Participatory healthcare-provider orientation to improve artemether-lumefantrine-based drug treatment of uncomplicated malaria: a cluster quasi-experimental study

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ABSTRACT

Objectives: To assess the effect of participatory healthcare-provider orientation in enhancing patient knowledge, appropriate prescribing and dispensing of artemether-lumefantrine, during drug treatment of uncomplicated malaria.

Methods: A cluster quasi-experimental study. The authors developed strategies to address challenges encountered by healthcare providers during clinical management of malaria. The primary outcome was patient knowledge on prescribed malaria drug treatment. Secondary outcomes were appropriate prescribing and provision of adequate drug dispensing information. The authors used generalised estimating equation logistic regression to investigate correlates of appropriate use of artemether-lumefantrine.

Results: The proportion of patients or caretakers of paediatric patients sufficiently knowledgeable about malaria treatment increased from 16/85 (18.8%) at baseline to 33/96 (34.4%) at evaluation, OR 2.26 (95% CI 1.13 to 4.49), p=0.020, in the intervention, and fell slightly from 49/134 (36.6%) to 35/114 (30.7%), OR 0.77, (95% CI 0.45 to 1.31), p=0.331 in the control district. This was enhanced by the existence of drug-dispensing standard operating procedures (adjusted OR 1.85, 95% CI 0.98 to 3.50; p=0.057). The proportion of appropriate prescriptions increased from 61/87 (70.1%) to 94/112 (83.9%) in the intervention district, OR 2.23 (95% CI 1.13 to 4.40), p=0.020 and reduced from 91/115 (79.1%) to 75/112 (67.0%) in the control district, OR 0.53, (95% CI 0.29 to 0.97), p=0.040. The frequency of adequately dispensed prescriptions increased in the intervention district (34 (32.4%) to 53(45.3%), OR 1.73 (95% CI 1.00 to 2.99), p=0.050) but decreased in the control location (94 (69.6%) to 71 (52.6%), OR 0.48 (95% CI 0.29 to 0.80), p=0.004).

Conclusions: Participatory healthcare-provider orientation enhanced patient knowledge, healthcare provider prescribing and dispensing of artemether-lumefantrine, bolstered by adequate medication counselling and use of drug-dispensing standard operating procedures.

BACKGROUND

Evidence on the efficacy of artemisinin-based combination treatments coupled with increasing failure rates of chloroquine and sulfadoxine-pyrimethamine were the major reasons for the change in drug-treatment choices for malaria.[1–5] Artemisinin-based combination treatments have consequently become the recommended treatment options. They have been reported to be cost-effective under most conditions of dynamic drug resistance and, also, to show population-level benefits.[6–8] Since the early 2000s, artemether-lumefantrine has become the most widely recommended chemotherapeutic agent used in drug treatment of *Plasmodium falciparum* malaria. Efficacy studies have reported an adequate clinical and parasitological response in about 90% of patients, with recrudescence occurring in 1–24% of patients, while safety monitoring indicates a relatively good degree of tolerance. Artemether-lumefantrine is generally not recommended in pre-existing cardiac conduction defects, in particular prolongation of the QTc interval on the electrocardiogram.[9 10]

In Uganda, artemisinin-based combination drug treatment policy began to be implemented in the year 2005. The policy encouraged presumptive treatment for malaria as the recommended practice. However, the

process of changing and implementing a new malaria treatment policy can be quite intricate.[9 11–20] For effective management of patients diagnosed as having malaria, there is a need to apply the best clinical and laboratory practices and to use recommended guidelines. Meanwhile, new and efficacious treatments need to be provided to patients. It has been shown that the use of several programmatic and multifaceted strategies can enable healthcare providers to improve drug treatment of malaria.[21–23]

In this study, we examined a participatory healthcare-provider orientation (PaHO) approach to elicit and provide practical solutions to challenges encountered by healthcare providers during clinical management of uncomplicated malaria using artemether-lumefantrine. We largely focused on healthcare providers' suggestions to enhance patient knowledge, prescribing and drug dispensing. The intervention was at the level of the health facility. Previously, Cassels and Janovsky[24] documented an approach involving the analysis of barriers to the implementation of programmes and the use of a health-systems matrix to strengthen the delivery of health services in devolved districts and provinces. Little has been reported on the design and effectiveness of such interventions in the improvement of clinical practice.[25 26]

METHODS

Design

This study was a cluster quasi-experiment in design. It was based in two purposively selected districts: an intervention district in Eastern Uganda and a control district in Western Uganda. Structured questionnaires were used to assess the prescribing, dispensing and patient use of artemether-lumefantrine at study health facilities. PaHO was provided to health workers in the intervention district and routine training to those in the control location.

Participants

Patients, or caretakers of paediatric patients, who had been diagnosed as having uncomplicated malaria, were consecutively selected for exit interviews and the prescriptions, which they received, assessed for appropriateness. A cluster comprised all patients or caretakers who had sought treatment for uncomplicated disease at the health facility on a clinic day.

Interventions

Participatory Healthcare provider Orientation

The PaHO framework comprised two phases as shown in figure 1. In the initial phase, we undertook orientation of healthcare providers on the use of first-line antimalarials, consisting of routine training on clinical management of uncomplicated malaria. However, emphasis was placed

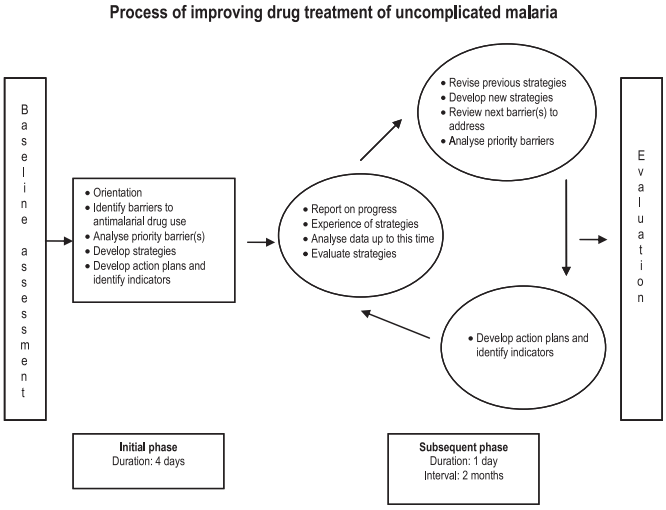

Figure 1 Participatory healthcare-provider orientation framework to improve the drug treatment of uncomplicated malaria.

on systematically defining and addressing identified and perceived barriers to rational use of antimalarial medicines; particularly in prescribing, dispensing and patient use of artemether-lumefantrine. Priority medicine use problems were analysed and plans developed to address them. The initial phase workshop took 4 days. In the subsequent phase, a follow-up workshop was held for participants from the same health facilities to examine progress and to develop new practical plans to improve the use of artemether-lumefantrine. Two healthcare providers from each health facility, one prescribing and another dispensing antimalarial medicines, attended these workshops. The effectiveness of strategies to improve medicine use was evaluated using a matrix.

Routine training

This consisted of didactic training on clinical management of uncomplicated malaria. It entailed the diagnosis of malaria, prescribing and dispensing of artemether-lumefantrine, together with the provision of drug-related information to patients or caretakers.

Objectives

To assess the effect of PaHO in enhancing patient knowledge, appropriate prescribing and provision of adequate dispensing information, during drug treatment of uncomplicated malaria using artemether-lumefantrine, a relatively new artemisinin-based combination treatment. Patient knowledge, prescribing and drug dispensing are key components of the drug use process and were used as surrogate indicators of drug treatment.[27]

Main outcome measures

We examined patient understanding of prescribed malaria drug treatment or that of caretakers of

paediatric patients, and also the quality of prescribing and dispensing of artemether-lumefantrine. The primary outcome was patient knowledge on malaria drug treatment. We regarded patients or caretakers of paediatric patients sufficiently knowledgeable if they could identify the medicine and knew the method of administration, number of doses, and frequency and duration of administration of artemether-lumefantrine. This was assessed at exit interviews with the aid of a checklist, at baseline and evaluation. Artemether-lumefantrine drug-use problems experienced by patients or caretakers were examined using self-reports.

Secondary outcomes were appropriateness of prescribing and dispensing of artemether-lumefantrine. An appropriate prescription conformed to the recommended malaria treatment guidelines in terms of choice of drug treatment and was assessed by a review of prescriptions and subsequent comparison with policy recommendations. A standard 3-day treatment schedule of artemether-lumefantrine (20/120 mg) for uncomplicated malaria in adults and children over 35 kg is a total of 24 tablets, administered in 12-hourly equally divided doses. It is noteworthy that the second dose is administered 8 to 12 h after the initial dose. The dose in younger children is also determined based on body weight and age. For instance, a 3-day treatment schedule for children weighing 5 to 14 kg or aged between 4 months and 3 years is a total of six tablets, administered in 12 hourly equally divided doses. In addition, we observed dispensing processes, during which we deemed information provided to patients adequate if the identity of artemether-lumefantrine, the method and the frequency of its administration were correctly explained. Prescribing and dispensing were also assessed at baseline and evaluation.

Sample size

The sample size for this study was based on the possible effect of the intervention on patient or caretaker understanding of instructions and of the dosage of prescribed artemether-lumefantrine, with adjustment for clustering. We assumed an intracluster correlation coefficient of 0.045 and a priori increase in the proportion of patients who would correctly understand instructions and the dosing of prescribed antimalarial medicine, from 60% at baseline to 80% during reassessment. The study was designed to have at least 80% power to estimate an effect size of 1.33, though 90% power was achieved. At baseline, 92 patients or caretakers of paediatric patients in the intervention and 135 in the intervention district were assessed for adequate knowledge on drug treatment of uncomplicated malaria. At evaluation, 96 patients or caretakers of paediatric patients were interviewed in the intervention and 114 in the control location.

Allocation to interventions

Initially, we used multistage sampling to select health facilities. In the first stage, this involved purposive selection of districts with high malaria transmission. Subsequently, health facilities were chosen by stratified random sampling according to Sub County. Thirty-two health facilities were eligible for inclusion; 18 were selected. Nine were allocated to receive PaHO, while another nine received routine training on clinical management of uncomplicated malaria.

We undertook a baseline assessment in August 2007 and an evaluation in May 2008, after half-day orientation of healthcare providers in the control location and PaHO at the intervention location. Clinical officers, nurses, midwives and other medically trained healthcare providers involved in prescribing and dispensing at the health facilities were interviewed.

Statistical analysis

We derived proportions of patients or caretakers of paediatric patients sufficiently knowledgeable about drug treatment of uncomplicated malaria. Binomial exact CIs for patient knowledge were then calculated. Patient-related, prescriber and dispenser-related drug-use indicators were compared before and after the intervention. The χ^2 test was used to compare the proportion of patients knowledgeable about malaria drug treatment, the proportion of appropriately prescribed drug treatments for malaria and the proportion of adequately dispensed prescriptions. ORs were derived using logistic regression. The t test was used to compare continuous health system and patient characteristics and the Mann–Whitney U test to compare the age of patients. In addition, we compared the level of awareness about antimalarial drug treatment by caretaker status, age and gender, as these patient attributes differed between intervention and control locations at baseline. The χ^2 and independent t tests were used for these comparisons. We used logistic regression with generalised estimating equations (GEE) and exchangeable correlation, to obtain independent correlates of patient knowledge on malaria treatment, appropriate prescribing and adequate dispensing of artemether-lumefantrine. This was intended to adjust for clustering, effect of study site, temporal effect and confounding by various health system and patient factors. A 5% level of significance was used, and analyses were performed using the Intercooled STATA V.11 (Stata Corporation) statistical software package.

Qualitative analysis

Grounded theory content analysis was used to examine patient and caretaker-related problems encountered during drug treatment of malaria. This also included self

reports of adverse drug events. Text mining was used in the qualitative analysis.

RESULTS

The flow diagram for health facilities and patients is shown in figure 2.

Baseline data

In this study, all health facilities had adopted the new malaria treatment policy. At baseline, almost all facilities had the recommended first-line antimalarial medicine, artemether-lumefantrine in stock. However, on evaluation, there was a stock-out at some facilities of age and weight-specific dose packs for patients 15 kg and over. Most patients with uncomplicated malaria in the intervention location were children (median age (IQR); 12.5 years (2.0 to 32.0)) and those in the control district, young adults (21.0 years (11.0 to 30.5)). The health facility and patient characteristics are shown in table 1.

Outcomes

Patient knowledge on malaria drug treatment

The level of patient knowledge about the new artemether-lumefantrine-based malaria treatment was rather low. The proportion of patients or caretakers of paediatric patients sufficiently knowledgeable about malaria drug treatment increased from 16/85 (18.8%) to 33/96 (34.4%), OR 2.26 (95% CI 1.13 to 4.49), p=0.020 (12/42 (28.6%) to 21/51 (41.2%) for caretakers), in the intervention district and fell slightly from 49/134 (36.6%) to 35/114 (30.7%), OR 0.77 (95% CI 0.45 to 1.31), p=0.331, (7/28 (25%) to 13/31 (41.9%) increase for caretakers) in the control district. Figure 3 shows the proportion of patients knowledgeable about malaria drug treatment.

The median age of patients for correct knowledge on prescribed antimalarial drug treatment was 5.3 years (IQR, 1.2 to 11.8) at baseline and 8.0 years (IQR, 3.0 to 25.0) at follow-up in the intervention and 23.0 years (IQR, 14.0 to 30.5) at baseline, 18.0 years (IQR, 5.0 to 33.3) at follow-up in the control locations, respectively. This implies that although patients were younger, caretakers were quite knowledgeable about artemether-lumefantrine dosage in the intervention group. At baseline, female patients or caretakers in the intervention location had less awareness about antimalarial drug treatment compared with those in the control location (14/71(19.7%) vs 30/89 (33.7%) χ^2=3.88, p=0.049). Changes following routine training and PaHO were not significant by female gender.

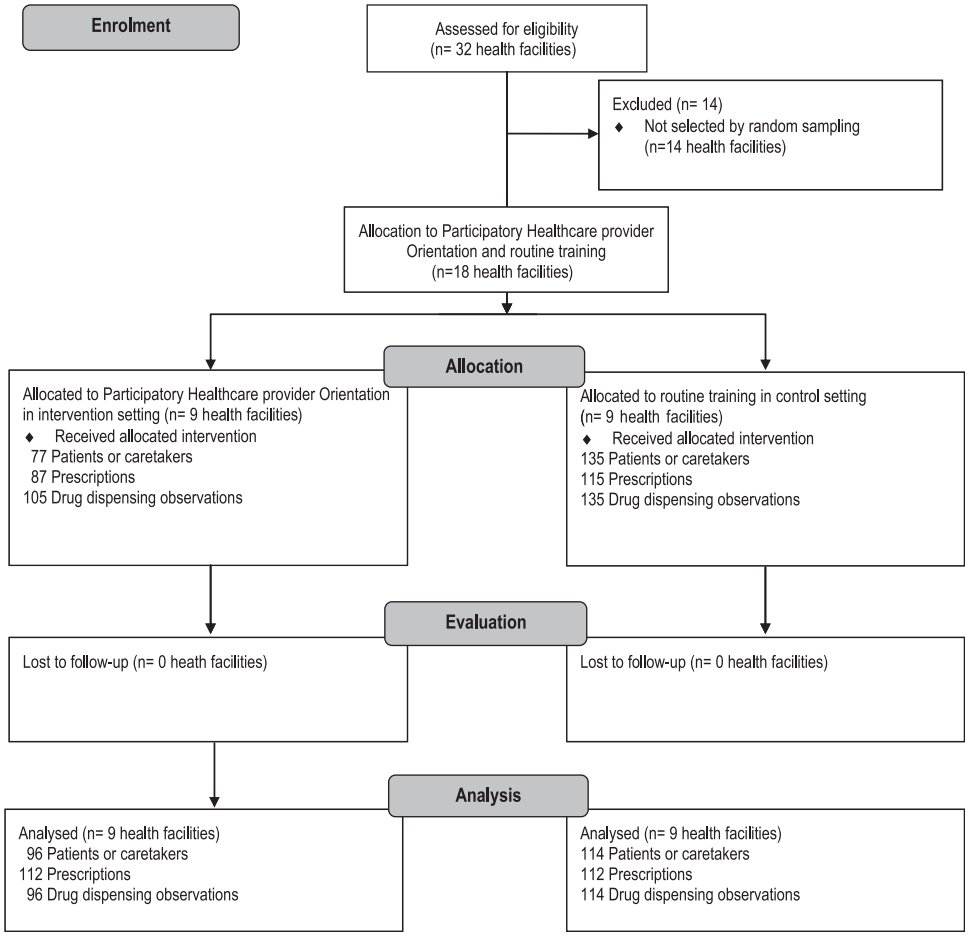

Figure 2 Flow diagram of a cluster quasi-experimental study of participatory healthcare-provider orientation versus routine training to improve the drug treatment of uncomplicated malaria (modified from Campbell *et al*[25]).

Table 1 Health facility and patient characteristics at baseline

Characteristics	No (%)	
	Intervention location	Control location
Health-facility characteristics		
Indicators exist for monitoring antimalarial drug use at the health facility		
Not in existence	5/9 (55.6)	8/9 (88.9)
In existence	4/9 (44.4)	1/9 (11.1)
Availability of artemether-lumefantrine at health facility		
Not available	0/9 (100.0)	1/9 (11.1)
Available	9/9 (0.0)	8/9 (88.9)
Mean no of patients per day (SD)	72.5 (41.3)	65.4 (22.3)
Mean no of health workers (SD)	10.6 (6.8)	6.9 (2.2)
Mean no of healthcare providers prescribing antimalarial medicines (SD)	4.9 (2.0)	6.2 (2.4)
Mean work experience of prescribing staff in years (SD)	4.9 (3.8)	9.3 (8.2)
Prescribing staff having received training in drug treatment of malaria		
Not received training	1/9 (11.1)	1/9 (11.1)
Received training	8/9 (88.9)	8/9 (88.9)
Mean no of healthcare providers dispensing antimalarial medicines (SD)	5.0 (3.4)	6.1 (2.5)
Mean work experience of dispensing staff in years (SD)	13.1 (12.2)	8.6 (4.3)
Mean no of patients seen by the healthcare provider dispensing (SD)	29.4 (9.4)	40.7 (17.8)
Existence of standard operating procedures for dispensing antimalarial medicines		
Not in existence	6/9 (66.7)	2/9 (22.2)
In existence	3/9 (33.3)	7/9 (77.8)
Patient characteristics		
Respondent		
Patient respondent	47/92 (51.1)	107/135 (79.3)
Caretaker respondent	45/92 (48.9)	28/135 (20.7)
Female gender of respondent	78/91 (85.7)	90/134 (67.2)
Mean age of respondent in years (SD)	31.4 (13.6)	26.3 (12.9)
Female gender of patient	67/91 (73.6)	80/134 (59.7)
Median age of patient in years (IQR)	12.5 (2.0-32.0)	21.0 (11.0-30.5)
Main source of antimalarial medicines for patients		
Study health facility	62/92 (67.4)	92/135 (68.2)
Other public health facility	14/92 (15.2)	22/135 (16.3)
Private medicine outlet or other source	16/92 (17.4)	21/135 (15.6)
Mean no of malaria episodes within the previous year (SD)	4.1 (2.5)	2.3 (1.6)
Mean no of malaria episodes treated at study health facility (SD)	2.6 (1.7)	1.5 (1.2)
Percentage of malaria episodes treated elsewhere	36.8	38.6

The relationship between health system and patient factors, and correlates of adequate patient knowledge about malaria drug treatment, obtained by GEE, are shown in table 2. Patients who had other health units as main sources of their antimalarial treatment were less knowledgeable compared with those whose main sources were study health facilities (adjusted OR 0.56 (95% CI 0.31 to 0.99), p=0.050). In addition, the existence of drug-dispensing standard operating procedures appeared to improve patient knowledge (adjusted OR 1.85 (95% CI 0.98 to 3.50), p=0.057).

Perceived low drug efficacy or lack of efficacy and the experience of side effects and adverse drug reactions were reported as important deterrents to patient adherence to malaria drug treatment. Overall, there was a reduction in self-reports of adverse drug events by patients or caretakers of paediatric patients subjected to PaHO compared with those subjected to routine training.

Prescribing of artemether-lumefantrine

A majority of prescriptions were in accordance with the malaria treatment guidelines. Over-prescribing was generally not noted, as antimalarial drug doses were often right-for-age and weight. In addition, the patient's age, weight and occasionally dosing charts were routinely used in dose determination. The proportion of

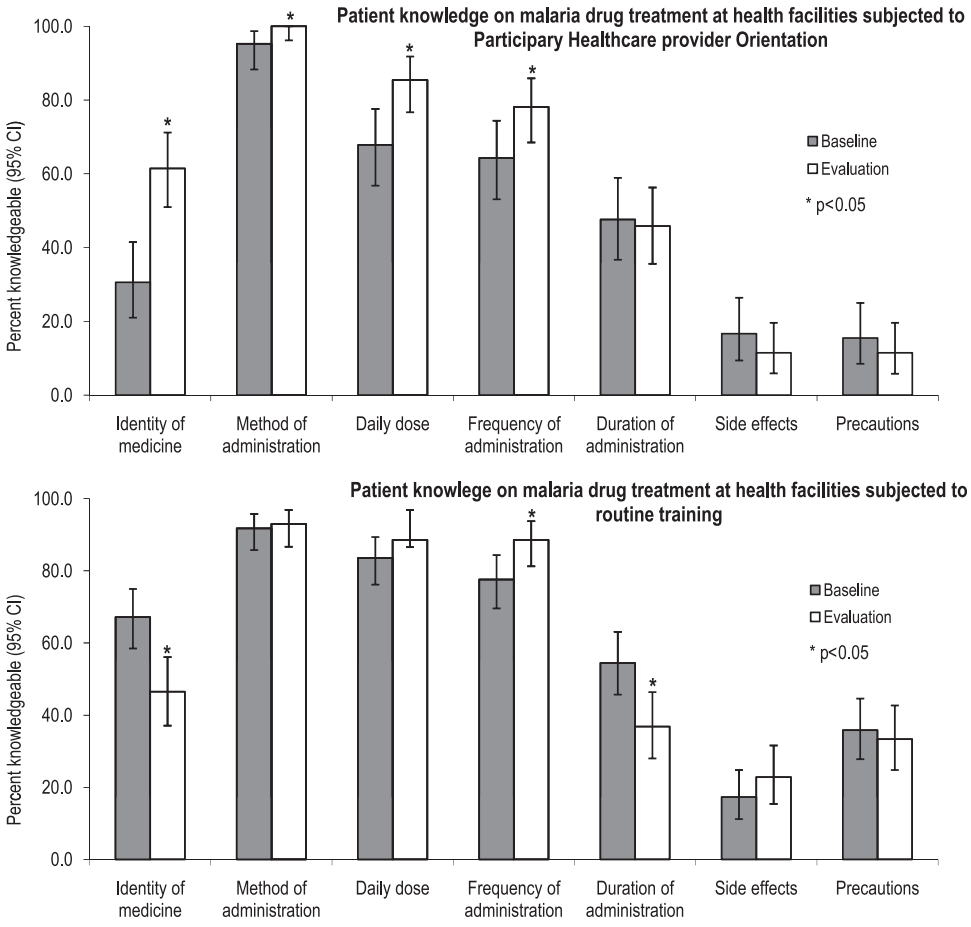

Figure 3 Patient knowledge on artemether-lumefantrine-based malaria drug treatment at health facilities subjected to participatory healthcare-provider orientation versus routine training.

appropriate prescriptions for uncomplicated malaria increased from 61/87 (70.1%) to 94/112 (83.9%) in the intervention district, OR 2.23 (95% CI 1.13 to 4.40), p=0.021, and decreased from 91/115 (79.1%) at baseline to 75/112 (67.0%) at evaluation in the control district, OR 0.53 (95% CI 0.29 to 0.97), p=0.040. The availability of artemether-lumefantrine at the health facility favoured appropriate prescribing and was included in the final regression model (table 3). Tabulated results were obtained using GEE.

Dispensing procedure and drug-dispensing information

Drug-dispensing practices differed between health facilities but were quite uniform within clusters. The quality of standard operating procedures for drug dispensing was initially varied but later on improved in the intervention location. The proportion of complete doses of prescribed drug that were dispensed decreased on evaluation in the intervention district (105/105(100%) to 80 (83.3%); p<0.001), probably due to temporary stockouts, but increased in the control location (105/120 (87.5%) to 112 (98.3%); p=0.002). Artemether-lumefantrine was often adequately prepacked in weight-specific dose packs and appropriately prelabelled. In contrast, the proportion of adequately dispensed prescriptions increased in the intervention district (34/105(32.4%) to 53/117(45.3%); OR 1.73 (95% CI 1.00 to 2.99), p=0.050) but decreased in the control location (94/135(69.6%) to 71/135(52.6%); OR 0.48 (95% CI 0.29 to 0.80), p=0.004).

The relationship between health system and patient factors, and correlates of adequate drug dispensing information, obtained by GEE, are shown in table 4. The adequacy of dispensing information provided to patients increased with the number of healthcare providers per facility (adjusted OR 1.42 (95% CI 1.11 to 1.85), p=0.006) and availability of artemether-lumefantrine at the health facility (adjusted OR 1.76 (95% CI 1.04 to 3.00), p=0.036). Adequate numbers of healthcare providers enhance opportunities for interaction with patients or caretakers, since the apparent workload is reduced.

DISCUSSION

In this study, all health facilities were found to have adopted the new artemether-lumefantrine-based drug-treatment policy, within 2 years of launching. However, in practice, the extent of implementation of this policy was influenced by various institutional, healthcare-provider-related and patient factors. Most respondents more often than not sought treatment for malaria at the health

Table 2 Correlates of adequate patient knowledge on drug treatment of uncomplicated malaria

Characteristics	No (%)				Intracluster correlation coefficient (ICC)	Adjusted OR (95% CI)	p Value
	Intervention		Control				
	Baseline	Evaluation	Baseline	Evaluation			
No of health facilities	9	9	9	9			
No of patients or caretakers	77	96	135	114			
Health system and patient characteristics							
Indicators exist for monitoring antimalarial drug use at the health facility	5/15 (33.3)	26/86 (30.2)	46/119 (38.7)	3/56 (5.4)	0.044	0.65 (0.20 to 2.18)	0.490
Mean no of healthcare providers dispensing antimalarial medicines (SD)	7.7 (1.8)	6.5 (3.4)	5.6 (2.7)	7.6 (2.3)	0.049	1.09 (0.94 to 1.26)	0.261
Existence of standard operating procedures for drug dispensing	0/35 (0.0)	28/68 (41.2)	42/104 (40.4)	4/15 (26.7)	0.043	1.85 (0.98 to 3.50)	0.057
Main source of antimalarial medicines compared with the study health facility							
Other public health facility	3/14 (21.4)	0/14 (0.0)	6/21 (28.6)	5/18 (27.8)	0.038	0.56 (0.31 to 0.99)	0.050
Private health facility or other source	1/15 (6.7)	5/14 (35.7)	6/21 (28.6)	2/7 (28.6)	0.038	0.75 (0.40 to 1.41)	0.376

facility where they were interviewed. This probably was in part a reflection of the degree of satisfaction with malaria treatment at the health facilities and a proxy for the efficacy of artemether-lumefantrine-based drug treatment. It is comparable with the findings of a study by Eriksen *et al*[28] which showed that there was a shift from patient-initiated drug treatment to the seeking of malaria treatment from the health facility, following introduction of artemisin-based combination therapy.

PaHO improved various aspects of patient use of artemether-lumefantrine; notably, knowledge about the identity of antimalarial medicine, method of drug administration, daily dose and frequency of administration. These are essential bits of required information to enable proper medicine use. In this study, strategies to address barriers to clinical management of malaria appeared to enhance overall knowledge significantly on artemether-lumefantrine-based drug treatment of uncomplicated malaria. Regardless, patients or caretakers of paediatric patients' knowledge about side effects and precautions were still fairly limited, although these are quite important for medication safety, adherence and efficacy. The perceived low drug efficacy or lack of efficacy and the experience of untoward drug effects were deterrents to patient adherence to antimalarial treatment; a large pill burden was also a problem for many patients. This underscores the necessity for continued counselling on such medicine-related issues. It is noteworthy that several months after the commencement of the implementation of the new malaria drug treatment policy and of this study, complaints about the lack of efficacy of antimalarial medicines decreased. This could be partly attributed to the known efficacy of artemisinin-based combination treatments.

Our findings show that patients who had other health facilities as main sources for their malaria drug treatment were less likely to be knowledgeable about antimalarial medicines compared with those whose main source was the study health facility at evaluation. This suggests that PaHO might have improved drug treatment information transfer from healthcare providers to patients. Moreover, there was a significant increase in the proportion of patients sufficiently knowledgeable about artemether-lumefantrine-based malaria-drug treatment in the intervention but not the control district. This implies that PaHO further reinforced healthcare-provider performance in medication counselling, particularly in the presence of drug-dispensing standard operating procedures. The findings are consistent with previous reports.[29 30]

Age- or weight-based under- or overprescribing of artemether-lumefantrine was rare, presumably because the medicine was presented in weight-specific dose packs and doses displayed on dosing charts. Also,

Table 3 Correlates of appropriate prescribing of artemether-lumefantrine for uncomplicated malaria

Characteristics	No (%)				Intracluster correlation coefficient	Adjusted OR (95% CI)	p Value
	Intervention		Control				
	Baseline	Evaluation	Baseline	Evaluation			
No of health facilities	9	9	9	9			
No of prescriptions	87	112	115	112			
Health system and patient characteristics							
Indicators exist for monitoring antimalarial drug use at the health facility	33/44 (75.0)	85/94 (83.3)	81/105 (77.1)	15/15 (100.0)	0.178	0.32 (0.06 to 1.66)	0.176
Mean no of healthcare providers prescribing antimalarial medicines (SD)	4.2 (1.8)	5.8 (1.5)	5.9 (2.1)	6.4 (1.3)	0.175	1.08 (0.72 to 1.62)	0.696
Mean work experience of prescribing staff in years (SD)	5.2 (3.9)	13.6 (6.0)	10.5 (8.0)	10.5 (7.0)	0.188	1.03 (0.94 to 1.14)	0.494
Prescribing staff having received training in case management of malaria	48/72 (66.7)	94/112 (83.9)	81/105 (77.1)	73/92 (79.4)	0.171	2.13 (0.56 to 8.10)	0.269
Mean age of patient in years (SD)	21.5 (21.4)	11.5 (12.2)	24.3 (15.2)	24.7 (19.4)	0.246	1.01 (0.98 to 1.03)	0.706

prescribers reported frequent use of patient's age, weight and, occasionally, available dosing charts. The presence of wall charts for dosing of antimalarials has not been shown to have a significant impact on correct prescribing elsewhere.[21] However, the combined use of PaHO-generated prescriber feedback together with treatment guidelines positively influenced prescribing behaviour.[31]

During the evaluation phase, there was a reduction in the proportion of complete doses of prescribed antimalarials that were dispensed, when compared with findings from the baseline assessment. This was likely due to non-availability of artemether-lumefantrine dose packs for older patients at some health facilities. However, it is notable that despite the seemingly more frequent stock-outs at the intervention location, partial

Table 4 Correlates of adequate artemether-lumefantrine drug-dispensing information

Characteristics	No (%)				Intracluster correlation coefficient	Adjusted OR (95% CI)	p Value
	Intervention		Control				
	Baseline	Evaluation	Baseline	Evaluation			
No of health facilities	9	9	9	9			
No of dispensing observations	105	96	135	114			
Health system and patient characteristics							
Availability of artemether-lumefantrine at health facility	26/65 (40.0)	35/89 (39.3)	61/91 (67.0)	41/65 (63.1)	0.266	1.76 (1.04 to 3.00)	0.036
Mean no of patients per day (SD)	85.7 (32.5)	63.8 (29.0)	62.6 (22.2)	52.9 (17.0)	0.274	1.01 (0.99 to 1.03)	0.071
Mean no of healthcare providers (SD)	13.9 (6.6)	9.4 (4.5)	7.5 (2.1)	7.8 (1.9)	0.205	1.42 (1.11 to 1.85)	0.006
Mean no of healthcare providers dispensing antimalarial medicines (SD)	8.0 (3.2)	6.8 (3.5)	6.4 (2.6)	7.1 (1.9)	0.223	1.04 (0.86 to 1.24)	0.706
Work experience of dispensing healthcare providers in years (SD)	7.5 (7.9)	14.2 (7.5)	10.1 (3.7)	10.4 (5.7)	0.306	1.00 (0.95 to 1.05)	0.970

dispensing of prescribed medicine was less noted. In addition, more health facilities in the intervention district later on developed standard operating procedures for dispensing artemether-lumefantrine. Standard operating procedures have been known to improve medicine-use practices.[29 30] Artemether-lumefantrine was often adequately prepacked and prelabelled for dispensing. However, when prepackaged medicine was fragmented due to the non-availability of weight-specific doses for older patients, the packaging and labelling were slightly compromised. Nevertheless, enhanced relay of information about the identity of antimalarial medicine during dispensing encounters in the intervention district was an indicator of partial improvement in the dispensing process. Medication counselling on side effects and timing of drug administration in relation to meals, though, remained relatively inadequate. These are important for patient adherence and drug efficacy, particularly with artemether-lumefantrine.[32 33]

Limitations

There was some variation in baseline characteristics between the intervention and control groups. Patients in the intervention group were younger, and respondents more likely to be caretakers and female. However, patient age and gender were not found to influence the effect of PaHO on drug treatment of uncomplicated malaria. Another limitation was that we did not assess the interobserver variability during assessment of prescribing and dispensing behaviour. In addition, individual-level patient outcome data on clinical and parasitological response were not obtained, and no objective criteria for therapeutic observance were used. However, despite a variation in medicine-use practices, the findings indicate that PaHO improved artemether-lumefantrine-based drug treatment of uncomplicated malaria.

CONCLUSIONS

PaHO enhanced patient knowledge, healthcare-provider prescribing and dispensing of artemether-lumefantrine, during drug treatment of uncomplicated malaria. Adequate medication counselling and use of drug dispensing standard operating procedures bolstered the effectiveness of PaHO. This study highlights the need to recognise variations in challenges to deployment of artemether-lumefantrine at different health facilities. It would be informative for additional PaHO trials to include both clinical and parasitological endpoints.

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