African Journal of Pharmacology and Therapeutics Vol. 2 No. 4 Pages 124-129, 2013
Open Access to full text available at http://journals.uonbi.ac.ke/ajpt

Research Article

Choice and Sources of Antimalarial Drugs Used for Self-medication in Kisumu, Western Kenya

Sammy Kimoloi [a,*], Nicky Okeyo [b], Bartholomew N. Ondigo [c], and Bernard K. Langat [d]

[a] *Department of Medical Laboratory Sciences, Masinde Muliro University of Science and Technology, Kakamega, Kenya*
[b] *Department of Nursing, Great Lakes University of Kisumu, Kenya*
[c] *Department of Biomedical Sciences and Technology, Maseno University, Kenya*
[d] *Department of Medical Laboratory Sciences, School of Science and Technology, University of Kabianga, Kericho, Kenya*

* **Corresponding author:** Department of Medical Laboratory Sciences, Masinde Muliro University of Science and Technology, P.O BOX 190-50100 Kakamega, Kenya; **Tel**: +254-56-31375; **Email**: samikimoloi@yahoo.com

Background: The choice and sources of antimalarial drugs used for self-medication has important implication to the current malaria treatment policies in Kenya. However, data on the choice of antimalarial drugs used for self-medication and their sources remains scanty.

Objectives: The objectives of this study were to determine the prevalence of self-medication, the choice and sources of antimalarial drugs used for malaria self-medication in Kisumu city, Western Kenya.

Methodology: This was a cross-sectional community based study, in which semi-structured questionnaires were randomly administered to 338 participants, in five administrative wards of Kisumu city.

Results: Overall, 250 (74%) of the participants reported self-medication for perceived malaria illness. Of the 250 participants, 219 (87.6%) had used an antimalarial drug(s), while 31 (12.4%) took other drugs (antipyretics and herbs), which they perceived to have antimalarial effect. Artemisinin-based combination therapies (ACT), was the drug of choice for majority 154 (70.3%) of those who had self-medicated. The other antimalarials used were sulphadoxine/sulphalene-pyrimethamine 25 (11.4%), amodiaquine 11 (5%), chloroquine 5 (2.3%), quinine 2 (0.9%), dihydroartemisinin 1 (0.5%), halofantrene 1 (0.5%) and 20 (9%) of participants had used two different antimalarials. The antimalarial drugs were sourced from private pharmacies/chemists (78.4%), general retail shops (29.2%), left over drugs at home (1.6%), or friends, relatives and neighbors (2.8%).

Conclusion: Self-medication for perceived malaria is prevalent in Kisumu city. ACT is the drug of choice for self-medication. However, a substantial proportion of individuals use currently ineffective antimalarials or other drugs, for example antipyretics, with no known antimalarial efficacy. Pharmacies/chemists and general retail shops are the major sources for self-prescribed drugs.

Key words: Self-medication, antimalarial drugs, choices, sources

Received: November, 2013
Published: December, 2013

1. Introduction

Malaria affects 154-289 million people and kills 610 000-971 000 annually, with majority of the clinical cases and deaths occurring in Sub-Saharan Africa (WHO 2012). This is in spite of various preventive measures and availability of effective therapies to control malaria. While several factors contribute to the persistence of malaria burden, inappropriate supply and use of antimalarial drugs is potentially a major contributory factor.

 ISSN 2303-9841

Self-medication with antimalarial drugs has been reported in several parts of the world including Yemen (Abdo-Rabbo 2003), Sudan (Awad, et al. 2005), Ghana (Buabeng, et al. 2007), Togo (Deming, et al. 1989) and Ethiopia (Deressa, et al. 2003). In Mtito Andei, Eastern Kenya, antimalarial self-medication was reported among 38% of preschool children, with majority of self-medication being facilitated by mothers (Verhoef, et al. 1999). Antimalarial drugs, mostly chloroquine (CQ), were used in self-treatment of up to 67% of febrile episodes in rural western Kenya (Ruebush, et al. 1995). Antimalarials were also found to be among the most commonly used drugs for self-medication among school going children in another rural area of western Kenya (Geissler, et al. 2000). In Bungoma, 50-80% of individuals obtained antimalarial drugs from private drug outlets for malaria treatment and used these antimalarial drugs even without prescription (Hamel, et al. 2001). A recent study of a peri-urban population in Kisumu found that 61.6% of the respondents took non-prescribed drugs for treatment of perceived malaria (Watsierah, et al. 2011).

Self-medication promotes selection and use of ineffective antimalarial drugs. In Ghana for example, about 56% self-treating individuals chose non-ACT drugs including CQ, artemether (ART), amodiaquine (AQ) and sulphadoxine/sulphalene-pyrimethamine (SP) (Buabeng, et al. 2007). In Kenya, the first line for the treatment of uncomplicated malaria changed from chloroquine to SP drugs in 1998 and subsequently from SP to ACT in 2003 owing to wide-spread CQ and SP resistance, respectively (Amin, et al. 2007). However, a recent study found that ineffective drugs including SP, CQ, and AQ were acquired and used by 46.3% of households in peri-urban parts of Kisumu city (Watsierah, et al. 2011). Similarly, use of ineffective antimalarial drugs for self-medication was also documented during the SP treatment policy period (Guyatt and Snow 2004; Abuya, et al. 2007). The choice of ineffective antimalarial drugs and or non-antimalarial drugs for self-medication may contribute to increased malaria burden, by providing symptomatic relief, thus delaying early diagnosis and administration of curative drug regimens (Watsierah, et al. 2011). Information on antimalarial drugs used for self-medication is therefore needed, as it will assist to curb continuous use of drugs with diminished efficacy.

Self-medication is also commonly associated with inappropriate use of therapeutic drugs. Wrong dosage, wrong frequency and/or wrong duration of therapy were reported among patients who had self-medicated with antimalarial drugs prior to attending health care facilities in Ghana (Buabeng, et al. 2007). Inappropriate use of antimalarial drugs among self-treating patients have also been reported in Southern Ethiopia (Deressa, et al. 2003), Ouagadougou, Burkina Faso (Ouedraogo, et al. 2008), Senegal (Souares, et al. 2009) and Eastern Uganda (Nshakira, et al. 2002).

Local sources of antimalarial drugs form an important component of therapeutic malaria control strategies. Ideally, the sources should persistently supply high quality drugs, at the right dosage and with adequate post-dispensing medical advice. This is not the case however, in malaria endemic regions, as some of the antimalarial drugs from local private pharmacies and general retail shops are of poor quality (Abdo-Rabbo 2003, Amin and Snow 2005, Bate, et al. 2008). Knowledge of key aspects of current antimalarial drug policy and dosing regimens among the workers of private retail drug sources is also poor and private retailers sell partial drugs packs (Watsierah, et al. 2012). In addition, high proportion of incorrect choice and inappropriate use of antimalarial drugs have been attributed to acquisition of drugs from the informal sources (Deressa, et al. 2003; Buabeng, et al. 2007; Watsierah, et al. 2011; Aborah, et al. 2013). Local sources of antimalarial drugs used for self-medication are therefore potential targets for interventions aimed at improving malaria control. In view of these, this study was designed to determine the prevalence of self-medication for malaria, the choice and the sources of antimalarial drugs in Kisumu city.

2. Methods

2.1 Study site

The study was conducted in Kisumu city (0° 06'S, 34 45'E), a third major Kenyan city with a population of about 388,311 [Kenya population and housing census, 2009, http://www.knbs.or.ke/census].The city serves as a major trading, industrial, transportation and administrative center in the Lake Victoria basin. The city also serves as the communication and trading link for the Great Lakes region, Tanzania, Uganda, Rwanda and Burundi. Healthcare in Kisumu city is provided by both public and private healthcare facilities.

2.2 Study Design and sampling

This was a community based cross-sectional study. Cluster sampling was used to obtain a representative sample of 338 respondents from five administrative city council wards namely; Manyatta, Nyalenda, Migosi, Nyawita and Kisumu Township. The wards were divided into clusters in proportion to populations of the residents living in them. From each of these clusters, ten households were randomly selected and data collected from consenting adult members, who had resided in their households for at least six months.

2.3 Data collection

Individuals in selected households were approached, given explanation on the purpose of the study and written consent sought. Semi-structured questionnaires consisting of both closed and open-ended questions were then administered to consenting individuals by research assistants. Collected information included; demographics, antimalarial self-treatment in the previous three months, choice of drugs, reasons for self-treatment and sources of antimalarial drugs. In cases of more than one malaria episodes within the previous three months, participants were asked about the most recent episode. Self-treatment was defined as the use of an antimalarial drug without clinical consultation.

2.4 Statistical analysis

Collected data were entered into an Excel sheet then exported into Statistical Package for Social Sciences (SPSS, version 17). Descriptive analysis was done to describe proportions of required indicators.

ISSN 2303-9841

2.5 Ethical considerations

The study was approved by Great Lakes University of Kisumu Ethical Review Committee, (Ref. **GERC/038/2011**). Written informed consent was obtained from each participant and confidentiality of responses was maintained throughout the study.

3. Results

Demographic characteristics of study participants

The study population comprised 338 individuals, and of those who disclosed their gender, 137 (40.5%) were men and 198 (58.6%) women. 50.6% of the study population had post primary education while 43.8% of the population had completed primary education and the remaining 5.6% had no formal education. Small business was the most commonly reported occupation (**Table 1**).

Table 1: Demographic characteristics of study population

Characteristic		N (%)
Gender:		
	Male	137 (40.5)
	Female	198 (58.6)
	No Response	3 (0.9)
Education:		
	Primary	148 (43.8)
	Secondary	98 (29.0)
	Tertiary	56 (16.6)
	University	17 (5.0)
	No formal education	14 (4.1)
	No Response	5 (1.5)
Occupation:		
	No response	29 (8.6)
	Local transportation	23 (6.8)
	'Jua kali' business*	141 (41.7)
	Construction/Masonry	4 (1.2)
	Formal employment	48 (14.2)
	Farming	8 (2.4)
	Fishing	4 (1.2)
	House wife	15 (4.4)
	Jobless	37 (10.9)
	Others	9 (2.7)
	Student	20 (5.9)

** Jua kali - a term used to mean informal, small scale artisan/craftsmen businesses*

Table 2: Reasons for self-medication (N=250)

Reason	(%)[a]
Lower cost	122 (42.8)
Time saving	51(17.9)
Easy accessibility to drug source	38(13.3)
Perceived self-medication effectiveness	33(11.6)
Perceived mild severity	22(7.7)
First treatment step	21(7.4)
Distant health care facilities	18(6.3)
Previous successful self-treatment experience	12(4.2)
Public medical education	7(2.5)
Relative or friend influence	6(2.1)
Did not mention any	5 (1.8)

[a] *Total percentages exceed 100% because of multiple responses.*

Table 3: Antimalarial drugs used for self-medication (N=219)

Drug (s)	N (%)
Artemisinin combined therapies (ACT)	154 (70.3)
Sulfadoxine–pyrimethamine (SP)	25 (11.4)
Amodiaquine (AQ)	11 (5.0)
Cloroquine (CQ)	5 (2.3)
Quinine	2 (0.9)
ACT + SP	7 (3.2)
ACT + AQ	9 (4.0)
ACT + Q	2 (0.9)
SP + AQ	2 (0.9)
Dihydroartemisinin	1 (0.5)
Halofantrine	1 (0.5)

Prevalence of self-medication

Out of the 338 participants 250 (74%) had self-medicated for malaria within the three months prior to the study. When asked whether any other member of their household had self-medicated within the same period, 220 (65%) of the respondents mentioned that other household member had also self-medicated. Analysis of the respondent's relationship to the other family members who had practiced self-medication revealed that, 55% were respondent's child, 18.6% were respondent's siblings, 11.8% were parents and 2.7% were other forms of relationship (house help, in-laws).

ISSN 2303-9841

Reasons given for self-medication with antimalarial drugs included; far distance to the nearest health care facilities, perceived mild severity of illness, perceived effectiveness of self-medication, cost effectiveness, to save time, previous successful self treatment, ease of access to drug sources, public medical education, family or friend influence and as initial treatment before visiting an hospital (**Table 2**). Of the 250 respondents, 219 (87.6%) had used antimalarial drug(s), while 31 (12.4%) took other drugs (antipyretics and herbs) perceived to have antimalarial effect.

Choice and sources of antimalarial drugs

Artemisinin combined therapy (ACT) antimalarial drugs were the most commonly used drug for self-medication (70.3%) The other antimalarials used were sulphadoxine/sulphalene-pyrimethamine (11.4%), amodiaquine (5%), chloroquine (2.3%), quinine (0.9%), dihydroartemisinin (0.5%), halofantrene (0.5%) and 9% of participants had used two different antimalarials (**Table 3**). When asked about the sources of the antimalarials, majority of the participants mentioned private pharmacy, followed by retails shop. Other reported sources included left over drugs from previous treatment, neighbors, friends and relatives (**Table 4** and **5**).

Table 4: Sources of drugs used for self-medication N=250

Source	N(%)[b]
Private pharmacy/chemist	196 (78.4)
Retail shops/kiosk	73 (29.2)
Left over drugs	4(1.6)
Friend	3 (1.2)
Relative	2 (0.8)
Neigbours	2 (0.8)

[b] *Total percentages exceed 100% because of multiple responses*

Table 5: Sources of specific antimalarial drugs used for self-medication

Drug	Private pharmacy/chemist	Retail shops	Left over	Neighbours	Relatives/friends
ACT	139 (81%)	30 (17%)	1(1%)	1 (1%)	
Dihydroartemisinin	1(100%)				
SP	22 (65%)	9 (26%)			3 (9%)
Amodiaquine	19 (86%)	3 (14%)			
Chloroquine	4 (75%)	1 (25%)			
Halofantrine	1 (100%)				

4. Discussion

Self-medication with antimalarial drugs is a widespread practice in malaria endemic countries and more than half of the world's antimalarials is consumed outside the formal health sector (Foster 1995). In this study, we show that 74% of the respondents had self-medicated with antimalarial drugs. Secondly, our study demonstrates that ACTs are drugs of choice for majority (70.3%) of the respondents, which highlights a relatively good awareness of current national policy of using ACTs as the first line treatment. Most importantly, this study reports that private pharmacies/chemists were the major sources of the antimalarial. The high endemicity of malaria in lake Victoria region (DOMC, 2011) and easy accessibility of antimalarial drugs from private drug outlets may account for the reported high proportion of respondents practicing self-medication. The high prevalence of self-medication with antimalarial drugs in our study population emphasizes the need for enhanced public medical education on the disadvantages of self-medication and/or appropriate self-medication practices.

Factors that have been cited to contribute to self-medication include cost, time, inadequate health services, perceived disease severity and distant formal health care facilities (McCombie 1996). In the present study, cost, time, easy accessibility to antimalarial drug source and perceived self-medication effectiveness emerged as the major contributory factors for malaria self-medication. One goal of national malaria control is prompt diagnosis and effective treatment of all suspected malaria cases and the government has strived to achieve this goal through provision of free malaria treatment in its health facilities (DOMC, 2011). However, the finding of cost as the most important factor driving self-medication in the present study demonstrate that indirect costs, probably transport and registration card fee may still be hindering many patients from seeking prompt and effective free malaria treatment offered in government facilities. One potential way of increasing the number of malaria cases that receive prompt and appropriate treatment would be provision of quality antimalarial drugs as close to the households as possible. The other factors motivating self-medication such as long waiting duration before one is attended to and perceptions should also be addressed effectively.

The prevalence of self-mediation reported in this study is in agreement with similar studies performed in rural areas of Western Kenya (Ruebush, et al. 1995), Kenyan Coast (Mwenesi, et al. 1995), Southern Ethiopia

 ISSN 2303-9841

(Deressa, et al. 2003) and Togo (Deming, et al. 1989). However, our reported self-treatment rate is much higher compared to findings of studies in Ghana (Buabeng et al. 2007; Aborah,et al. 2013) and Guyana (Booth 2001). In contrast to our findings, an earlier study conducted in Nigeria, reported that 27.1% of self-treating respondents used ACTs, while majority used chloroquine and quinine (Jombo, et al. 2010). Concerted public education campaigns by the health care authorities, mass media and the aggressive marketing by distributors may have all contributed to selection and use of ACTs by a large proportion of the study population. Our findings showed that 25.5% of respondents who had self-treated for malaria, used non-ACT drugs including CQ, DHA, AQ and SP. The use of these currently ineffective drugs threatens the success of malaria control efforts since it leads to delay in early diagnosis and treatment with effective ACTs. The continuous use of non-ACT drugs may be due to low awareness and knowledge about the effective treatment for malaria among consumers in the study area (DOMC, 2011) or inadequate public education on malaria treatment policies.

The sources of drugs for self-medication in our study included private pharmacies, general retail shop, left over drugs at respondent's home, neighbor's homes, friends and relatives. These sources are similar to those reported earlier in other regions where malaria is endemic (Deressa, et al. 2003; Buabeng, et al. 2007; Aborah, et al. 2013). Private pharmacies and retails stores were the most popular source of ACTs and non-ACTs. This can be attributed to the urban nature of our study area, where several private pharmacies/chemist and general retail stores can easily be accessed by household members. The easy acquisition of ACTs from these two commercial drug sources without a prescription may also explain their popularity among the study population. The continued availability and easy access of non-ACTs in private pharmacies and general retail stores in our study area raises serious health concerns. Apart from being ineffective against malaria, the quality and safety of non-ACT antimalarial drugs, some of which have been banned by the government is questionable. The acquisition and use of artemisinin monotherapies like dihydroartemisin also exposes artemisinin to parasite resistance. Lack of knowledge about the recommended first line treatment among the private retail drug sellers (Watsierah, et al. 2012), or weak enforcement of drug policies in the private retail market may be responsible for the continuous stocking and dispensing of non-ACTs.

Equally alarming is the sourcing of antimalarial drugs from relatives, neigbours or friends. These sources points to malaria treatment non-adherence, potential underdosage and use of expired or poor quality drugs in the study area. Non-adherence and underdosage of ACTs may accelerate emergence of resistance, as already witnessed in parts of Asia (Dondorp, et al. 2009, Noedl, et al. 2008, Phyo, et al. 2012), thus threatening the worldwide malaria control and treatment efforts (Dondorp, et al. 2011).

The antimalarial drug sources identified by our study represent potential targets for interventions against inappropriate use of ACTs. There is urgent need for increased awareness campaigns and/or training of private health sector and informal drug outlet workers on the importance of dispensing, only the recommended effective antimalarial to users. The government through drug regulatory agencies should also conduct continuous market surveillance to ensure that ineffective drugs are not stocked and made available to consumers in order to reduce their persistent use. These should be complemented with education of the consumers who obtain and use antimalarial drugs from these sources for self-medication.

5. Conclusion

The findings of this study reveal a high prevalence of self-medication with both ACT as well as currently ineffective non-ACT drugs in Kisumu city. Private pharmacies and general retail shops are two main sources of antimalarial drugs used for self-medication.

Conflict of Interest declaration

The authors declare no conflict of interest

Acknowledgement

The authors acknowledge the hardworking research assistants, who collected the data in this study, and appreciate the study participants who volunteered to participate in the study.

References

Abdo-Rabbo A (2003). Household survey of treatment of malaria in Hajjah, Yemen. *East Mediterr Health J.* **9:** 600-606.

Aborah S, Akweongo P, Adjuik M, Atinga RA, Welaga P, and Adongo PB (2013). The use of non-prescribed antimalarial drugs for the treatment of malaria in the Bolgatanga municipality, northern Ghana. *Malaria J.* **12:** 266-272.

Abuya TO, Mutemi W, Karisa B, Ochola SA, Fegan G, and Marsh V (2007). Use of over-the-counter malaria medicines in children and adults in three districts in Kenya: implications for private medicine retailer interventions. *Malaria J.* **6:** 57-66.

Amin AA, and Snow RW (2005). Brands, costs and registration status of antimalarial drugs in the Kenyan retail sector. *Malaria J.* **4:** 36-41.

Amin AA, Zurovac D, Kangwana BB, Greenfield J, Otieno DN, Akhwale WS, and Snow RW (2007). The challenges of changing national malaria drug policy to artemisinin-based combinations in Kenya. *Malaria J.* **6:** 72-82.

Awad A, Eltayeb I, Matowe L, and Thalib L (2005). Self-medication with antibiotics and antimalarials in the community of Khartoum State, Sudan. *J. Pharm. Pharm. Sci.* **8:** 326-331.

Bate R, Coticelli P, Tren R, and Attaran A (2008). Antimalarial drug quality in the most severely malarious parts of Africa - a six country study. *PLoS One.* **3:** 2132-2134.

 ISSN 2303-9841

Booth C (2001). Knowledge, Treatment-Seeking and Socioeconomic Impact of Malaria on the Essquibo Coast of Guyana. *McGill J. Med.* **6:** 17-25.

Buabeng KO, Duwiejua M, Dodoo AN, Matowe LK, Enlund H (2007). Self-reported use of antimalarial drugs and health facility management of malaria in Ghana. *Malar J.* **6:** 85-90.

Deming MS, Gayibor A, Murphy K, Jones TS, and Karsa T (1989). Home treatment of febrile children with antimalarial drugs in Togo. *Bull. World Health Organ.* **67:** 695-700.

Deressa W, Ali A, Enqusellassie F (2003) Self-treatment of malaria in rural communities, Butajira, southern Ethiopia. *Bull. World Health Organ.* **81:** 261-268.

Department of malaria control, KNBS, Macro I (2011). 2010 Kenya Malaria Indicator Survey. Ministry of Public Health and Sanitation, Nairobi, Kenya.

Dondorp AM, Fairhurst RM, Slutsker L, Macarthur JR, Breman JG, Guerin PJ, Wellems TE, Ringwald P, Newman RD, Plowe CV (2011). The threat of artemisinin-resistant malaria. *New Engl. J. Med.* **365:** 1073-1075.

Dondorp AM, Nosten F, Yi P, Das D, Phyo AP, Tarning J, Lwin KM, Ariey F, Hanpithakpong W, Lee SJ, Ringwald P, Silamut K, Imwong M, Chotivanich K, Lim P, Herdman T, An SS, Yeung S, Singhasivanon P, Day NP, Lindegardh N, Socheat D, and White NJ (2009). Artemisinin resistance in *Plasmodium falciparum* malaria. *New Engl. J. Med.* **361:** 455-467.

Foster S (1995). Treatment of malaria outside the formal health services. *J. Trop. Med. Hyg.* **98:** 29-34.

Geissler PW, Nokes K, Prince RJ, Odhiambo RA, Aagaard-Hansen J, and Ouma JH (2000). Children and medicines: self-treatment of common illnesses among Luo schoolchildren in western Kenya. *Soc. Sci. Med.* **50:**1771-1783.

Guyatt HL, and Snow RW (2004). The management of fevers in Kenyan children and adults in an area of seasonal malaria transmission. *Trans. R. Soc. Trop. Med. Hyg.* **98:** 111-115.

Hamel MJ, Odhacha A, Roberts JM, and Deming MS (2001). Malaria control in Bungoma District, Kenya: a survey of home treatment of children with fever, bednet use and attendance at antenatal clinics. *Bull. World Health Organ.* **79:** 1014-1023.

Jombo G, Mbaawuaga E, Akaa PD, Alao O, Peters E, Dauda M, Okwori E, Akosu T, Etukumana E, and Yaakugh J (2010). Choices of drugs for self-treatment of malaria among adult women in a Nigerian city: Implications for the success of the ongoing 'roll back' malaria programme. *J. Microbiol. Antimicrob..* **2:** 57-63.

McCombie SC (1996). Treatment seeking for malaria: a review of recent research. *Soc. Sci. Med.* **43:** 933-945.

Mwenesi H, Harpham T, and Snow RW (1995). Child malaria treatment practices among mothers in Kenya. *Soc. Sci. Med.* **40:** 1271-1277.

Noedl H, Se Y, Schaecher K, Smith BL, Socheat D, and Fukuda MM (2008). Evidence of artemisinin-resistant malaria in western Cambodia. *New Engl. J. Med.* **359:** 2619-2620.

Nshakira N, Kristensen M, Ssali F, and Whyte SR (2002). Appropriate treatment of malaria? Use of antimalarial drugs for children's fevers in district medical units, drug shops and homes in eastern Uganda. *Trop. Med. Int. Health.* **7:** 309-316.

Ouedraogo LT, Some IT, Diarra M, and Guissou IP (2008). Self-medication in the treatment of acute malaria: study based on users of private health drug stores in Ouagadougou, Burkina Faso. *Bull. Soc. Pathol. Exot.* **101:** 124-127.

Phyo AP, Nkhoma S, Stepniewska K, Ashley EA, Nair S, McGready R, ler Moo C, Al-Saai S, Dondorp AM, Lwin KM, Singhasivanon P, Day NP, White NJ, Anderson TJ, and Nosten F (2012). Emergence of artemisinin-resistant malaria on the western border of Thailand: a longitudinal study. *Lancet.* **379:** 1960-1966.

Ruebush TK, Kern MK, Campbell CC, Oloo AJ (1995). Self-treatment of malaria in a rural area of western Kenya. *Bull World Health Organ.* **73:** 229-236.

Souares A, Lalou R, Sene I, Sow D, and Le Hesran JY (2009). Factors related to compliance to antimalarial drug combination: example of amodiaquine/sulphadoxine-pyrimethamine among children in rural Senegal. *Malaria J.* **8:**118-225.

Verhoef H, Hodgins E, Eggelte TA, Carter JY, Lema O, West CE, and Kok FJ (1999). Antimalarial drug use among preschool children in an area of seasonal malaria transmission in Kenya. *Am. J. Trop. Med. Hyg.* **61:** 770-775.

Watsierah CA, Jura WG, Oyugi H, Abong'o B, and Ouma C (2010). Factors determining antimalarial drug use in a peri-urban population from malaria holoendemic region of western Kenya. *Malaria J.* **9:** 295-302.

Watsierah CA, Jura WG, Raballah E, Kaseje D, Abong'o B, and Ouma C (2011). Knowledge and behaviour as determinants of antimalarial drug use in a peri-urban population from malaria holoendemic region of western Kenya. *Malaria J.* **10:** 99-105.

Watsierah CA, Onyango RO, Ombaka JH, Abong'o BO, and Ouma C (2012). Provider knowledge of treatment policy and dosing regimen with artemether-lumefantrine and quinine in malaria-endemic areas of western Kenya. *Malaria J.* **11:** 436-444.

World Health Organization (2012). World Malaria Report. Geneva, Switzerland. 53-62.

 ISSN 2303-9841