International Health 2 (2010) 262–268

Contents lists available at ScienceDirect

International Health

journal homepage: http://www.elsevier.com/locate/inhe

Challenges to implementation of artemisinin combination therapy policy in Uganda

Vincent Batwala [a,c,*], Pascal Magnussen [b], Fred Nuwaha [c]

[a] Department of Community Health, Mbarara University of Science & Technology, P. O. Box 1410, Mbarara, Uganda
[b] Centre for Health Research and Development, Faculty of Life Sciences, Copenhagen University, Thorvaldsensvej 57, DK1871 Frederiksberg C, Denmark
[c] Disease Control and Environmental Health, Makerere University School of Public Health, PO Box 7072, Kampala, Uganda

ARTICLE INFO

Article history:
Received 25 November 2009
Received in revised form 5 April 2010
Accepted 6 July 2010
Available online 7 August 2010

Keywords:
Artemisinin Combination Therapy
Malaria diagnosis
Treatment

ABSTRACT

Uganda launched an artemisinin combination therapy (ACT) policy in 2006, using artemether-lumefantrine (AL) as first-line treatment for uncomplicated malaria, but insufficient information is available regarding its implementation. Semi-structured interviews were conducted with key personnel: 32 clinical and four laboratory staff from 32 health centres (HCs) in Bushenyi and Iganga districts and the Ministry of Health. Structured interviews with 613 patients receiving malaria treatment at six randomly chosen HCs were held. Data were collected on availability of antimalarials, treatment guidelines, staffing and malaria treatment decisions. Posts for clinical staff were inadequately filled. Only 15 (46.9%) HCs stocked AL for all weight categories. Nationwide, AL was out-of-stock March–July 2007. Twenty-one (65.6%) HCs stocked chloroquine. Out of 193 patients, 177 (91.7%) used antimalarials other than AL before coming to HCs. The unrecommended antimalarials were mainly sourced from the private for profit (PFP) sector yet there were no guidelines regarding provision of AL in the PFP sector. Only 53/613 (8.6%) patients were examined for parasites and only 8 (15.1%) had a positive blood slide. The majority of the patients attending HCs (560; 91.4%) received antimalarials but only 323 (57.7%) received AL. In order to improve the implementation of the current policy, AL should be availed in adequate amounts at all points of care including the PFP sector; non-recommended drugs should be withdrawn from the market and it should be ensured that malaria is confirmed by laboratory diagnosis. Study registration: Clinicaltrials.gov NCT00565071.

1. Introduction

In recent years, the threat posed by failing, but inexpensive, antimalarial monotherapy such as chloroquine (CQ), sulphadoxine-pyrimethamine (SP) or in combination led to an international effort to replace these drugs with relatively more expensive artemisinin combination therapies (ACTs) for the treatment of uncomplicated malaria.[1,2] In 2002, the treatment policy in Uganda was changed from CQ to a combination of CQ + SP. This policy was short-lived due to an observed increase in resistance to 16% for SP alone and 12% to CQ + SP by 2004.[3] This observation coincided with the World Health Organization (WHO) recommendation to treat uncomplicated malaria using ACT. The Uganda government again changed the first-line drug from CQ + SP to artemether-lumefantrine (AL) in 2005.[4] The current malaria treatment policy further states that artesunate + amodiaquine is the alternative that can be used in situations where AL is not available. Oral quinine is the second-line drug to be given if AL has failed or when it is contra-indicated. Parenteral quinine is recommended for

* Corresponding author. Tel.: +256 712 074706.
E-mail addresses: vbatwala@yahoo.com, vkbatwala@gmail.com (V. Batwala).

1876-3413/$ – see front matter © 2010 Royal Society of Tropical Medicine and Hygiene. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.inhe.2010.07.002

severe and complicated malaria, while SP is for intermittent preventive treatment during pregnancy. For malaria in pregnancy, quinine is the recommended treatment.

AL is a co-formulation containing 20 mg artemether and 120 mg lumefantrine per tablet. It is supplied by government through the drugs and supply delivery chain from the National Medical Stores (NMS). Patients access these drugs at no cost. AL is distributed as packaged in four different weight-specific categories: 5–14 kg, 15–24 kg, 25–34 kg and ≥35 kg.[5] It is a three-day course of oral treatment with tablets taken twelve-hourly.

Several studies have reported on the difficulties facing changes in national antimalarial drug policy such as conflict of interest of pharmaceutical companies, delays in release of funds, complex drug ordering[6–8] and non adherence of health workers to treatment guidelines.[9–11] Thus, understanding the key factors that facilitate or undermine policy implementation in various contexts is critical for guiding resource allocation. In this paper, we describe the challenges to ACT policy implementation at rural public health centres in Bushenyi and Iganga districts of Uganda. This data is part of the ongoing trial assessing the cost-effectiveness of managing malaria with AL using various diagnostic techniques.

2. Materials and Methods

2.1. Type of study, population and setting

The study design was cross sectional and data was collected from September 2006 to February 2007. Thereafter, drug stock status was monitored monthly until July 2007. Information was collected from rural health workers at public health centres at sub-county level (HC III), outpatients attending these units and at the Ministry of Health level. The study was carried out in Bushenyi district located in south-western Uganda and Iganga district in the eastern part of the country. The two districts were selected because they experience different malaria transmission intensities.

Bushenyi district: Bushenyi has a population of 731 392. The district is divided into seven health service zones (Health Sub-Districts or HSDs) with four hospitals, six health centres (HC) at county level (HC IV), 20 public HC III and 56 health centres at parish level (HC II). The district experiences low and unstable malaria transmission with people of all ages being at risk. It is epidemic-prone, with occasional malaria outbreaks occurring shortly after the rains.[12] Before the change to the current malaria policy, Bushenyi had a strong home-based management of fever (HBMF) strategy that was being implemented by 4034 community drug distributors (CDDs). HOMAPAK (CQ + SP) was used in HBMF for children under five years of age.

Iganga district: Iganga has a total population of 540 939. The district is divided into four HSDs. It has one public hospital, three HC IV, 15 HC III and 57 HC II. The district experiences very high malaria transmission intensity. Malaria is the leading cause of morbidity and outpatient attendance for all age-groups.[13] Before the current malaria treatment policy, Iganga trained 1396 CDDs but they were not active due to lack of HOMAPAK.

2.2. Health Centre grade III

HC III is an intermediate-referral unit serving a sub-county with an estimated population of 25 000. It provides the following services: general outpatient, family planning, immunisation, counselling and testing of HIV, maternity and postnatal care, laboratory, inpatient care, environmental health and home visiting to review the progress of critically ill patients. Ideally it is manned by two clinical officers (medical assistants), one nursing officer, two enrolled/registered nurses, two midwives, three nursing assistants, one health assistant, one laboratory technician, one laboratory assistant, a records officer, two night watchmen and two porters. However, all these staff categories are rarely found at the HCs. Clinical officers have three years of pre-service training, certificate-holder nurses and midwives have two, while the training for nursing assistants varies from three to nine months.

Requisition for AL is made by HC staff employing the 'pull' system. This is a demand-based system where quantification of drugs is based on the number of patients seen and the diagnoses made in the previous month. Drugs are delivered by NMS to the district headquarters from where they are collected by the HCs. The duration from requisition to notification of drug availability at NMS is unpredictable. However, if some of the requested drugs are not available, a certificate of non-availability is issued permitting the HC to purchase elsewhere.

The policy was changed in 2005, but it was launched on 25 April 2006. Prior to the distribution of AL, malaria case management guidelines were developed,[14] and wall charts were prepared to serve as job aids.[7,15] In-service training for health workers was conducted starting with 'training of trainers' (that included senior clinicians) at the national level, who in turn facilitated the training at the districts. The training sessions for lower cadres of staff were conducted at their health units. AL was then distributed to public health units.

As a quality control measure in the delivery of services, sub-county HCs are visited and supervised by staff from the county-level HC, termed 'support supervision'. At the end of the visit, a technical support supervision report is made and a meeting held with staff to discuss the findings plus giving suggestions for improvement.

The HC III is unique in that it is placed in the middle of the patients' referral pathway (between parish HCs and county HCs). Unlike at the higher levels of care, the policy of having functional laboratories at HC III is not fully implemented. Most HCs either lack equipment and supplies or do not have laboratory personnel. In order to contribute to improvement of delivery of health services, it was considered appropriate to conduct the study at this level.

2.3. Data collection

A one-week training workshop for the research team was conducted in each district. All members underwent rigorous training including theory and practice during pilot testing of the questionnaires. The questionnaires were tested in three HCs in Mbarara and three in Mayuge districts for their accuracy and reliability in collecting the required

Table 1
Posted staff at sub-County public health centres compared with the recommended staffing.

Cadre	Health centres with stated cadre posted					Recommended staffing	Total filled post in 32 HCs	Total[b] recommended in 32 HCs	% posts filled
	0	1	2	3	4				
Clinical officer	6	25	1			2	27	64	42
Nursing officer	17	14	1[a]			1	15	32	47
Enrolled/Registered nurse	18	13	1			2	15	64	23
Midwife	3	25	3		1[a]	2	31	64	48
Nursing assistant	4	15	8	4	1[a]	3	43	96	45
Laboratory technician	31	1				1	1	32	3
Laboratory assistant	21	11				1	11	32	34
Health assistant	6	25	1[a]			1	26	32	81
Records assistant	17	15				1	15	32	47
Night watchman	6	22	4			2	30	128	23.4
Porter		22	9	1[a]		2	42	64	65

[a] Excess staff were excluded in computation of percentages.
[b] Total recommended posts = 32 health centres **x** recommended staffing for that post.

information. Thereafter, the research team was involved in refining the questionnaires. The malaria transmission intensities in these districts are similar to Bushenyi and Iganga respectively.

The study participants included: clinical staff (clinical officers, nurses and midwives), laboratory personnel and Ministry of Health officials. All 20 sub-county public HCs in Bushenyi and 12 in Iganga were visited. On the day of visit, one of the available clinical staff was interviewed using a semi-structured questionnaire. Data were collected on: staffing levels, availability of malaria treatment guidelines and drugs, personnel involved in management of malaria patients and treatment decisions. Equipment and supplies such as thermometers, microscopes and laboratory reagents were checked to confirm their availability. The staff in the four HCs with functioning laboratories were also interviewed. Six HCs (three per district) were randomly chosen to collect baseline patient data. Six hundred and thirteen patients clinically treated for malaria were interviewed (exit interviews). This sample size was estimated using a standard formula[16] assuming 50% suspected malaria cases received AL with 90% power and 95% Confidence Interval. Patient interviews were conducted using a structured questionnaire and collected data on use of antimalarials before reporting to the HCs, sources of drugs used, and on the services received at the health units.

2.4. Data management

All questionnaires were manually checked for completeness and the semi-structured interviews were coded before entry. All quantitative data was then entered in EpiData version 3.1 software (The EpiData Association, Odense, Denmark), and exported to SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) for analysis using descriptive statistics. The qualitative data was analysed manually and common themes developed. The outcomes were: availability of staff, antimalarials, treatment guidelines, use of antimalarials before reporting to HC, proportion of patients receiving parasitological confirmation of malaria and treatment decisions by staff.

3. Results

Thirty two interviews were conducted with the clinical staff (one per HC), four laboratory staff and one at the Ministry of Health. Six hundred and thirteen patient interviews were also conducted after receiving the services.

3.1. Staffing, practices and guidelines

Only 27 (42%) of the clinical officer posts were filled (Table 1). Six HCs were headed by Enrolled Nurses. In all health units, the clinical staff including midwives and nursing assistants managed malaria patients. In some centres, nursing assistants managed clinics without support of more qualified staff. Only one HC had a laboratory technician–this was the referral facility for trypanosomiasis located in Iganga district. Eleven HCs (34%) had the laboratory assistant post filled, although only four had functioning laboratories.

All HCs had AL malaria case management guidelines displayed in the consultation rooms. The diagnosis of malaria was based on signs and symptoms in 28 (88%) HCs. However, 17 (53%) did not have thermometers to measure body temperature. In these centres, patient temperatures were qualitatively estimated using the back of the palm and reported either as high or normal.

Only 53 (8.6%) patients attending the four HCs with functional laboratories had their blood tested for malaria. Of these, 8 (15%) had a positive blood slide. The decision to send the patient for microscopy was based on: (1) if the clinician was not sure of the diagnosis, (2) patients had not responded to initial antimalarial treatment, (3) level of workload (number of patients) as microscopy creates some delays, (4) patients that had never taken antimalarial medication for the current illness, (5) a patient demand for laboratory testing, (6) availability of laboratory personnel and (7) patient ability to pay 1000 Uganda shillings (US$ 0.59). Out of the 53 patients tested for malaria, 27 (51%) were charged 1000 Uganda shillings (US$ 0.59) each for laboratory service.

Table 2
Percent sub-County public health centres with antimalarial drugs in-stock.

Antimalarial	Bushenyi *n* (%)	Iganga *n* (%)	Total *n* (%)
AL (for all weight categories) in stock	9 (45)	6 (50)	15 (47)
AL for 5-14 kg in-stock	20 (100)	10 (83)	30 (94)
AL for 15-24 kg in-stock	16 (80)	7 (58)	23 (72)
AL for 25-34 kg in-stock	12 (60)	6 (50)	18 (56)
AL for >34 kg in-stock	11(55)	11 (92)	22 (69)
Quinine (injectable formulation)	15 (75)	5 (42)	20 (63)
Chloroquine	17 (85)	4 (33)	21(66)
Artesunate-Amodiaquine	0	0	0
Sulphadoxine/pyremethamine	0	0	0

AL = Artemether-Lumefantrine.

3.2. Availability and use of antimalarials

Only 15 (47%) of the HCs had AL in stock for all weight-specific categories (Table 2). Of the different weights, 30 (94%) had AL stock for children weighing 5–14 kg; 23 (72%) stocked AL for 15–24 kg; 18 (56%) for 25–34 kg; and 22 (69%) for $\geq$ 35 kg. Twenty four (75%) of the HCs experienced AL stock-out during the six months preceding this study. There was a nationwide AL stock-out from March to July 2007.

All HCs stocked neither SP nor artesunate-amodiaquine. Only 20 (63%) had injectable quinine in stock. For those without quinine, the average duration of stock-out was five months. Twenty one (66%) stocked CQ.

HCs followed the demand-driven system in making requisitions for AL. NMS however continued to supply CQ together with AL. The presence of both antimalarials in stock complicated the treatment decisions. Table 3 shows the decisions by clinicians to dispense either AL or CQ when both were in-stock. CQ was reserved for pregnant women in first trimester, children who were not vomiting but suspected to have malaria, patients with a negative blood slide and those who wanted to keep antimalarials for future use. The need to get CQ off the shelves also influenced its prescription. The HC staff also reported that AL was reserved for patients not responding to CQ or CQ/SP, allergy to CQ and those with positive blood slide.

Due to the erratic supply of drugs, availability, especially of antimalarials, at the health unit was a prime determinant of patient attendance. Whenever new drug consignments arrived at HCs, word spread rapidly among community members and many people reported to health units for treatment. 'Information about drug availability was shared during community gatherings such as local council meetings and funeral services' (Clinical Officer, Nambale HC III, Iganga). The marked increased patient attendance at HC coinciding with availability of drugs was also reported by health personnel in Bushenyi HCs.

3.3. Patient data

Of the 613 patients clinically diagnosed as having malaria, 360 (58.7%) were female and 194 (31.6%) were children below five years of age. Table 4 shows that there were significantly more children below five years attending HCs in Iganga than in Bushenyi ($P < 0.0001$). The fewer children attending HCs in Bushenyi was attributed to the strong HBMF strategy that was implemented through CDDs. The majority (341, 55.6%) of the patients reported after initiating treatment with a range of medications. Of these, 193 (56.6%) had used antimalarials including: CQ alone (115, 59.6%), SP alone (23, 11.9%), artemisinin derivatives (16, 8.3%), quinine (28, 14.5%) and CQ + SP combination for children under five years of age (11, 5.7%). Patients who used CQ before reporting to HCs were more likely to be in Iganga ($P < 0.0001$). Ten patients used herbs that they believed cured malaria. Patients obtained antimalarials from multiple sources (one patient trying more than one source) including: drug shops 111 (32.6%), home (leftover drugs from previous illness episodes) 88 (25.8%), other HC 99 (29.0%) and CDDs 11 (3.2%).

At the study HCs 560 (91.4%) patients received antimalarial treatment. This included 323 (57.7%) AL, 159 (28.4%) CQ monotherapy and 78 (13.9%) CQ + SP for children under five years. Clinicians in Iganga were more likely to prescribe AL compared to their counterparts in Bushenyi

Table 3
Factors considered in dispensing AL or CQ if both are in stock at sub-County public health centres.

Criteria for giving CQ if AL is also in stock	Criteria for giving AL if CQ is also in stock
• Pregnant women in first trimester	• Those who have already used CQ for current illness
• Children because they do not complain about bitterness	• If the patient asks for AL
• If blood smear result is negative	• If the patient suffered from malaria less than three months ago
• If patient had malaria three or more months ago	• If the patient has been on CQ or CQ/SP and not improving
• If clinician detects that the patient just wants to keep drugs at home	• Patient is allergic or complains of itching while on CQ treatment
• If patient has no complaint about CQ	• Because parasites in adults are resistant
• If the patient had no previous malaria treatment for the current complaint	• Patient is re-attending at the centre
• If the patient refuses AL because the tablets are too many	• Patient has severe symptoms
• If it is uncomplicated malaria	• Patient has positive blood smear
• Sickle cell patient with malaria infection	• If the patient is about 60yrs or above

AL = Artemether-Lumefantrine, CQ = Chloroquine.

Table 4
Patient data stratified by District.

Variable	Bushenyi *n* (%)	Iganga *n* (%)	*P*-value[a]
Female	176 (56.4)	184 (61.1)	0.251
<5 years of age	70 (22.4)	124 (41.2)	0.000[b]
Got some treatment before coming	167 (53.5)	174 (57.8)	0.292
Got malaria drug before coming			
AL	3 (1)	13 (4.3)	NC
Chloroquine	29 (9.3)	86 (28.6)	0.000 [b]
Quinine	21 (6.7)	7 (2.3)	NC
Sulfadixine/Pyrimethamine	10 (3.2)	13 (4.3)	NC
Source of drugs			
Home (left over from previous treatment)	40 (24)	48 (27.6)	0.460
Drug shops	53 (31.7)	58 (33.3)	0.871
Community Drug Distributors	11 (3.2)	0	NC
Another health centre	13 (4.2)	86 (49.4)	0.000 [b]
Prescribed AL at study health centre	136 (42)	187 (58)	0.000 [b]

AL = Artemether-Lumefantrine.
[a] Two-sided Fisher's Exact Test.
[b] Statistically significant, NC = Not calculated.

($P < 0.0001$). Out of 323 treated with AL, 25 (7.7%) and 16 (5.0%) were given quinine or CQ injections respectively as starting dose although they were not vomiting. Persistent vomiting is one of the danger signs of severe malaria where patients cannot tolerate oral medication and therefore merit parenteral treatment.

4. Discussion

The decision to change the antimalarial treatment policy and the subsequent implementation of the policy has been challenging. The major challenges identified in this study regarding use of AL for every patient of non-severe malaria were: stock-outs in HCs, continued use of non-recommended antimalarials, lack of parasitological diagnosis and problems with human resources.

Less than 50% of the HCs had AL for all weight-specific categories in stock. Several factors contributed to the stock-out of AL. At the national level, stock-out was related to delayed release of procurement funds, bureaucracy in the procurement process, limited stocks at NMS and erratic delivery schedules. The Malaria Control Programme at the Ministry of Health confirmed that the delay in release of procurement funds directly impacts onto the AL stocks (personal communication). NMS was supposed to deliver drugs quarterly to district medical stores. In some quarters however, drugs were not delivered prompting HCs to make alternative collection arrangements. Even after quantification following guidelines by HCs, NMS issued fewer quantities of the drugs requested. As discussed elsewhere,[17] this stock-out crisis is a health systems issue resulting from inadequate ordering, distribution and supply. Because AL comes in four weight-specific packs, NMS is managing the supply of four products and not one.

Stock-out in HCs was related to increased utilisation of outpatient services, and inability to make a parasitological confirmation of malaria. Clinical management of all fevers as malaria was the norm even with these expensive drugs. At the same time, utilisation of outpatient services in HCs had increased since the abolition of user fees in 2000.[18] In another study in Uganda it was reported that in the public sector, ACT stock-outs was an obstacle to antimalarial treatments with only 34% of the health units stocking all tablet packs of AL; ACTs are often unavailable 33% of the time.[19] AL stock-outs have also been reported in Kenya.[20] In Zambia, health units had AL stock-outs for 30% of the year.[21]

Due to frequent stock-outs (especially tablets for patients weighing $\geq$14 kg) and because the strength of 20 mg artemether and 120 mg lumefantrine is the same across the weight-specific categories, clinicians coped with the shortage by combining the children's blister packs to treat adults. Although this practice led to treatment of those patients in need instead of sending them away without treatment, it impacted the drug stocks for the young children. In the whole country, there was a general stock-out of AL from March to July 2007, in addition to HCs experiencing stock-outs within the six months preceding this study. AL stocks have not stabilised to date. In order to maintain adequate stocks, the procurement system and stock management information system need to be strengthened.[17]

Unfortunately, none of the HCs stocked artesunate-amodiaquine (the alternative first-line drug) although it is manufactured by a local company. Artesunate-amodiaquine is available in private for profit (PFP) drug outlets. A memorandum of understanding needs to be drawn between government and the local manufacturing company to supply artesunate-amodiaquine so as to bridge the gap whenever AL stock-out is anticipated.

The current malaria policy provides guidance on malaria therapy and simplifies treatment decisions by specifying which drugs are to be used for uncomplicated malaria. This policy includes provision of antimalarials through the public and private not for profit facilities, but it is silent regarding the PFP sector. As elsewhere, the PFP sector serves a major part of the population seeking care.[22–24] The current study reports that 55.6% patients came to HCs after initiating treatment, with 56.6% using antimalarials that included CQ, SP, quinine and branded artemisinin derivatives. The non first-line antimalarials were sourced from the PFP sector mainly from private clinics, pharmacies and drug shops where they are normally accessed without prescription.

However from the outset, the PFP sector was excluded in the new ACT malaria treatment policy, yet as evidenced from this study many patients with malaria continue to seek care from this sector. Thus, measures are required to subsidise and scale up the availability of the recommended antimalarials to include the PFP sector and to train providers in this sector on the implementation of ACT policy.[9,11]

In HCs, clinicians administered CQ or quinine injections as a starting dose followed by AL. None of the patients given injections had danger signs of severe malaria such as persistent vomiting that would merit parenteral treatment. This clearly demonstrated non-adherence to malaria treatment guidelines. Furthermore, clinicians prescribed CQ monotherapy, although the first-line regimen had been changed to CQ + SP in 2002 and from 2005 to AL. CQ was supplied by NMS in addition to donations from health partners. CQ is imported by private pharmaceutical companies, as well as being manufactured locally. The continued availability of non-recommended antimalarials is a setback to AL policy implementation.[19] Our findings are in agreement with another study,[25] which reported that AL was more likely to be prescribed in the absence of CQ. A study in Kenya[26] also reported that presence of amodiaquine + SP in health units was an impediment to AL implementation. Earlier observations[27] have shown that the probable result of continued use of ineffective drugs such as CQ are increases in malaria-associated morbidity and mortality, expansion of malaria in new areas and outbreaks in areas of unstable malaria. Strategies are needed to suspend the local manufacturing and importation of ineffective drugs and to systematically withdraw those in circulation without creating a vacuum. Furthermore, there is need to conduct regular refresher training for clinicians so that they adhere to the policy guidelines.

We report here the shortage of clinical staff and laboratory personnel at HC III. Due to under-staffing, nursing assistants managed outpatients' clinics without the support of more qualified staff. Additionally, those in charge of health units were frequently unavailable, reportedly attending workshops. The turnover of staff was also high with no immediate replacement due to public service recruitment restrictions.

The health policy recommends having a laboratory with a functioning microscope at all sub-count HCs. However, a HC at this level serves about 25 000 people, implying that there is one microscope for this population. The microscope is also used for investigations other than malaria. Furthermore, in the four HCs where the laboratory was operational, the personnel also performed HIV, pregnancy and syphilis tests. We have reported that these laboratories were charging fees from patients which were a barrier for those who could not afford the service. Lack of adequate laboratory services was a weakness that some people exploited by collecting antimalarials even when they were not sick. In order to focus the new policy, current recommendations of presumptive diagnosis and subsequent management of fever with antimalarials needs to be adjusted. Guidelines for parasitological confirmation are needed so that all patients are tested and AL is prescribed to only those with confirmed malaria.[28] Malaria rapid diagnostic tests could be considered in these rural HCs where microscopy is a challenge.[29,30]

This study shows the major challenges to use of ACTs in Uganda that are related to drug stock outs, non availability of ACTs in the private for profit sector, continued use of ineffective antimalarials and treatment of every patient with fever as malaria. In order to overcome these challenges there is need to supply adequate quantities of ACTs to all first line care facilities including the PFP sector, withdraw ineffective antimalarials from the market and to strengthen the health centres to carry out laboratory diagnosis of malaria.

Authors' contributions: All authors conceived and designed the study; VB and FN collected, analysed, interpreted the data and drafted the manuscript; PM critically revised the manuscript. All authors read and approved the final manuscript and are guarantors of the paper.

Acknowledgements: We thank the health workers and patients who participated in this research.

Funding: The study was funded in part with grants from the Department for International Development (DFID) through the TARGETS project of Makerere University School of Public Health; and DBL-Centre for Health Research and Development, Denmark.

Conflicts of interest: None declared.

Ethical approval: The study was cleared by Makerere University School of Public Health Institutional Review Board and the Uganda National Council for Science and Technology (Ref: HS 209). Informed consent was obtained from participants at the time of interview.

References

1. WHO. Antimalarial drug combination therapy. *Report of a technical consultation*. Geneva: World Health Organization; 2001.
2. WHO. *Access to antimalarial medicines: improving the affordability and financing of artemisinin based combination therapies*. Geneva: World Health Organization; 2003.
3. Checchi F, Piola P, Kosack C, Ardizzoni E, Klarkowaski D, Kwezi E, et al. Antimalarial efficacy of sulphadoxine-pyrimethamine, Amodiaquine and a combination of chloroquine plus sulphadoxine-pyrimethamine in Bundi Bugyo, western Uganda. *Trop Med Int Health* 2004;**9**:445–50.
4. Malaria Control Programme. *National Policy on Malaria Treatment* 2005. Kampala, Uganda: Ministry of Health; 2005.
5. Malaria Control Programme. *Antimalarial Drug Policy Chart*. 2nd ed. Kampala, Uganda: Ministry of Health; 2005.
6. Kamya MR, Bakyaita NN, Talisuna AO, Were WM, Staedke SG. Increasing antimalarial drug resistance in Uganda and revision of the national drug policy. *Trop Med Int Health* 2002;**7**:1031–41.
7. Williams HA, Durrheim D, Shretta R. The process of changing national malaria treatment policy: lessons from country level studies. *Health Policy Plan* 2004;**19**:356–70.
8. Amin AA, Zurovac D, Kangwana BB, Greenfield J, Otieno DN, Akhwale W, et al. The challenges of changing national malaria drug policy to artemisinin-based combinations in Kenya. *Malar J* 2007;6:72, doi:10.1186/1475-2875-6-72.
9. Zurovac D, Rowe AK, Ochola SA, Noor AM, Midia B, English M, et al. Predictors of the quality of health worker treatment practices for uncomplicated malaria at government health facilities in Kenya. *Int J Epidemiol* 2004;**33**:1080–91.

10. Nicholas DD, Heiby JR, Harzel TA. The Quality Assurance Project: introducing quality improvement to primary health care in less developed countries. *Qual Assur Health Care* 1991;**3**:147–65.
11. Ofori-Adjei D, Arhinful DK. Effects of training on the clinical management of malaria by medical assistance in Ghana. *Soc Sci Med* 1996;**42**:1169–76.
12. Uganda Bureau of Statistics. *Uganda population and housing census analytical report: Bushenyi District Local Government Planning Unit*. Bushenyi, Uganda 2007.
13. Uganda Bureau of Statistics. *Uganda population and housing census analytical report: Iganga District Local Government Planning Unit*. Iganga, Uganda 2007.
14. Malaria Control Programme. *Management of uncomplicated malaria: a practical guide for health workers*. Kampala, Uganda: Ministry of Health; 2005.
15. Malaria Control Programme. *Flowchart for management of malaria*. Kampala, Uganda: Ministry of Health; 2005.
16. Kish L. *Survey Sampling*. New York: Wiley; 1965.
17. The *PLoS Medicine* Editors. Time for a "Third Wave" of Malaria Activism to Tackle the Drug Stock-out Crisis. *PLoS Med* 2009; 6: e1000188. doi:10.1371/journal.pmed.1000188.
18. Nabyonga J, Desmet M, Karamagi H, Kadama PY, Omaswa FG, Walker O. Abolition of cost-sharing is pro-poor: evidence from Uganda. *Health Policy Plan* 2005;**20**:100–8.
19. Talisuna AO. The process of malaria drug policy change in Uganda: practical realities in implementing new treatment policies. Presented at: Expanding reach of ACTs in the private sector: dialogue with countries. MMV Access Symposium 2008 Accra, Ghana.
20. Kangwana BB, Njogu J, Wasunna B, Kedenge SV, Memusi DN, Goodman CA, Zurovac D, Snow RW. Malaria drug shortages in Kenya: a major failure to provide access to effective treatment. *Am J Trop Med Hyg* 2009;**80**:737–8.
21. Zurovac D, Ndhlovu M, Sipilanyambe N, Chanda P, Hamer DH, Simon JL, Snow RW. Paediatric malaria case-management with artemether-lumefantrine in Zambia: a repeat cross-sectional study. *Malar J* 2007;**16**:31.
22. Nuwaha F. People's perception of malaria in Mbarara. *Uganda Trop Med Int Health* 2002;**7**:462–70.
23. Amuge B, Wabwire-Mangen F, Puta C, Pariyo GW, Bakyaita N, Staedke S, et al. Health-seeking behaviour for malaria among child and adult headed households in Rakai district, Uganda. *Afr Health Sci* 2004;**4**:119–24.
24. Martin Enserink. GLOBAL HEALTH: Malaria Drugs, the Coca-Cola Way. *Science* 2008; 322:1174. DOI:10.1126/science.322.5905.1174.
25. Zurovac D, Tibenderana JK, Nankabirwa J, Ssekitooleko J, Njogu JN, Rwakimari JB, et al. Malaria case-management under artemether-lumefantrine treatment policy in Uganda. *Malar J* 2008;**19**:181.
26. Wasunna B, Zurovac D, Goodman CA, Snow RW. Why don't health workers prescribe ACT? A qualitative study of factors affecting the prescription of artemether-lumefantrine. Malar J 2008;7:29, doi:10.1186/1475-2875-7-29.
27. Nuwaha F. The challenge of chloroquine-resistant malaria in sub-Saharan Africa. *Health Policy Plan* 2001 Mar;**16**:1–12.
28. D'Acremont V, Lengeler C, Mshinda H, Mtasiwa D, Tanner M, Genton B. Time to move from presumptive malaria treatment to laboratory-confirmed diagnosis and treatment in African children with fever. *PLoS Med* 2009;**6**:e252.
29. WHO. Guidelines for the treatment of malaria. 2nd ed. Geneva: World Health Organization; 2010. http://www.who.int/malaria/publications/atoz/9789241547925/en/. [accessed 5 April 2010].
30. Guthmann JP, Ruiz A, Priotto G, Kiguli J, Bonte L, Legros D. Validity, reliability and ease of use in the field of five rapid tests for the diagnosis of *Plasmodium falciparum* malaria in Uganda. *Trans R Soc Trop Med Hyg* 2002;**96**:254–7.