Original Research Article

Treatment of malaria in pregnancy: Knowledge of community pharmacists in Ibadan, Nigeria

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Abstract

Purpose: To evaluate the knowledge of community pharmacists in the management of malaria in pregnancy and their adherence to the World Health Organisation (WHO) treatment guidelines.
Methods: Questionnaires were administered to obtain information on knowledge and adherence to WHO guidelines. Respondents' scores on a 12-item knowledge question on the management of malaria in pregnancy were categorized as good knowledge if ≥ 10, and poor knowledge if < 10. Descriptive statistics were used to summarise the data. Chi-square test was used to explore the association between sociodemographic characteristics and knowledge.
Results: Pharmacists qualified within 10 years of the study period were 29 (48.3 %). Only 25 (31.3 %) of the pharmacists possessed an additional qualification to Bachelor of Pharmacy degree. Rapid diagnostic test kits (RDT) and light microscopy test (LMT) have been used by 51 (76.2 %) and 17 (28.8 %), respectively, to diagnose malaria. About three-quarters (71.3 %) had poor knowledge of the medication for the treatment of malaria in pregnancy. Knowledge score was neither significantly associated with the pharmacists' years of qualification (p = 0.174) nor with possession of additional qualification (p = 0.334).
Conclusions: There is a substantial gap in pharmacists' knowledge on the management of malaria in pregnancy, revealing an urgent need for training and adherence of community pharmacists to World Health Organisation treatment guidelines to ensure the safety of pregnant women and the unborn baby.

Keywords: Community pharmacists, Malaria in pregnancy, Rapid diagnostic test, Light microscopy

INTRODUCTION

In Nigeria, community pharmacies are one of the first points for the purchase of drugs for treating common ailments and initial source of counsel regarding illness and drug therapy. The general opinion is that community pharmacies have shorter waiting times, longer operating hours, convenience and are more cost effective with usually no need to pay consultation fees compared to the visit to a clinic or hospital [1,2]. Community pharmacists are readily accessible to the public for the treatment of various disease conditions including Malaria [3].

In 2015, the World Health Organization (WHO) reported malaria cases worldwide as over 200

million, with more than 95 % of the cases in Africa [4]. In malaria-endemic countries, malaria during pregnancy remains a significant factor in maternal and infant illness and death and a major public health concern [5]. Pregnant women are more susceptible to malaria and have a greater risk of severe *Plasmodium falciparum* malaria. Malaria in pregnancy is responsible for 11 % of maternal deaths, 2-5 % of maternal anemia, 8-15 % low birth weight infants and 3-8 % of infant deaths in Nigeria [6].

According to the WHO recommendations, adopted by the Nigerian Ministry of Health (MoH), early and efficient diagnosis and treatment of malaria are essential to avoid adverse effects during pregnancy [7]. Pregnant women should use long-lasting insecticidal nets (LLINs) and intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP) [7]. The Nigerian National Treatment Guidelines recommend Artemether-lumefantrine (AL), an artemisinin combination therapy (ACT), as first-line treatment for uncomplicated *P. falciparum* malaria in the general populace and pregnant women in their second and third trimesters. AL is contraindicated in first trimester, and oral quinine is suggested in its place [8].

In Ibadan, Nigeria, 35 % of pregnant women who practice self-medication visited a pharmacist [9]. Pharmacies are located within different parts of almost all the communities in Nigeria. They provide various health care services including public health education, appropriate drug procurement, dispensing drugs and counseling patients on the use of prescription and non-prescription drugs. Previous studies done in Nigeria have not determined the knowledge of community pharmacists in the treatment of malaria in pregnancy despite its importance. The objective of our study, therefore, was to determine the knowledge of community pharmacists in the treatment of malaria in pregnancy in Nigeria.

METHODS

Study area

The study was conducted in Ibadan, the capital of Oyo State, southwestern Nigeria. The State has a landmass of 27,249 square kilometers and is one of the 36 states of Nigeria. Ibadan has a population of 3.6 million inhabitants, while Oyo State has a population of 5.6 million [10]. Located in Ibadan are federal and state government hospitals, Primary Health Care (PHC) facilities as well as numerous private

hospitals. Pharmacies and patent medicine stores are present throughout Ibadan.

Study population

Pharmacists in registered community pharmacies in Ibadan, Oyo State, southwestern Nigeria.

Study design and setting

This was a cross-sectional survey among community pharmacists in the Ibadan metropolis, between June and September 2016, using a pre-tested questionnaire. Eligible participants were registered community pharmacists practicing in the Ibadan metropolis, who gave voluntary informed consent to partake in the study. Participating pharmacists must have had a minimum of one-year practice experience in a community pharmacy. Pharmacy students, interns, non-pharmacist attendants and community pharmacists who were absent from their pharmacies were excluded from the study.

Sample size determination

The sampling frame consisted of an updated list of 98 registered community pharmacy premises provided by the Pharmacists Council of Nigeria Oyo State chapter directory. Total sampling of all pharmacies was embarked on, however some of the pharmacies declined participation in the study. Of the 98 pharmacies, 90 consented to participate. Out of the 90, five were used for the pre-test and they were excluded from the study.

Data collection procedure

The investigator visited the registered community pharmacy premises and approached the pharmacists. The questionnaire distribution continued every day of the week to the community pharmacies by the principal investigators. Participants were assured of their anonymity and confidentiality of response. Each questionnaire took about 30 min to complete after which the questionnaire was returned and checked for completeness by the investigator. Measures were put in place to ensure that no pharmacist filled more than one questionnaire. This was achieved by coding of each questionnaire administered to the pharmacist from each community pharmacy to avoid duplication. At least one pharmacist per community pharmacy completed the questionnaire on his/her own. The investigator collecting the data was given all the necessary training about the instrument and appropriate ways of approaching the pharmacists and

gaining their permission for filling the questionnaire prior to the data collection process.

Date collection

The main instrument for data collection was a pre-tested semi-structured questionnaire which comprised four sections. Section A obtained the socio-demographic information. Section B contained questions on the community pharmacist's knowledge of the World Health Organisation (WHO) recommended treatment guidelines for malaria. Section C explored the community pharmacist's adherence to WHO treatment guidelines. Section D contained questions on the knowledge of malaria treatment in special risk groups and the treatment of malaria in pregnancy. Respondents who scored at least 10 out of 12 questions were categorized to have had good knowledge.

Pretest/validation of the questionnaire

The questionnaire was assessed for content validity by two academics with public health expertise. The pretest was done among 5 randomly selected pharmacies in Ibadan metropolis, these pharmacies were not included in the study. Feedback from the pretest and validity assessments led to minor modifications.

Statistical analysis

Data was entered and analysed using the Statistical Package for Social Sciences SPSS (version 23). Descriptive statistics including frequencies and percentages were used to summarise the data. Appropriate charts were used to illustrate categorical variables. Chi-square statistics were used to assess association between categorical relevant sociodemographic variables and binary categories of knowledge of malaria treatment in pregnancy. The level of statistical significance was set at $p < 0.05$.

Ethics approval

Ethics consent for the study was acquired from the joint University of Ibadan/University College Hospital Institutional Ethical Review Board (approval no. EC/16/0118). The study was carried out by following the principles outlined in the Helsinki Declaration of 1964 [11].

RESULTS

Of the 85 community pharmacies, 80 (94.1 %) returned the filled questionnaire and were included in the analysis. The sociodemographic characteristics of the community pharmacists in Ibadan are given in Table 1. More than half 44 (55 %) were female, 29 (48.3 %) qualified as pharmacists less than 10 years ago and 25 (31.3 %) of the pharmacists possessed an additional qualification to Bachelor of Pharmacy degree.

Table 1: Socio-demographic characteristics of the community pharmacists in Ibadan, 2016

Characteristic	Frequency	%
Gender (n=80)		
Male	36	45
Female	44	55
Years of qualification (n=60)		
<10	29	48.3
≥10	31	51.7
Additional qualification (n=80)		
Yes	25	31.25
No	55	68.75

The most frequent additional qualification possessed by the community pharmacists was a Master of Science degree 8 (10 %), followed by an MPharm, and fellowship of the West African Postgraduate College of Pharmacists 4 (5 %), respectively. Other additional qualifications are as shown in Figure 1.
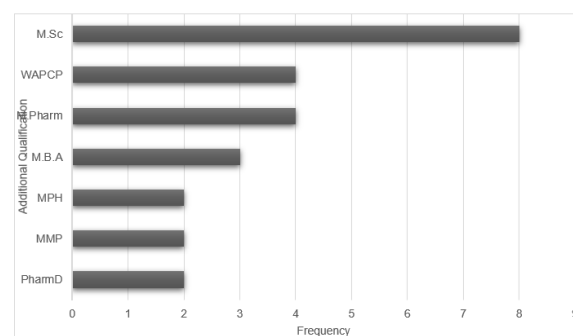
Figure 1: Additional qualification of community pharmacists in Ibadan, Nigeria (2016). *M.Sc = Master of Science; WAPCP = West African Postgraduate College of Pharmacist; M.Pharm = Master of Clinical Pharmacy; M.B.A = Master of Business Administration; MPH = Master of Public Health; MMP = Master in Managerial Psychology; PharmD = Doctor of Pharmacy degree

Table 2 shows the knowledge of WHO treatment guidelines for malaria. From this result, 73 (91.2 %) community pharmacists in Ibadan were aware of WHO treatments guidelines; 27 (35.1 %) had the knowledge that Rapid Diagnostic Test kits and Light Microscopy test are the recommended tools for diagnosis of malaria; 77 (96.2 %) had knowledge of Artemisinin-based combination therapy as the recommended treatment for uncomplicated malaria and 78 (98.7 %) knew the recommended duration of use for Artemisinin-based combination therapy. Intermittent

Prevention and Treatment of malaria in pregnancy (IPTp) was understood by 55 (69.6 %) of the community pharmacists, while 65 (83.3 %) knew the drug of choice in IPTp to be Sulphadoxine-Pyrimethamine; and 13 (18.6 %) were aware of Sulphadoxine-Pyrimethamine to be the recommended drug to prevent malaria in infants less than a year.

The knowledge of special risk groups in malaria treatment shows that 18 (22.7 %) of the pharmacists were aware that HIV patients require special attention; 52 (65.8 %) revealed infants less than a year; and 66 (83.5 %) alleged pregnant women require special attention in treatment of malaria, as shown in Table 3.

The practice of community pharmacists in Ibadan is as shown in Table 4; 65 (92.9 %) have made use of clinical symptoms to diagnose malaria, 51 (76.2 %) have made use of rapid diagnostic test kit (RDT) to diagnose malaria and 17 (28.8 %) have made use of light microscopy test (LMT) to diagnose malaria. On accessibility of the tools for diagnosis of malaria: 19 (30.6 %), and 16 (35.6 %) of the pharmacist said they had access to RDT and LMT, respectively.

Table 2: Knowledge of WHO treatment guideline for malaria among community pharmacists in Ibadan

Variable	Frequency	%
Are you aware of the WHO treatment guidelines		
Yes	73	91.2
No	7	8.8
What are the recommended tools for malaria diagnosis (n=77)		
Clinical symptoms only	7	9.1
RDTs only	35	45.5
Light Microscopy only	8	10.4
RDTs and Light Microscopy	27	35.0
What is the recommended treatment (n=80)		
Artemisinin based combination therapy	77	96.2
Non-Artemisinin based	3	3.8
Recommended duration of ACTs (n=79)		
3 days	78	98.7
Others	1	1.3
Are you aware of IPTp (n=79)		
Yes	55	69.6
No	24	30.4
What is the drug of choice for IPTp (n=78)		
Sulphadoxine-Pyrimethamine	65	83.3
Others	13	16.7
Drug of choice to prevent malaria in infants less than a year (n=70)		
Sulphadoxine-Pyrimethamine	13	18.6
Others	57	81.4

Table 3: Knowledge of special risk group treatment of malaria (n = 79)

Risk group	Frequency	%
Pregnant women (n=79)		
Yes	66	83.5
No	13	16.5
Infants < 1 year- old		
Yes	52	65.8
No	27	34.2
HIV patients		
Yes	18	22.8
No	61	77.2
Hypertensive patients		
Yes	0	0
No	79	100.0
Obese and diabetic patients		
Yes	0	0
No	79	100.0

Table 4: Adherence to WHO treatment guidelines among community pharmacist in Ibadan

Variable	Frequency	%
Ever used clinical symptoms to diagnose malaria (n=70)		
Yes	65	92.9
No	5	7.1
Ever used RDTs to diagnose malaria (n=67)		
Yes	51	76.2
No	16	23.8
Ever used light microscopy test to diagnose malaria (n=59)		
Yes	17	28.8
No	42	71.2
Accessibility of RDTs (n=62)		
Yes	19	30.6
No	43	69.4
Accessibility of light microscopy tests (n=45)		
Yes	16	35.6
No	29	64.4

A majority, 57 (71.3 %) of the community pharmacists had poor knowledge of the medication safety for the treatment of malaria in pregnancy. Table 5 shows their knowledge of anti-malaria safety during pregnancy. Only 41 (51.3 %) of the pharmacist knew Quinine was the safe recommended anti-malaria for use in the first trimester, 47 (58.8 %) and 48 (60.0 %) were aware ACTs are safe for treatment of malaria in second and third trimester respectively.

Table 6 shows the factors associated with knowledge of anti-malaria safety in pregnancy. There was no statistically significant association with pharmacists' years of qualification (p = 0.174) and additional qualification (p = 0.334) acquired by the pharmacists.

DISCUSSION

This study found that the general procedure of managing uncomplicated malaria at community pharmacies in Ibadan, Nigeria was not in agreement with the World Health Organisation (WHO) treatment guidelines. Only about a third of the community pharmacists could identify the recommended tools for the diagnosis of malaria as Rapid Diagnostic Tests (RDTs) and Light Microscopy (LM). The accessibility of both the RDTs and LM were low and could explain why almost all the community pharmacists used clinical symptoms only to diagnose malaria.

Table 5: Knowledge of antimalaria medication safety during pregnancy

Drug	Correct Response n (%)	Wrong Response n (%)
1ST trimester		
Quinine	41 (51.3)	39 (48.8)
ACTs	60 (75.0)	20 (25.0)
S-P	55 (68.8)	25 (31.3)
Primaquine	74 (92.5)	6 (7.5)
2ND trimester		
Quinine	40 (50.0)	40 (50.0)
ACTs	47 (58.8)	33 (41.3)
S-P	60 (75.0)	20 (25.0)
Primaquine	69 (86.3)	20 (25.0)
3RD trimester		
Quinine	36 (45.0)	44 (55.0)
ACTs	48 (60.0)	32 (40.0)
S-P	47 (58.8)	33 (41.3)
Primaquine	70 (87.5)	10 (12.5)
Score distribution	n (%)	
< 40 %	5 (6.3)	
40-79%	52 (65)	
≥ 80 %	23 (28.8)	
Cut-off score		*Remark*
< 80%	57 (71.3)	Poor knowledge
≥ 80 %	23 (28.8)	Good knowledge

*ACTs = artemisinin-based combination therapy; S-P = sulphadoxine-pyrimethamine

Table 6: Factors associated with knowledge of antimalaria safety in pregnancy

Factor	Knowledge of antimalaria safety in pregnancy		Chi square	*P*-value
	Good knowledge (score ≥ 80 %) n (%)	*Poor knowledge (score < 80%) n (%)*		
Gender				
Male	12 (33.3)	24 (66.7)	0.671	0.413
Female	11 (25.0)	33 (75.0)		
Years of Qualification				
Less than 10 years	11 (31.4)	24 (68.6)	1.851	0.174
10 years and above	4 (16)	21 (84)		
Additional qualification				
Yes	9 (36)	16 (64)	0.933	0.334
No	14 (25.5)	41 (74.5)		

*P < 0.05 is significant difference

Misdiagnosis of malaria generally and especially in pregnancy could be dangerous. Misdiagnosis could predispose patients to unnecessary anti-malaria treatment agents, waste of funds in resource-limited environments and perhaps contribute to the development of drug resistance [12,13].

Findings from this study show that the majority of the community pharmacists were aware of the WHO treatment guidelines. Furthermore, the majority of the community pharmacists knew that artemisinin-based combination therapy (ACT) is the recommended medication for malaria management in the general populace and that the duration for treatment with ACT was three days. Less than a quarter of the community pharmacists were aware that Sulphadoxine-Pyrimethamine was the choice of drug to prevent malaria in infants aged less than a year. The lack of knowledge and unawareness of health care professionals including pharmacists about the national and global guidelines on the case management of malaria has been documented in various parts of Africa, such as Benin Republic, Mali, Ghana, Nigeria and also in Asia (Pakistan) [14-18]. Malaria during pregnancy is a substantial public health problem with considerable threats for the pregnant woman, her fetus and the newborn child [8]. Eze *et al* reported malaria as the most prevalent illness among pregnant women visiting antenatal clinics in Nigeria [19]. Early detection of malaria is essential for all patients and especially pregnant women. The non-adherence of the health care professionals to both national and WHO malaria case treatment guidelines is similar to the findings in Western Kenya, Uganda and Nigeria [20-22].

Knowledge of the treatment of uncomplicated malaria in special risk groups by the community pharmacists was poor, only a few of the pharmacists were aware that co-infected HIV patients fall in the risk group. The majority of the pharmacists were, however, aware that infants under one year and pregnant women were also in the malaria risk group. On the other hand, about three-quarters of the community pharmacists had poor knowledge of the case management of malaria in pregnancy and just about two-third of the community pharmacists were knowledgeable about Intermittent Prevention and Treatment of malaria in pregnancy (IPTp).

World Health Organisation recommended a package of interventions for the prevention and treatment of malaria during pregnancy, which include the use of long-lasting insecticidal nets (LLINs); in all malaria-endemic areas in Africa. In addition, intermittent preventive treatment in pregnancy (IPTp) with sulfadoxine-pyrimethamine (SP), as part of antenatal care services and rapid diagnosis and efficient treatment of malaria infections. Unfortunately, the efficacy of sulfadoxine–pyrimethamine is confronted by extensive resistance to drug in various regions. Likewise, some articles reported novel discoveries to encourage the use of artemisinin-based combination therapy equally for the prevention and the management of uncomplicated malaria in pregnancy [23-25].

Data from this study shows no statistically significant difference among community pharmacists concerning years of practice. However, it was observed that pharmacists who

were under 10 years post qualification had better knowledge than their counterparts who had qualified 10 years and over. There are no data in Nigeria showing pharmacists with < 10 years post qualification had better knowledge, however, this might be because the younger pharmacists engage more in training and some professional development. Additional qualification in this study had no statistically significant association in the community pharmacist's knowledge in case management of malaria in pregnancy. This might explain the need for all pharmacists to undergo training in this area regardless of their qualifications. The results in this study are comparable to the findings of Ezennia *et al* [22].

Limitations of the study

This study was conducted among community pharmacists in the Ibadan metropolis, perhaps if conducted in more cities we might have a more comprehensive scenario of the knowledge of community pharmacists in the treatment of malaria in pregnancy. Thus, this may not allow for the generalization of the findings to all community pharmacists in Nigeria. Despite this, the study had a high response rate of 94.1 % and still offers a key insight into the treatment of malaria in pregnancy: knowledge of community pharmacists.

CONCLUSION

This study recognizes substantial gaps among community pharmacists' knowledge on the case management of malaria, and the adherence to the World Health Organisation treatment guidelines. Thus, quality evaluation on the use of appropriate diagnostic tools for malaria such as RDT and LM in pharmacies should be encouraged through monitoring. For example, Pharmacist Council of Nigeria (the body regulating pharmacy practice in Nigeria) or Association of Community Pharmacists in Nigeria (ACPN) could integrate monitoring of RDT and LMT use in pharmacy premises as part of their obligations. There should be active participation of community pharmacist through education and training towards achieving national and global control for successful treatment and regulation of malaria, especially in pregnancy in Nigeria.

DECLARATIONS

Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the author(s) named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Wuraola Akande-Sholabi (WAS) conceived the idea, Ayandare S Ayanleke (ASA), and WAS developed the study protocol, WAS and ASA contributed in the data collection. Olayinka S Ilesanmi (OSI), ASA and WAS, performed data analysis, WAS drafted the manuscript. All authors contributed to the preparation of the manuscript, read and approved the final version.

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REFERENCES

1. Puspitasari H, Aslani P, Krass I. A review of counseling practices on prescription medicines in community pharmacies. Res Social Adm Pharm. 2009; 5(3): 197-210.
2. Brugha R, Zwi A. Improving the quality of private sector delivery of public health services: challenges and strategies. Health Policy Plan. 1998; 13(2): 107-120.
3. Awad A, Abahussain E. Health promotion and education activities of community pharmacists in Kuwait. Pharm World Sci. 2010; 32(2): 146-153.
4. World Health Organization. Global health observatory data repository. Geneva: 2014.
5. World Health Organization. World malaria report (http://wwwwhoint/malaria/publications/world-malaria 2015. (accessed March 20, 2019)
6. Amoran OE, Ariba AA, Iyaniwura CA. Determinants of intermittent preventive treatment of malaria during pregnancy (IPTp) utilization in a rural town in Western Nigeria. Reprod Health. 2012; 9: 12-12.
7. Federal Ministry of Health FMoH. National Malaria Elimination Programme, 20. National Malaria Policy Abuja: 2015.
8. World Health Organisation. Malaria in pregnant women. 2017: 1-3. Available at: https://www.who.int/malaria/ areas/high_risk_groups/pregnancy/en (accessed February 14, 2019)

9. *Yusuff KB, Omarusehe L. Determinants of self-medication practices among pregnant women in Ibadan, Nigeria. Int J Clin Pharm. 2011; 33: 868-875.*

10. *National Population Commission of Nigeria. National and states population and housing tables. Population and housing census of the Federal Republic of Nigeria. Available at www.population.gov.ng. 2006; Accessed 14th February 2018.*

11. *Snežana B. "The declaration of Helsinki: The cornerstone of research ethics". Archive of Oncology 2001; 9 (3): 179–184.*

12. *Chuma J, Okungu V, Molyneux C. Barriers to prompt and effective malaria treatment among the poorest population in Kenya. Malar J. 2010; 9:144.*

13. *White NJ. Antimalarial drug resistance. J Clin Invest. 2004; 113: 1084-1092.*

14. *Ganfon H, Ekanmian G, Amoussou L, Emilie DG, Allabi AC. Evaluation of the knowledge and attitude of pharmacists about the national malaria control policy in southern Benin. BMC Malar J. 2017; 16 (231).*

15. *Sangaré E, Diop S, Dembélé B, Diawara S, Diakité S, Doumbia S. Evaluation de la qualité de la prescription et de la dispensation des combinaisons thérapeutiques à base d'artémisinine (cta) dans le district de Bamako, Mali. Mali Med. 2010; 25: 31-40.*

16. *Asante K, Abokyi L, Zandoh C, Owusu R, Awini E, Sulemana A. Community perceptions of malaria and malaria treatment behaviour in a rural district of Ghana: implications for artemisinin combination therapy. BMC Public Health. 2010; 10: 409.*

17. *Igboeli NU, Ukwe CV, Ekwunife OI. Increasing use of artemisinin-based combination therapy for treatment of malaria infection in Nigerian hospitals. Pharm Pract (Internet). 2010; 8(4): 243-249.*

18. *Malik M, Hassali MA, Shafie AA, Hussain A, Aljadhey H, Saleem F. Case management of malaria fever at community pharmacies in Pakistan: a threat to rational drug use. Pharm Pract 2013; 11(1): 8-16.*

19. *Eze UI, Eferakeya AE, Oparah AC, Enato EF. Assessment of prescription profile of pregnant women visiting antenatal clinics. Pharm Pract. 2007; 5(3): 135-139.*

20. *Riley C, Dellicour S, Ouma P, Kioko U, O. ter Kuile F, Omar A, Kariuki S, Buff AM, Desai M, Gutman J. Knowledge and adherence to the national guidelines for malaria case management in pregnancy among healthcare providers and drug outlet dispensers in rural, western Kenya. PLoS ONE 2016; 11(1).*

21. *Mbonye AK, Buregyeya E, Rutebemberwa E, Clarke SE, Lal S, Hansen KS, Magnussen P, LaRussa P. Treatment and prevention of malaria in pregnancy in the private health sector in Uganda: implications for patient safety. BMC Malar J. 2016; 15: 212.*

22. *Ezennia I J, Nduka S O, Ekwunife O I. Cost benefit analysis of malaria rapid diagnostic test: the perspective of Nigerian community pharmacists. BMC Malar J. 2017; 16:7.*

23. *Tarning J. Treatment of Malaria in Pregnancy Editorial. N Engl J Med. 2016; 374(10).*

24. *The PREGACT Study Group. Four artemisinin-based treatments in African pregnant women with malaria. N Engl J Med. 2016; 374: 913-927.*

25. *Kakuru A, Jagannathan P, Muhindo MK, Natureeba P, Awori P, Nakalembe M, Opira B, Olwoch P, Ategeka J, Nayebare P, Clark TD, Feeney ME, Charlebois ED, Rizzuto G, Muehlenbachs A, Havlir DV, Kamya MR. Dihydroartemisinin–piperaquine for the prevention of malaria in pregnancy. N Engl J Med. 2016; 374: 928-939.*