Research Articles

J Vect Borne Dis 42, September 2005, pp 87–94

Epidemiology, therapeutic agents and cost of management of paediatric malaria in a Nigerian tertiary hospital

Godwin Ray Anugboba Okogun[a] & A.N. Amadi[b]

[a]*Department of Medical Laboratory Sciences, Ambrose Alli University, Ekpoma, Edo State;* [b]*Department of Community of Medicine, College of Medicine, Abia State University Teaching Hospital, Aba, Nigeria*

Background & objectives : Malaria is the most widespread parasitic disease in sub-Saharan Africa with associated high morbidity and mortality especially among the highly predisposed population of pregnant women and children of age five years and below. Living in malaria endemic regions of the world has become associated with health and economic hazards placing financial and productive burden on affected households.

Methods: A prospective study of children treated for malaria and other associated illnesses at a Nigeria tertiary health institution between May and October 2003 was undertaken. The various malaria-associated diseases treated were determined from their provisional diagnosis, hospital records and causative agents confirmed from their diagnostic laboratory results. Cost of treatment was determined from the patients' guardian and confirmed from relevant hospital departments. Common drugs for malaria treatment, their costs, relative effectiveness and frequency of use were determined through a completed questionnaire by health officers and patients' guidance.

Results: Of 5356 paediatric patients suspected of having malaria, 5100 (95.2%) were confirmed positive for malaria parasites microscopically. Of these, 4119 (80.8%) were aged 0 – 6 years, with children aged 1 to 3 years being mostly affected. Eight hundred and twenty (16.1%) of them were in-patients spending an average of six days on hospital bed. Over 22 million naira ($ 0.22 m) was spent on the treatment of malaria with drugs accounting for the major cost (66.81%). About 33.7% of the patients had malaria complicated with other diseases.

Interpretation & conclusion: The effectiveness of common therapeutic agents used for malaria treatment, their costs and associated side effects is discussed. Recommendations are made for appropriate care and government subsidy for paediatric malaria management in sub-Saharan Africa.

Key words Cost – epidemiology – management – Nigeria – paediatric malaria – tertiary hospital – therapeutic agents

Malaria is the most prevalent infectious disease in sub-Saharan Africa. WHO[1] estimated approximately 300–500 million annual cases of malaria world over, with 90% of this number in sub-Saharan Africa, resulting in 1.5–3.5 million deaths. Mortality is predominantly among children of age five years and below[2]. In Nigeria, malaria is directly responsible for over 1,00,000 deaths of children below school age and one quarter of an average family income is spent on the treatment of malaria[3]. The malaria burden is further compounded by abundant vectorial system of the anopheline mosquito vector and its increasing insecti-

cide resistance. The increasing wave of the parasite resistance to current antimalaria drugs has made matters worse[4].

Malaria obstructs overall economic development in Africa. It contributes significantly to hurting the living standards of Africans and impedes the improvement of the living standard of future generations by its debilitating effects. Funds meant for development are channeled annually into provision of malaria drugs, bednets and insecticides. Africa's gross domestic product (GDP) is reduced by over $100 billion by the disease[1].

In malaria endemic areas children suffer an average of six bouts of the disease yearly making it the most common cause of school absenteeism[5]. At least, one third of primary school children in endemic rural areas miss a week of school time due to the disease[6]. Anaemia is an inevitable consequence of malaria infections in children and pregnant women, accounting for 30% of preventable low birth weights among newborn infants, undermining their growth and development[6].

The present study is a prospective investigation of the epidemiology, therapeutic agents used for treatment and management cost of paediatric malaria at the Abia State University Teaching Hospital, Aba. It is aimed at determining some demographic risk factors, common associated diseases, and relative cost of diagnosis and treatment of paediatric malaria.

Material & Methods

Study area: The study was carried out at the Abia State University Teaching Hospital, Aba. Aba is located in Abia State, Eastern Nigeria. It consists of five local government areas. Aba city is located between latitude 5º8'N and longitude 7º20'N. It is tropical in climate with a relief of about 0–200 ft (0–61 m) above the sea level and mean annual temperatures range from 25.5–26.5ºC. It has a wet/raining season (April–early October) and a dry season (late October–March) with peak raining period in June/July. Maximum annual rainfall is 2250–2500 mm. The mean relative humidity is 80%. The population density is about 2000 persons/km^2.

Study design: The study was designed to obtain relevant demographic data, diagnostic laboratory results, drugs and other medications administered and the cost of paediatric malaria management of patients aged 12 years and below suspected of malaria and malaria related illnesses in the hospital between May and October 2003. Investigations were done routinely using standard diagnostic methods. Care types were registered under in-patients, out-patients and children emergency. Data collected from patients and/or patients' records were age, care type, duration of hospital stay, investigations carried out, drugs administered and amount expended at various departments/units in the hospital on treatment folder/receipts at the medical records. Patients without complete records were excluded from the study.

Medical laboratory results were used to confirm clinical provisional diagnosis of consulting physicians. Malaria parasites were investigated using thick and thin blood films and results recorded by the methods of Bruce-Chwatt[7] and Olsen *et al* [8]. Haematocrit, total and differential leucocytes counts were done using Bain's method in Dacie and Lewis[9]. Anaemia was confirmed with a haematocrit value of 25% and below in the study. Urinary tract infections (UTI), upper respiratory tract infection, enteric fever, gastroenteritis and otitis media were confirmed by culture methods, while subcultures were identified using standard bacteriological techniques as described by Mackie and McCartney[10]. Antibiodisc susceptibility was carried out by multidisc technique as described by Stokes and Ridgwey[11]. Amoebiasis and helminthiasis were confirmed in stool by direct saline smear and stool concentration was carried out by formal ether concentration techniques[12]. Jaundice was confirmed by serum and urine bilirubin and viral hepatitis ruled out using hepatitis B and C antigen-antibody reaction kits of Randox Laboratories Inc[13].

Detailed questionnaires prepared for the purpose were used to obtain information on malaria therapeutic

agents used by health officers and patients, their effectiveness, costs and associated side effects.

Statistical analysis: Simple percentages, mean scores, histograms and χ^2 were used to depict the statistical significance of results obtained in the study.

Results

A total of 5766 children aged 12 years and below clinically suspected of malaria fever were examined, of these 5356 children had complete records and were used for this study. Out of the 5356 children clinically suspected and examined for malaria, 5100 (95%) were microscopically confirmed malaria cases [2439 (47%) males and 2661 (53%) females]. The health point prevalence rate of malaria for the age bracket 0–12 years in the hospital was 95%. Fig. 1 shows the paediatrics malaria intensity in the study.

Table 1 shows other paediatric malaria related disease conditions in the study. Anaemia was found to be the

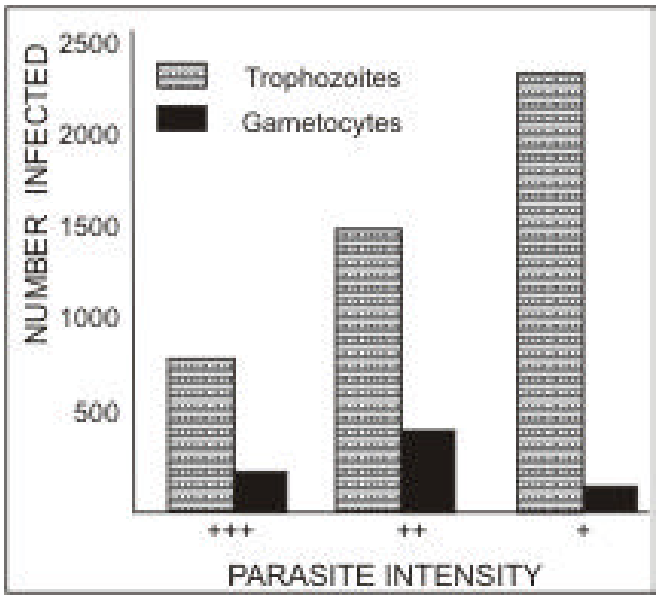

Fig. 1: Intensity of malaria parasites in the study

+ = 10 parasites per 100 thick film fields; ++ = 100 parasites per 100 thick film fields; +++ = 10 parasites per one thick film fields; and ++++ = more than parasites per one thick film fields[7,8].

Table 1. Other diseases/conditions associated with paediatric malaria

Disease	No. infected/ affected (%)	No. uninfected (%)	χ^2	p-value
Urinary tract infections (UTI)	162 (3)	5194 (97)	4.85	> 0.05
Anaemia	689 (12.86)	4667 (87.14)	74.67	< 0.01
Upper respiratory tract infections/Pneumonia	105 (1.96)	5251 (98.04)	7.19	= 0.05
Gastroenteritis	168 (3.14)	5188 (96.86)	7.37	= 0.05
Enteric fever	193 (3.6)	5163 (96.4)	13.59	> 0.05
Helminthiasis	213 (3.98)	5143 (96.03)	33.2	< 0.05
Bacterial skin infection	45 (0.84)	5311 (99.16)	15.2	> 0.05
Jaundice	28 (0.52)	5328 (99.48)	6.1	> 0.05
Amoebiasis	67 (1.25)	5289 (98.75)	35.2	< 0.05
Otitis media	34 (0.64)	5322 (99.36)	12.1	> 0.05
Dysponea	6 (0.056)	5350 (99.89)	3.5	> 0.05
Asthma	6 (0.056)	5350 (99.89)	3.5	< 0.05
Oral thrush	6 (0.056)	5350 (99.89)	3.5	< 0.05
Total	1722 (100)			

most serious and prevalent condition associated with paediatric malaria with a prevalence of 12.86%. This was followed by helminthiasis (3.98%), enteric fever (3.6%), gastroenteritis (3.14%), and urinary tract infection (3%). Others include upper respiratory tract infection/pneumonia (1.96%), amoebiasis (1.25%), bacterial skin infections (0.84%), otitis media (0.64%) and jaundice (0.52%). Dyspnoea, asthma and oral thrush were each 0.056%.

Fig. 2 shows the age related distribution of paediatric malaria in the study. More than 50% of infection rates were at the age bracket 1–3 years, the age bracket 4–6 years followed these with 20.1% of infections recorded. The age groups 0–1 and 7–9 years were both 16.5% and 10–12 years were 8.7% respectively. The mean age of the affected children was 3.12 ± 2.99 (Table 2).

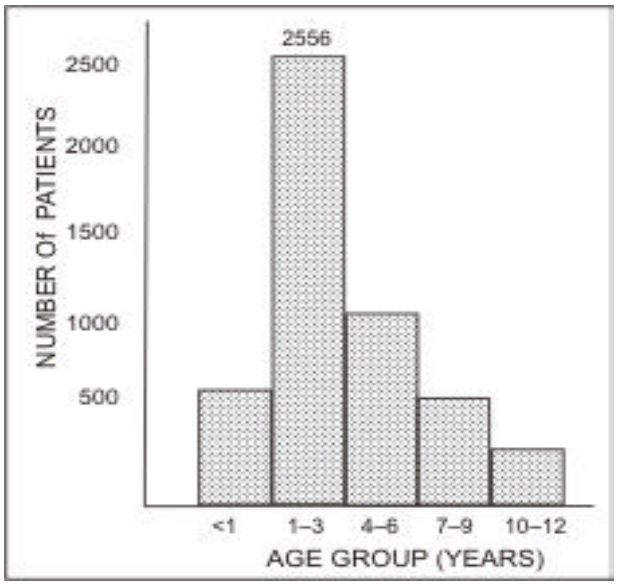

Fig. 2: Age distribution of paediatric malaria patients

The present investigations showed that drugs accounts for > 66.8% of the cost of malaria treatment in the area with 14.71 million Naira. Medical laboratory analysis accounted for 15.5% amounting to 3.42 million Naira and professional fees 11.6% accounting for 2.5 million Naira. Hospital bill (in patients) was 5% accounting for 1.11 million Naira and blood transfusion was 1.1% amounting to 0.24 million Naira. A total of 22 million Naira were expended by 5356 children for treating malaria and malaria related illnesses over a period of six months in the study area (Table 3).

Table 2. Care type, age and sex distribution of patients

Distribution of patients	Male	Female	Total
Age in yr (mean ± SD)	3.16 ± 2.9	3.08 ± 3	3.12 ± 2.99
Number of out-patients	2130	2150	4280
Number on admission	390	430	820
Admission duration (days)	2430	2070	4500

A total of 4280 patients were treated as out-patients, and 642 (15%) of this number were noted to have rejected being admitted on account of lack of funds. In all 820 children were treated as in-patients spending a total of 4500 days in hospital with a mean hospital stay of 5.5 days. In-patients attracted an average additional fee of 1,350 Naira per patient. The hospital charged a professional fee/indirect cost of 500 Naira on prolateral basis for treating children as out-patients (Table 3).

Fig. 3 shows the common therapeutic agents used for malaria treatment in the area. Chloroquine sulphate was the most common drug in use in the area. It also had the highest cases of parasites resistance and treatment failure in the course of the study. This was followed by quinine hydrochloride, which was mainly given to in-patients as quinine drip. The pyrimethamine/

Table 3. Cost of malaria treatment

Bill /Headings	Amount in Naira (%)
Drugs	14,709,500 (66.8)
Laboratory analysis	3,417,000 (15.5)
Professional fee/indirect cost (at 500 Naira per out-patient)	2,550,000 (11.6)
Hospital bill (in-patients)	1,107,540 (5)
Blood transfusion (in-patients)	235,385 (1.1)
Total	22,019,425 (100)

Note: US$ 1 is equivalent to 100 Naira.

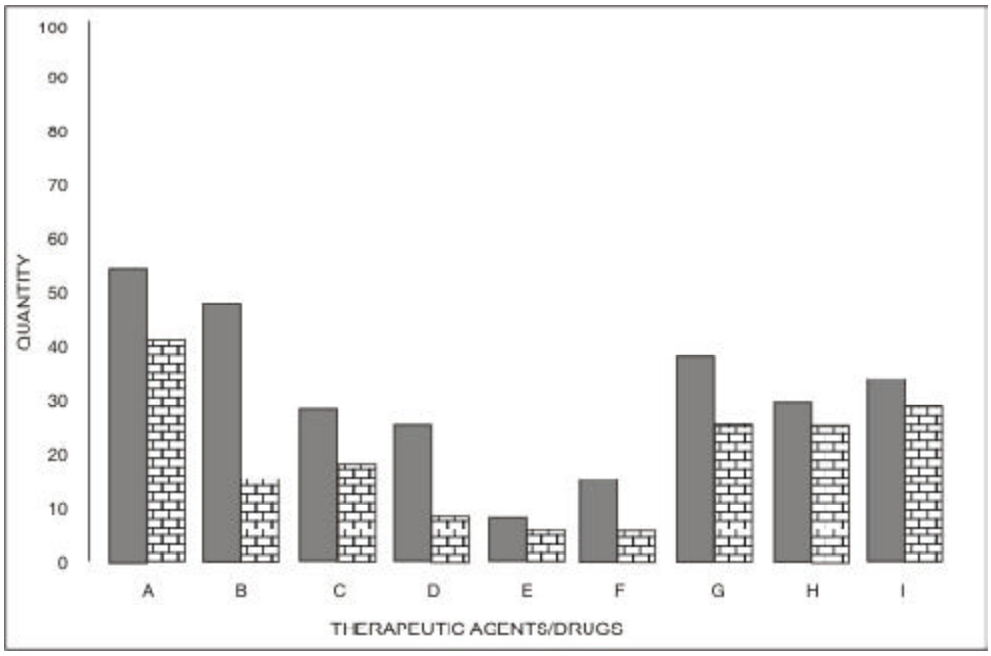

Fig. 3: Common therapeutic agents used in the study area for malaria treatment

A= Chloroquine (Chloroquine sulphate); B = Quinine (Quinine hydrochloride); C = Fansidar (Sulphadoxine/pyrimethamine); D = Maloxine (Sulphadoxine/pyrimethamine); E = Cotecxine (Artimisinin); F = Camoquine (Amodiaquine); G = Halfan (Halofantrine); H = Amalar (Sulphadoxine/pyrimethamine); I = Malwin (Sulphadoxine/pyrimethamine)

sulphadoxine preparations were next most commonly used followed by the amodiaquine. Halfan (halo-fantrine) was mostly given to children aged 0–3 years as syrups, while chloroquine preparations were often combined and/or supplemented by pyrimethamine/sulphadoxine preparations as malwin, amalar and maldox tablets. Cotecxin (artemisinin) was the least prescribed drugs from the hospital pharmacy antimalaria drugs list on the basis of cost. Fig. 4 shows that cost was the most important consideration for paediatric malaria treatment in the hospital. This was followed by effectiveness and side effects in that order.

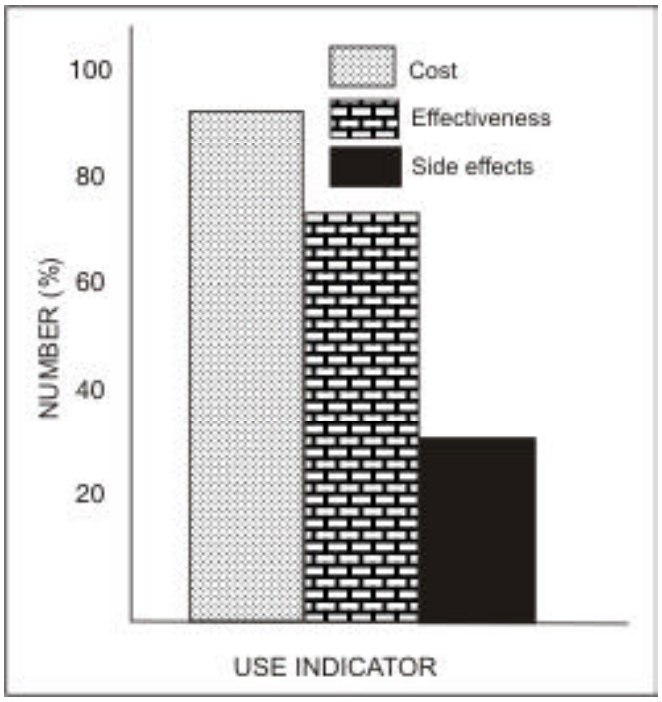

Fig. 4: Cost benefit relationship of common drugs used in the study area

Discussion

Malaria is holoendemic in Nigeria. Various factors are known to contribute to the endemicity of the disease in the study area. These include the ever-deplorable conditions of Aba urban with refuse heaps in and around dust bins, littered around major street junc-

tions, becoming breeding sites for mosquito malaria vectors. Blocked drainages, and domestic water storage facilities contribute to malaria vector abundance in the study area. Further into the suburban areas, mosquito breeding sites are superfluous with ponds, puddles, domestic water storage facilities and bushy surroundings of living homes forming suitable breeding sites for mosquito vectors.

The Abia State University Teaching Hospital as a tertiary hospital serves as a referral centre for patients both from the urban and suburban areas referred from hospitals and health centres in these areas and also it is a resort by patients who chose to come directly to it for purpose of benefiting from its available manpower and facilities.

The health point prevalence of malaria in this study is 95% with a mean infected age of 3.12 ± 2.09 years. This is expected as the hospital is a reference centre with convergence of sick children who may have been treated at home, chemist shops or referred from other hospitals. Furthermore investigation and treatment for malaria is a first line of management for paediatrics in Nigerian health centres. The health point prevalence in this study represents the positive blood smear among investigated children is slightly higher than the crude parasite rates reported by Salako[14] among pre-school age children in parts of Western Nigeria. This is expected as malaria is the major cause of hospital attendance in Nigeria, hence higher infection rates are expected for the children within the age group under study. However, the results confirm a higher parasites rate among pre-school children (below 6 years) as reported by Salako[14] and Stanley[2].

Plasmodium falciparum was the parasite reported in 98% of the cases found in the study. The parasites intensity reported in the study was +, ++ and +++ in that order. This is also similar to the gametocyte rates found in the study. Low parasite counts are often due to ineffective treatment and/or treatment failure as most parents only resort to hospital when they cannot bring the treatment under control. Lack of funds, poor human development index and a poorly developed health system may be accountable for the resort to self-medication by such parents. There was no significant sex-related distribution of infected children in this study. This confirms earlier reports by Stanley[2] and Salum *et al*[15]. Anaemia accounts for 40.1% of the serious conditions associated with malaria in this study. Anaemia is known to be the major cause of death in paediatric malaria especially among children with haemoglobin AA and more precarious are those with haemoglobin SS. In heavy infections, haematocrit of infected children may be reduced by 10% over a 24-hour duration where the treatment failed and/or where proper management was not given. Enteric fever and helminthiasis were compromising conditions among older children of age 6–12 years.

The economic cost of malaria in the study area is high especially on low income earning families as most children have a range of 2–6 bouts of the disease a year with an average of four bouts, this confirms that malaria is a major cause of school absenteeism in sub-Saharan Africa[6]. In our study, an average cost of managing a bout of the disease was 3,800 Naira for out-patients and 4,700 Naira for in-patients, this could be more if blood transfusion is required. The minimum income earning capacity of a Nigerian worker is 6,000 Naira. This portends that such tertiary hospitals that insist on proper procedures of investigation and management outline are beyond the reach of low-income earners. Hence, most parents patronise patent medicine dealers/pharmacy shops, nursing homes and private clinics that are usually less equipped and manned. The issue of meeting with cost of drugs and other services is a major obstacle to the success of home management of malaria in the roll back malaria programme currently being embarked upon by the Nigerian government.

The increasing and widespread of malaria parasite to low cost antimalaria drugs with minimal side effect including chloroquine and sulphadoxine/pyrimethamine

preparations has led to a push to introduce combination therapies particularly those containing more expensive combination drugs including the artemisinin-based derivatives which are over thirty times more expensive than the older drugs. The recent decision by the Nigerian government to subsidise artemisinin for paediatric malaria treatment is a step in the right direction. However, the Nigerian government is currently contemplating a ban on chloroquine-based antimalarial, this does not seem to be a possible solution to malaria resistance as substandard quality and dosage contributed immensely to its ineffectiveness as an antimalarial. The activities of National Food and Drugs Administration and Control (NAFDAC) are currently combating the sales of substandard and fake brands in the Nigerian market.

A combination of chloroquine and sulphadoxine/pyrimethamine preparations seem to be succeeding in malaria management in the study area. This, however, requires proper dosing and management by trained health officers as improper dosing was noticed as the major cause of treatment failure at the family levels. Despite reported cases of treatment failures in some parts of the world, the Chinese herbal drugs Artemisinin and Artemether are highly effective in the study area. An additional advantage of these drugs was that their use did not seem to result in increase of serum fibrinogen concentrations, as is the case with the chloroquine, pyrimethamine/sulphadoxine and the amodiaquine. This, however, requires further studies on its mode of action and effect on human rheology. The major consideration in the choice of therapeutic agents for the management of malaria in the study was at higher cost. This underlines the need for effective and less expensive drugs for malaria management in Nigeria and tropical Africa in general. The economic cost of malaria to sub-Saharan Africa is enormous, and external efforts and cooperation of donor agencies are required to find a solution to this great killer of our time.

Acknowledgement

The authors are grateful to the staff of children emergency, pharmacy and pathology departments of Abia State University Teaching Hospital, Aba. We are particular indebted to Mr. C.O. Emuchuay of the haematology and blood transfusion departments for his assistance and criticisms in the course of this study.

References

1. WHO expert committee on malaria. *XX Tech Rep Ser* No. *892;* 2002: 32.
2. Stanley S. Emergence. Me*d Clin North Am* 1997 *15*(1): 113 – 5.
3. Etuk EU, Umoh UF. The evaluation of some commercially available oral preparations of chloroquine in Sokoto urban. *J Life Environ Sci* 2001; *2*(3): 103–7.
4. White NJ. *Malaria*. In : Cook GC editor. *Manson's tropical diseases*. XX edn. London: WB Saunders 1996; p. 1087–1164.
5. Nigeria supports roll back malaria movement. September Newsletter. Abuja: WHO 1999; p. 2.
6. Roll back malaria. March Newsletter. Lagos: UNICEF 1999; p. 5.
7. Bruce-Chwatt LJ. *Essential malariology*. II edn. London: William Heinemann Medical Books 1985; p. 265.
8. Olsen I, Magnussen P, Onuma JH, Andraessen J, Frilis H. The contribution of hookworm and other parasitic infections to haemoglobin and iron status among children and adults in western Kenya. *Trans R Soc Trop Med Hyg* 1989; *92*: 643–9.
9. Bain BJ. *Basic haematological techniques*. In: Dacie JV, Lewis SM editors. *Practical haematology*. VIII edn. London: Churchill Livingstone1994*;* p. 57–60.
10. Mackie TJ, MacCartney JE. *Practical medical microbiology*. London: Churchill Livingstone 1989; p. 457–78.
11. Stokes EJ, Ridgwey GL. *Clinical bacteriology*. V edn. London: Arnold 1980; p. 33.
12. Muller RH. Worms and disease. *A manual of medical helminthology*. London: Butler and Tanner Ltd, William Heinemann Medical Books 1975; p. 167.

13. *Manual and procedures for clinical reagents*. IV edn. Antrim N. Ireland: Randox Laboratories Ltd. 2001; p. 13–6.

14. Salako LA. In: Alfred C. Buck editor. *USAID: Malaria problems in Africa. III series of regional conferences on the development and clinical evaluation of potential malaria vaccines* 1997; p. 131–40.

15. Salum FM, Wilkes TJ, Kwunbi K, Curtis CF. Mortality of under-fives in a rural area of holoendemic malaria transmission. *Acta Tropica* 1994; *58*: 29–34.

Corresponding author: Dr. G.R.A. Okogun, Department of Medical Laboratory Sciences, College of Medicine, P.M.B. 14, Ekpoma, Edo State, Nigeria
e-mail: graokogun@yahoo.com