient of 0.74 was obtained.

Study Population

After obtaining informed consent, eligible pregnant women aged between 18 and 45 years and attending the antenatal clinic were included.

Inclusion criteria: These included pregnant women aged 18-45 years attending the antenatal clinic of BUTH and pregnant women whose last delivery was less than three years before the survey.

Exclusion criteria: Pregnant women who were severely ill or referred to the antenatal clinic or were observed to have obstetric emergencies.

Sample size, sampling technique and procedures

The minimum sample size was determined using the Leslie Kish formula for estimating a single proportion with significance. [17] The prevalence of 32% obtained for maternal TT2 or TTPDI immunisation in 2020 by the WHO was used to calculate the sample size as 334, using a 95% confidence interval and a degree of freedom of 0.05. The participants were selected by simple random sampling, and they filled out the questionnaire after providing written informed consent. The completed questionnaire was deposited in large labelled brown envelopes in each consulting room. These were collected after every clinic by the data collection team (who were resident doctors in the department) and handed over to the principal investigator for further processing.

Definition of operational terms

Parity was defined as the number of pregnancies carried beyond 28 weeks irrespective of the outcome of such pregnancy.

A participant was considered booked for antenatal care if she registered for antenatal care at our facility and had one other visit where the results of investigations requested at the first visit were reviewed.

The tetanus toxoid protective dose for index pregnancy (TTPDI) or the TT2 vaccination rate was calculated by expressing the number of eligible women who had received a second dose of tetanus toxoid at four or more weeks beyond

the date of the registration for antenatal care as a percentage of the total eligible pregnant women at the same time.

The lifetime tetanus protective dose was calculated by expressing the number of women who had completed the recommended vaccination schedule according to the NPI (completed TT5) as a percentage of the eligible women who have been pregnant before.

Ethical consideration

Ethical clearance was obtained from the institutional ethics review board of the hospital before the commencement of the study, and protocol number BUHREC/319/20 was assigned. A written, informed consent was obtained from each participant before administering the questionnaire. Participation was voluntary, and confidentiality was maintained throughout the study.

Data Analysis

The collected data were analysed using the Statistical Software Package for Social Sciences (SPSS) version 21.0 (Chicago, Illinois). Frequency tables were constructed while numerical data were expressed as mean ± standard deviation. Bivariate analysis was done with the Student's t-test for the comparison of mean values of continuous variables, while the Chi-Squared test was used for the comparison of categorical variables. The level of statistical significance was set at a *P*-value of less than 0.05.

Results

The response rate in this study was 98.9% (347/351). The median age of the participants was 30 years (21-42 years), and the majority had tertiary education (303/347; 87.3%) and were married (330/347; 95.1%). Most (248/347; 71.9%) of them have had one or more previous pregnancies resulting in delivery, while 29.1% (101/347) were in their first pregnancy. All the participants were booked for antenatal care in our facility, and the median gestational age at booking was 14 weeks (range 4-29 weeks) (Table I).

Table I: Socio-demographic and obstetric characteristics of the participants

Characteristics	*Category*	*Frequency (n = 347)*
Educational level	Primary	0 (0.0)
	Secondary	44 (12.7)
	Tertiary	303 (87.3)
Ethnicity	Hausa	4 (1.2)
	Igbo	98 (28.2)
	Yoruba	210 (60.5)
	Others	35 (10.1)
Marital status	Single/separated/divorced	17 (4.9)
	Married	330 (95.1)
Parity	0	101 (29.1)
	1	177 (51.0)
	2	48 (13.8)
	3	14 (4.0)
	4	7 (2.0)

Figures in parentheses are percentages of the total.

Table II shows that 83.9% (291/347) of the respondents had received a tetanus injection in the index pregnancy as of the survey, and 80.7% (280/347) received their first dose of TT at the booking visit. In comparison, 84.9% (202/238) of those who had attended ANC for more than four weeks at the survey had received at least two doses of TT.

Table II: Tetanus vaccination completion rates among participants

Items	*Category*	*Frequency (n = 347)*
Received TT vaccines in the index pregnancy		291 (83.9%)
	Yes	
		56 (16.1%)
	No	
Received the first dose of TT vaccine at booking		280 (80.7%)
	Yes	
		67 (19.3%)
	No	
*Received two or more doses of TT vaccine in index pregnancy (n=238)		202 (84.9%)
	Yes	
		36 (15.1%)
	No	
Ever received TT vaccination in a previous pregnancy		301 (86.7%)
	Yes	
		46 (13.3%)
	No	
Ever returned for TT vaccination after delivery		78 (22.5%)
	Yes	
		269 (77.5%
	No	
**Completed TT schedule (n=246)		23 (9.3%)
	Yes	
		223 (90.7%)
	No	
Ever had TT vaccination outside pregnancy		149 (42.9%)
	Yes	
		198 (57.1%)
	No	

***Participants ≥ 4 weeks post booking visit at the time of the survey**
****Eligible women who had up to TT5 after a previous delivery**

Considering postpartum practices, only 22.5% (78/347) had 'ever returned' after delivery for TT administration, while the median number of vaccine doses received was 2 (range 1-4). Close to a third (29.5%; 23/78) of these returnees completed the nationally recommended five doses of TT. However, with the exclusion of 101 primigravidae, the calculated tetanus vaccination completion rate among eligible mothers was 9.3% (23/246). Outside of pregnancy, 42.9% (149/347) had received TT vaccine either as adolescents or as adults, and the median number of TT doses received was 2 (range 1-5).

In Table III, parity ($p<0.001$) and ethnicity ($p = 0.013$) were the main determinants of maternal completion of tetanus vaccination schedule

(TT5), with significantly more multiparous and Hausa women completing the schedule.

Table III: Socio-demographic determinants of maternal completion of tetanus vaccination schedule (TT5) and tetanus toxoid protective dose for index pregnancy (TTPDI)

Socio-demographic determinants of maternal tetanus vaccination (TT5) completion				
Factor	**Completion (n = 246)**		**95%CI**	**p-value**
	Yes (n = 23)	**No (n = 223)**		
Mean age ± SD	32.30±4.97	30.28±4.56	-2.026 - 1080	0.072
Parity				
1 (n = 177)	8 (4.5)	169 (95.5)		<0.001
>1 (n = 69)	15 (21.7)	54 (78.3)		
Marital Status				
Presently single, separated or divorced (n = 11)	1 (9.1)	10 (90.9)		1.000
Presently married (n = 235)	22 (9.4)	213 (90.6)		
Highest educational level				
Secondary (n = 33)	4 (12.1)	29 (87.9)		0.525
Tertiary (n = 213)	19 (8.9)	194 (91.1)		
Ethnicity				
Hausa (n = 2)	2 (100)	0 (0.0)	0.010-0.016	0.013
Igbo (n = 60)	7 (11.7)	53 (88.3)		
Yoruba (n = 157)	12 (7.6)	145 (92.4)		
Others (n = 27)	2 (7.4)	25 (92.6)		
Religion				
Christianity (n = 212)	19 (9.0)	193 (91.0)		0.536
Islam (n = 34)	4 (11.8)	30 (88.2)		
Socio-demographic determinants of TTPDI				
Factor	**TTPDI (n = 238)**		**95%CI**	**p-value**
	Yes (n = 202)	**No (n = 36)**		
Mean age ± SD	30.2±4.51	29.78 ± 4.88	-2.067-1.187	0.616
Parity				
1 (n = 198)	172 (86.9)	26 (13.1)		0.087
>1 (n = 40)	30 (75.0)	10 (25.0)		
Marital Status				
Presently single, separated or divorced. (n = 13)	12 (92.3)	1(7.7)		0.387
Presently married (n = 225)	190 (84.4)	35 (15.6)		
Highest educational level				
Secondary (n = 25)	21 (84.0)	4 (16.0)		0.544
Tertiary (n = 213)	181(85.0)	32 (15.0)		
Ethnicity				
Hausa (n = 2)	1 (50.0)	1 (50.0)	0.385-0.411	0.398
Igbo (n = 69)	59 (85.5)	10 (14.5)		
Yoruba (n = 144)	121 (84.0)	23 (16.0)		
Others (n = 23)	21 (91.3)	2 (8.7)		
Religion				
Christianity (n = 206)	175 (85.0)	31 (15.0)		1.000
Islam (n = 32)	27 (84.4)	5 (15.6)		

Figures in parentheses are percentages of the total.

Women who returned postnatally and completed the vaccination schedule were older, with a mean age of 32.30 ± 4.97 years compared to 30.28 ± 4.56 among those who did not complete the schedule, although without statistical significance (p = 0.072). Other factors such as marital status (p = 1.000), educational level (p = 0.525) and religion had no significant relationship with the completion of the tetanus vaccination schedule. A different trend was observed for the attainment of the tetanus toxoid protective dose immunisation (TTPDI) as reception of two or more doses of TT in the index pregnancy did not depend on any of age (p = 0.616), parity (p = 0.087), marital status (p = 0.387), educational attainment (p = 0.544), ethnicity (p = 0.398) or religion (p = 1.000).

Figure 1 shows that forgetfulness (172/218; 78.9%) was the commonest reason for non-completion of TT schedule, while the least common reasons included 'vaccine is no longer wanted' (6/218; 2.8%) and 'inconvenient timing' (6/218; 2.8%). Table IV highlights the perception of the participants on the role of communication in ensuring compliance with the anti-tetanus immunisation schedule; the commonest suggested remedy was the use of reminder messages to be sent to postpartum mothers (174/347; 50.1%). Most (91.4%; 317/347) wished to be contacted to ensure a postnatal return to the clinic for the completion of their anti-tetanus vaccination. The telephone was the most preferred medium of contact (287/322; 89.1%), while a combination of a phone call and text messaging (42.0%; 133/317) was the most preferred telephone contact modality.

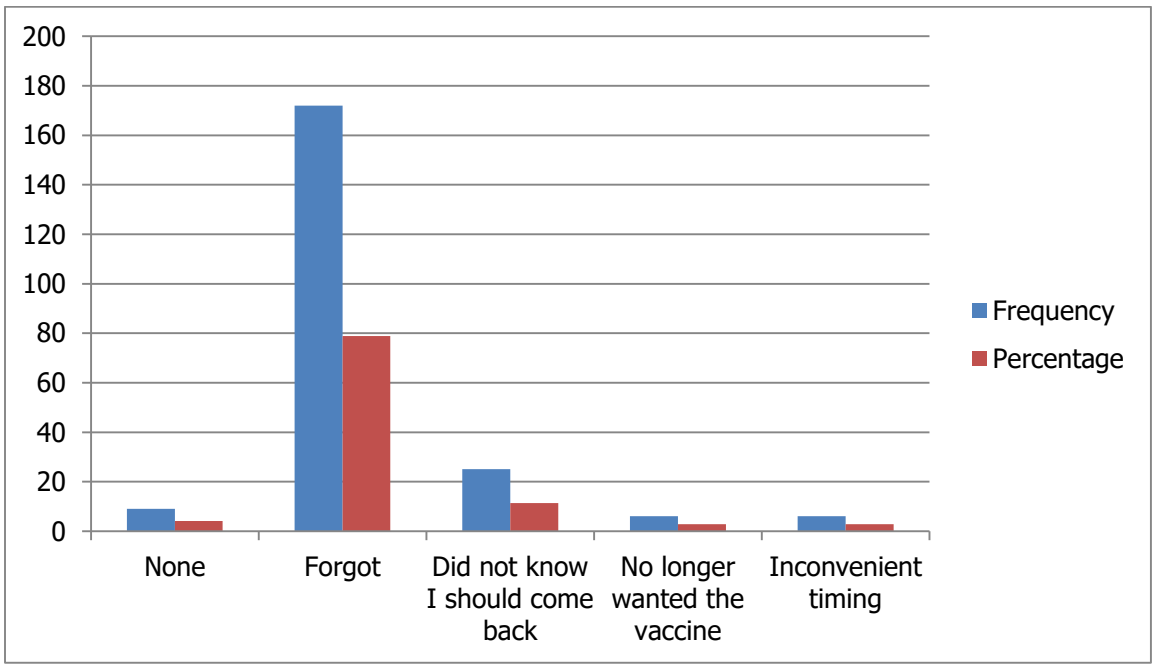

Figure 1: Reasons for non-return/non-completion of the tetanus vaccination schedule

Table IV: Perceptions of respondents on the role of communication in the prevention of non-completion of the tetanus vaccination schedule

Variable	*Frequency (n=347)*
Suggested remedies to reduce non-completion rates	
Send reminder to mothers	174 (50.1)
Educate women on the TT schedule	42 (12.1)
Provide a more convenient time	25 (7.2)
Community awareness	3 (0.9)
Go and vaccinate mothers at home	18 (5.2)
Include the vaccination in child welfare clinics	10 (2.9)
Nothing	75 (21.6)
Wish to be contacted to ensure a return for vaccination completion	
Yes	317 (91.4)
No	30 (8.6)
Preferred contact modality (n = 322)*	
Telephone	287 (89.1)
Home Visit	27 (8.4)
Letter	8 (2.5)
Preferred phone contact modality **(n = 317)**	
Call only	62 (19.5)
SMS only	122 (38.5)
Both call and SMS	133 (42.0)

***Multiple responses; Figures in parentheses are percentages of the total.**

Discussion

In the face of dwindling global financial resources, the burden of health resource wastage, particularly from incomplete and repeat vaccinations, needs to be critically evaluated. In the present study, the high proportion (83.9%) of participants who had received at least a dose of TT in pregnancy is slightly higher than observed in Benin City, southern Nigeria. [13] However, the proportion (80.7%) of eligible participants who had a vaccine shot at the booking visit is lower than expected since the NPI targets all eligible pregnant women at the booking visit. An additional second TT dose is thus required to confer protective immunity in the current pregnancy.[9] It is also encouraging to note that as of the time of the survey, most (84.5%) of the participants who were eligible for a second dose (TT2) of TT (those who were ≥ 4 weeks from booking) had received two doses of TT vaccination. Indeed, TT2 vaccination is considered one of the definitions for Tetanus Toxoid Protective Dose Immunisation(TTPDI). [14] Both maternal and neonatal protection against tetanus depends on the vaccination of mothers.[8]

Vaccination of pregnant women with at least two doses of tetanus toxoid has been estimated to reduce mortality from neonatal tetanus by 94%.[4] The WHO also advocates that a minimum of two doses of TT are required in any pregnancy to confer protection against neonatal tetanus. [8, 9] However, low immunisation coverage has been consistently reported in studies in Nigeria as the major reason for the rather slow decline in the

prevalence and mortality rates of tetanus infection. [16,17] The rate obtained in the present study (84.5%) far exceeds the current Nigerian national coverage of 62% (NDHS 2018), which is an improvement over 48% reported in the NDHS of 2013. [7,10] It is also higher than rates reported from Lagos (20%) and Ibadan (38.1%), both in the southwest, Umuahia (50%) in the southeast and Zaria (45%), in the north-western part of Nigeria, where religion and culture were the main determinants of vaccination rates. [18–21] This finding also exceeds the TT2 vaccination rates reported in a study in Ankara, Turkey (27.8%). [22] These TT2 vaccination rates are, however, in accordance with observations from Ghana (82.6%), Ethiopia (82.3%) and Pakistan (90.5%). [23–25] The relatively high tertiary education rate (87.3%) observed in the present study, conducted in a University community setting, may be responsible for the observed high TT2 vaccination rates. Educational attainment has been shown in an earlier similar study as a major determinant of attaining protective immunisation doses of the TT vaccine. [14]

Although high, the proportion (86.7%) of participants who had 'ever received TT' in a previous pregnancy is lower than the 96.3% reported from a cross-sectional survey in Sierra Leone. [26] The observed lifetime tetanus protective dose vaccination rate (TT5 completion) for all eligible women who had been pregnant before was 9.5%. This low rate is similar to what was observed in Zaria, which also happens to be a town with a university community. It also compares with observations from Pakistan, a similar third world country. [21,27] Low rates of protective TT vaccination have been consistently reported in some other African and Asian countries. [28–31] The dismal low rate of lifetime protective tetanus vaccination, translating to an inversely high proportion of repeat doses of tetanus toxoid required in subsequent pregnancies, creates the potential for huge resource wastage, especially in low resource settings. It is imperative to note that every extra dose of TT vaccine given above the recommended five results in more than a US dollar loss. This cost can be huge, considering Nigeria's high total fertility rate and the number of women that would be thus included for their protection against tetanus. [7,10,11]

Considering tetanus vaccination in adulthood 'outside pregnancy' reveals that less than half of the respondents have 'ever received at least one dose of TT'. Mass anti-tetanus vaccination in adulthood is currently not a routine practice. However, some authors have suggested vaccination of women of reproductive age (15-49 years) to prevent neonatal tetanus, but this would not be cost-effective as not all women would eventually get pregnant. [4, 32] TT vaccination is also indicated in conditions that increase the risk of infection with *Clostridium tetani,* such as cuts, puncture wounds, abrasions, road traffic accidents with open injuries, and chronic leg and foot ulcers.[4, 33] This fact may be the reason behind the low rates of TT vaccination outside pregnancy observed in the present study.

The association between parity and higher uptake of lifetime protective dose of tetanus vaccination suggests that repeated skilled antenatal care and exposure to health information may play an essential role in creating the awareness required to complete the immunisation schedule. The lack of awareness has been demonstrated as one of the major barriers to immunisation completion in the report of the Nigeria Immunization Survey (IVAC). [39] The foregoing is also buttressed by the absence of a statistically significant relationship between socioeconomic factors of age, marital status, educational attainment, ethnicity and religion with the achievement of TTPDI in the index pregnancy. The equal opportunity created by the participants' exposure (who were all booked for antenatal care) to health information may be responsible for this finding which highlights the

role of communication in improving the uptake of proven health interventions.

The commonest reason respondents gave for non-return to complete the TT immunisation schedule was forgetfulness, suggesting that acceptance of TT vaccination is not in doubt. Only 2.8% of the participants stated 'inconvenient timing' or 'refusal' as plausible reasons not receiving the vaccine. This finding is in contrast to a report from Ethiopia, where the most important reason for not completing the immunisation by a majority of the participants was that 'no one advised them' on ensuring continuation and completion of the TT immunisation schedule, whereas 'forgetfulness' was not listed as a reason, in that study. [14] This observation suggests that while healthcare providers and the health system updates and reminders may work for that Ethiopian population, patient-targeted reminders such as phone messages or calls may be required to improve vaccination coverage in our people.

Text message and phone call reminders have been shown to improve childhood immunisation uptake, timeliness and schedule completion in high-income countries and some African countries.[34–36] Two earlier studies in Nigeria (one of which is a randomised controlled trial) also have findings corroborating the foregoing.[37,38] In addition, another finding bothering on the fact that the majority of the participants suggested that reminders be sent to postpartum mothers to reduce this default rate also supports the hypothesis that forgetfulness rather than rejection is the main reason for non-completion of the TT vaccination schedule. Therefore, it is not surprising that most participants chose to be contacted through their mobile phones either by calls or the short message service (SMS) to remind them of their next TT dose. A very high proportion of Nigerian women own and use mobile phones today. The affordable SMS and call rates make the mobile phone an essential tool for improving maternal, child and family health and reproductive health outcomes.

Conclusion

Although a high proportion of women in this study received anti-tetanus vaccination enough to prevent neonatal tetanus in the current pregnancy, very few women returned after delivery to complete the WHO-recommended five doses, which creates a potential for resource wastage. This can be addressed with telephone-based reminders.

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