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Treatment for clinical malaria is sought promptly during an epidemic in a highland region of Uganda

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Summary Early diagnosis of malaria followed by appropriate treatment can help reduce related morbidity and mortality as well as interrupt transmission. Previous studies of household responses to malaria have tended to focus on endemic areas where the burden of this disease is greatest. With the apparent increasing frequency of epidemics in African highlands, a better understanding of treatment behaviours in areas of unstable transmission may be important to future public health interventions. This study was undertaken following a serious epidemic of malaria in the highlands of south-western Uganda. Our objectives were to characterize actions taken by both adults and caretakers of children ≤5 years old during their most recent episode of self-diagnosed malaria, and to identify factors that were associated with prompt treatment at a health facility. A survey of 300 households selected in a 2-stage cluster sampling procedure produced 453 adult respondents and 133 caretakers of children ≤5 years old. We found that almost 65% of adults and 62% of children who had experienced an episode of malaria in the last year (most during the epidemic) had sought treatment from a health facility first as opposed to self-treatment. Most of these people had visited the health facility within 1 day of symptom onset. By the end of their malaria episode, over 87% of adults and 80% of children had visited a health facility at least once. Factors associated with prompt presentation at a health facility included severity of illness, household proximity to a health facility, and knowledge of malaria prevention methods. Our results indicate that there is an important role for the formal health care system in mitigating morbidity and mortality and reducing transmission during malaria epidemics in Uganda.

keywords malaria, attitude to health, fever, epidemic, altitude, Uganda

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Introduction

Early diagnosis and prompt treatment of malaria remains an important cornerstone of the global malaria control strategy (World Health Organization 1993). Not only will early and appropriate treatment for malaria reduce morbidity and the likelihood of developing life-threatening complications, but such treatment also may lower the proportion of the population with gametocytes, thereby decreasing transmission rates (Price *et al*. 1999). Early diagnosis and prompt treatment depend on correct recognition of malaria signs and symptoms, presentation at a medical establishment with trained staff, treatment based on established criteria, and proper adherence to the treatment regime (World Health Organization 1993). Unfortunately, in developing countries there are many individual and structural barriers to effective and timely treatment of malaria.

In Africa, several factors have been identified that affect people's responses to febrile illness. These include access to a health care facility, availability of drugs, quality of care received, traditional beliefs, socioeconomic status, knowledge of malaria transmission and prevention, and perceived severity of disease symptoms (Glik 1989; Snow *et al*. 1992; Slutsker *et al*. 1994; Foster 1995; Konradsen *et al*. 1997). Understanding these factors can help identify appropriate interventions or high-risk subpopulations that should be targeted by malaria control programs. To date, malaria-endemic regions have received the most attention from public

health and research programs due to the overwhelming burden of disease in these areas. Consequently, studies examining malaria treatment-seeking behaviours generally have been conducted in areas with seasonal or perennial transmission of malaria.

Recently, there has been increased recognition of the severe morbidity and mortality associated with malaria epidemics in highland regions of Africa (Lindsay & Martens 1998; Mouchet *et al*. 1998; Lindblade *et al*. 1999). Human disease is typically more severe in non-immune than semi-immune populations and people of all ages are likely to be affected. In areas where malaria is unstable and occurs as infrequent epidemics, household responses are likely to differ from households in endemic areas, where knowledge of the signs and symptoms of malaria and perception of the severity of disease will be different due to the more frequent occurrence of the disease (Tanner & Vlassoff 1998). Therefore, it seems inappropriate to assume that the malaria treatment-seeking behaviours of people in such areas of epidemic transmission will be like those in endemic areas.

Accordingly, we undertook a study of people's responses to malaria in Kabale District, a highland region of south-western Uganda, after a serious epidemic of malaria that occurred in early 1998 (Lindblade *et al*. 1999). Records from health clinics in the area indicated that up to 41% of the population was diagnosed with clinical malaria from January through August 1998. This study began toward the end of the epidemic period and aimed to describe actions taken by both adults and caretakers of children ≤5 years old during their most recent episode of self-diagnosed malaria, focusing on identifying factors associated with prompt presentation at a medical establishment.

Materials and methods

Study site and population

Kabale District, in the south-western highlands of Uganda, is a region of steep hills and narrow valleys bordering Rwanda to the south. Elevation in the district ranges from 1500 to 2400 m. Rainfall (850–1200 mm annually) occurs in two seasons (February–May and September–October). Mean daily minimum (9.8–12.6 °C) and maximum temperatures (23.2–24.4 °C) do not vary much throughout the year. The infant mortality rate in Kabale District is high (114 deaths per 1000 live births) but slightly less than the Ugandan national average (122 per 1000 live births). Within Kabale District there is good utilization of health facilities as indicated by high vaccination coverage (Uganda Ministry of Finance and Economic Planning 1992). Approximately 71% of residents of Kabale District live within 5 km of a health facility. Malaria transmission in Kabale District at elevations >1500 m was rare in the mid-1900s, apart from an endemic focus immediately surrounding Lake Bunyonyi, the district's largest water body (De Zulueta *et al*. 1964). However, this district recently suffered two serious epidemics of malaria, in June–July 1994 (Mouchet *et al*. 1998) and February–May 1998 (Lindblade *et al*. 1999). Chloroquine remains the first-line treatment for uncomplicated malaria and is widely available in area shops and clinics.

Sampling

The study was conducted in three valleys within a 25-km radius of Kabale Town (Figure 1) at elevations ranging from 1800 to 2400 m. Ten villages were selected from each of the 3 valleys with probability of selection proportional to the number of households within each village (estimated from government census data and district lists). Within each of the 30 villages, 10 households were randomly selected from a list of all households that had been prepared by the village chairman. Appointments were made with each household for the day of the interview; the next nearest house was selected if the original household was not available on the interview date.

We attempted to interview both the household head and his wife concerning their most recent bout of self-diagnosed malaria after informed consent was received. Additionally, in households with at least one child up to 5 years old, the caretaker of the youngest child (usually the mother) was interviewed concerning the child's most recent malaria episode.

Survey instrument

A draft questionnaire was developed from focus group interviews and then pilot tested in 20 households. Four trained interviewers, fluent both in English and Rukiga (the local language), administered the survey. After making adjustments indicated by results of the pilot-testing, the questions were finalized and the interviewers reached consensus on the wording of each question in Rukiga. The semi-structured questionnaire requested information surrounding each respondent's most recent self-diagnosed malaria episode. Questions included perceived severity of selected symptoms, number of days before treatment, types of interventions sought, means of transport to health facilities, and total cost of treatment. Similar questions were asked to the caretaker of the youngest child ≤5 years in each household. Respondents were queried about their preferred treatment sources, and their understanding of causes and prevention of malaria. Basic demographic information was collected from each respondent, as were general household wealth indicators.

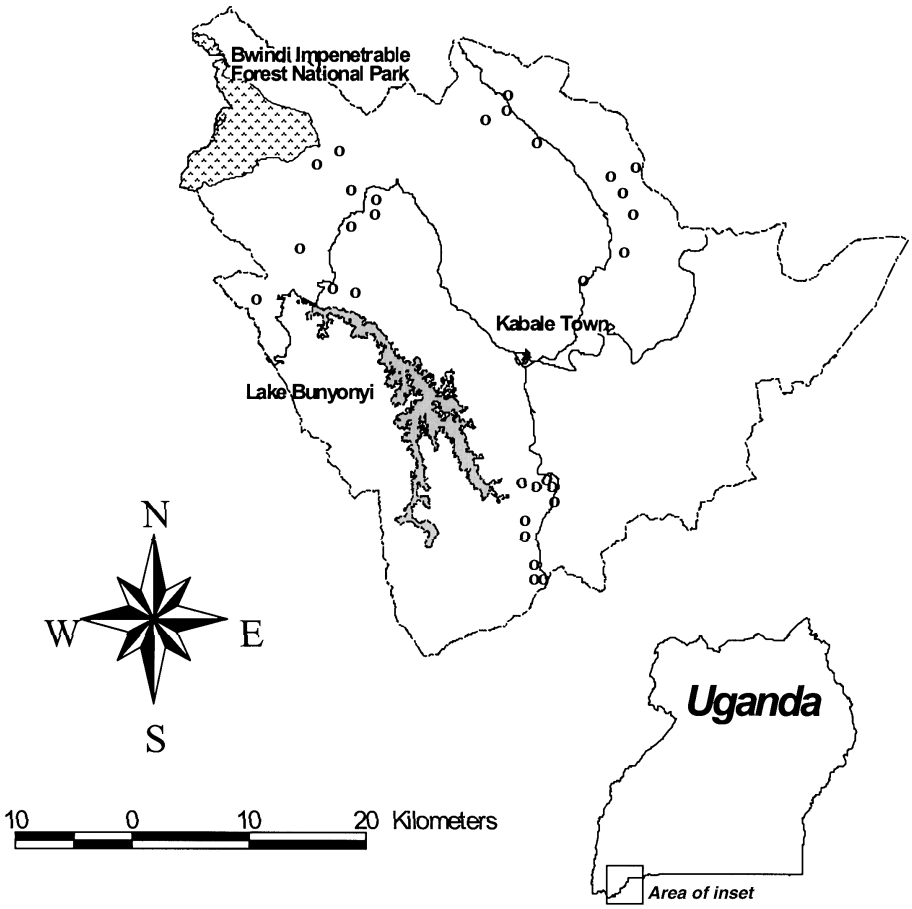

Figure 1 Map of Kabale District, Uganda, indicating the location of 30 study villages.

Derived variables

Because severe complications of malaria can arise within 2 days of the onset of symptoms (Greenwood *et al.* 1987; Molyneux *et al.* 1989), we categorized 'prompt' treatment as occurring <1 day between onset of symptoms and first treatment. 'Appropriate' treatment was considered to be any treatment received from a medical establishment staffed by trained health workers. In this region of Uganda, medical establishments included private clinics, government health centres, and mission or government hospitals (hereafter collectively referred to as health facilities). However, we did not request information on the type or dosage of drugs prescribed, nor on patient adherence to the treatment regimen. Home remedies (usually herbs) and drugs purchased from local shops were classified as 'inadequate' treatment, as other studies in Africa have found that shop-bought drugs are often purchased in inadequate quantities (Deming *et al.* 1989; Slutsker *et al.* 1994).

Each adult respondent was asked to grade the common symptoms associated with malaria (high temperature, headache, body aches, sweating, weakness, shivering and diarrhoea) according to his or her perceived severity of the symptom (not present, mild, moderate, or severe, respectively, scored 0, 1, 2, 3). In addition to these symptoms, caretakers were asked to grade the severity of unresponsiveness and deep breathing in their children. To summarize the overall perceived severity of selected illness symptoms in adults, a summary index of scores (0–3 each) for high temperature, headache, body aches and weakness was calculated, resulting in an index ranging from 0 to 12 for those four symptoms. For children <2 years old, only those signs that the mother could detect (i.e. high temperature, unresponsiveness, deep breathing and diarrhoea) were used to construct the overall illness severity score. We assumed that children ≥2 years could communicate internal symptoms, and therefore the overall illness severity score for these children was constructed from the severity scores for high temperature, body aches, weakness, headache, unresponsiveness, diarrhoea and deep breathing. The median scores for adults, children <2 and children ≥2 years was used to classify overall illness severity as either mild or severe. Results for both groups of children were combined.

An index of household wealth was constructed from questionnaire responses by calculating estimated 1998 values in Ugandan shillings (1000 UgSh ≈ US $1) for ownership of common household items such as radios, bicycles, mattresses and livestock. Quartiles of total household wealth for all houses were computed and used as a predictor variable. Ease of access to a health facility was determined using two methods: the first asked respondents to choose whether it was easiest to reach a drug shop or a health facility, while the second asked which was closest.

Knowledge of malaria was assessed by asking each respondent a series of open-ended questions regarding their beliefs concerning the causes of malaria and personal protection measures. Respondents who mentioned only mosquitoes as a cause of malaria were categorized as having good knowledge of the causes of malaria. Those who mentioned mosquitoes but also included an incorrect cause, such as dirty water or heat, were labelled as having some knowledge of the causes of malaria, and respondents who did not mention mosquitoes at all were categorized as having no knowledge. Similarly, people who said that bed nets, sprays, coils or medicines could prevent malaria were categorized as having good knowledge of personal protection against malaria. Respondents who included an irrelevant protection measure such as boiling drinking water in addition to bed nets, sprays, coils or medicines were labelled as having only some knowledge of personal protection measures. Others who reported no accepted method of personal protection were categorized as having no knowledge.

Ethical review

This project was reviewed and approved by the University of Michigan Health Sciences Institutional Review Board and the Ethics Committee of the Uganda Council on Science and Technology.

Results

From 300 households in 30 villages that were visited and interviewed, 453 adults, including 133 caretakers of children ≤5 years old, agreed to participate in the survey. Forty-five adults (9.9%) reported never having had malaria and 57 (12.6%) reported that their most recent episode of self-diagnosed malaria had occurred prior to the specified recall period (July 1997–August 1998). This left 351 (77.5%) adult respondents for analysis. Similar proportions of children were excluded for never having had malaria (12.0%) or reporting a date outside the recall period (7.5%), resulting in a sample of 107 (80.5%) children. Responses indicated that >77% of adults and >72% of children experienced their most recent episode of malaria during the 1998 epidemic (Figure 2).

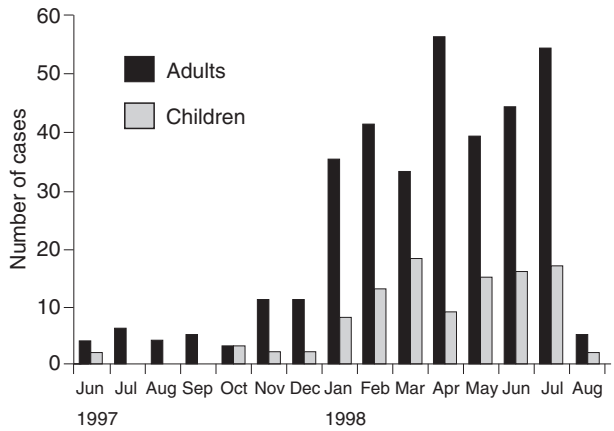

Figure 2 Frequency distribution of the number of cases of self-diagnosed malaria per month in 453 adults and 133 children ≤5 years, June 1997–August 1998, Kabale District, Uganda.

There was some evidence that adults who reported having had malaria during the recall period were better educated, more likely to be formally employed, had better knowledge about causes and prevention of malaria and lived closer to a health facility than those who never had malaria or those reporting malaria episodes outside of the recall period, but these differences were not statistically significant (not displayed).

Households with children ≤5 years were similar to the other households in the survey except that caretakers were younger than the other adults, less likely to be formally employed and less likely to be among the wealthiest households (Table 1). Almost three-quarters of the households were wealthy enough to roof their houses with metal sheets. Furthermore, the majority had easy access to a health facility, although in comparison to shops, a health facility was the closest source of treatment for just over one-third of households.

Symptoms of malaria

We asked adults and caretakers of children to evaluate their experience of selected illness symptoms on the first day of illness by ranking each from 0 for not present to 3 for severe. A high temperature was noted in most adults, as were headache, body aches, sweating, weakness and shivering (Table 2). Diarrhoea in adults was much less common (22.2%). Mean severity scores for each symptom were similar. In children, high temperature was the most common symptom followed by deep breathing, shivering and sweating. Unresponsiveness was found in almost 15% of children while diarrhoea occurred in less than half. Because many of the children were too young to communicate internal symptoms,

Table 1 Characteristics of 351 adult respondents and 107 children and their caretakers, Kabale, Uganda 1998

	Adults		Children's caretaker		Children	
Variable	N	(%)	N	(%)	N	(%)
Sex						
Female	208	(60.6)	99	(94.3)	54	(50.9)
Age (years)						
0–1					15	(13.5)
1–2					28	(25.3)
2–3					41	(36.9)
3–4					11	(9.9)
4–5					16	(14.4)
15–25	87	(24.9)	40	(36.1)		
25–35	101	(28.9)	50	(45.0)		
35–45	73	(20.8)	16	(14.4)		
45 +	89	(25.4)	5	(4.5)		
Education						
None	143	(41.4)	46	(42.2)		
Primary	161	(46.7)	56	(51.4)		
Secondary or above	41	(11.9)	7	(6.4)		
Source of income						
Sale of crops	267	(78.8)	87	(87.0)		
Formal employment	18	(5.3)	1	(1.0)		
Trade/shop keeping	11	(3.2)	4	(4.0)		
Other	30	(8.9)	7	(7.0)		
None	13	(3.8)	1	(1.0)		
Wealth index (UgSh)*						
0–62 500	72	(23.5)	23	(23.2)		
62,500–120,000	73	(23.9)	30	(30.4)		
120,000–227,500	85	(27.8)	35	(34.3)		
227,500–2,955,000	76	(24.8)	12	(12.1)		
House with metal roof	253	(73.8)	75	(70.1)		
Easy access to health facility	210	(59.8)	68	(61.3)		
Health facility closest	125	(35.6)	40	(36.0)		
Knowledge of cause of malaria						
None	108	(30.8)	38	(35.5)		
Some	81	(23.1)	25	(23.4)		
Good	162	(46.2)	44	(41.1)		
Knowledge of malaria prevention						
None	279	(79.5)	88	(82.2)		
Some	34	(9.7)	9	(8.4)		
Good	38	(10.8)	10	(9.3)		

*The wealth index was calculated for each household by assigning 1998 values in Ugandan shillings to ownership of radios, chickens, goats, cattle, mattresses, and bikes. Categories were constructed as quartiles of all households.

the prevalence of headache, body aches and weakness was low.

Health facility preferences

Most respondents stated that they preferred receiving treatment for malaria from a hospital (67.3%), with equal numbers of these people choosing government (34.1%) and mission hospitals (33.2%). Almost one-fifth of respondents named government health clinics (18.1%) as their preferred source of treatment while just over 13% of respondents said they would rather be treated at a private clinic. Treatment obtained from local shops was least preferred (1.7%).

Hospitals were favoured for the high quality of care, the ability to treat severe cases of malaria and the reliable supply of medicines (data not displayed). Government hospitals had

Table 2 Presence of common illness symptoms and their perceived severity in 351 adults and 107 children during their most recent self-reported episode of malaria, Kabale, Uganda 1998

	Adults				Children			
	Number with symptom		Severity score		Number with symptom*		Severity score	
Symptom†	N	(%)	Mean	(Std dev)	N	(%)	Mean	(Std dev)
High temperature	326	(92.9)	2.37	(0.78)	109	(98.2)	2.58	(0.66)
Headache	321	(91.5)	2.43	(0.72)	33	(29.7)	2.45	(0.67)
Body aches	336	(95.7)	2.32	(0.78)	57	(51.4)	2.67	(0.55)
Sweating	307	(87.5)	2.24	(0.75)	86	(77.5)	2.40	(0.71)
Weakness	336	(95.7)	2.28	(0.78)	59	(53.2)	2.41	(0.72)
Shivering	334	(95.2)	2.17	(0.74)	90	(81.1)	2.17	(0.81)
Diarrhoea	78	(22.2)	2.00	(0.76)	45	(42.5)	2.38	(0.68)
Unresponsive					15	(13.5)	2.47	(0.64)
Deep breathing					105	(94.6)	2.47	(0.68)
Overall illness severity‡								
Mild	152	(43.3)			49	(44.1)		
Severe	199	(56.7)			62	(55.9)		

* Percentages are a proportion of all children, regardless of whether the child was too young to communicate.
† Individual symptoms were self-scored as not present = 0, mild = 1, moderate = 2, and severe = 3.
‡ Overall illness severity score for adults was constructed by summing scores for high temperature, body aches, weakness and headache. For children <2 years old, individual symptom severity scores for high temperature, diarrhoea, unresponsiveness and deep breathing were used to create the overall illness severity score. For children ≥2, high temperature, body aches, weakness, headache, unresponsiveness, diarrhoea and deep breathing were used. The median score for adults, children <2 and children ≥2 years was used to classify overall illness severity as either mild or severe. All children were grouped together.

the additional advantage over mission hospitals of low cost; similarly, government health clinics were also appreciated for the low cost and accessibility. Private clinics were perceived to provide high quality of care, but at an increased expense. Although shops were not a preferred treatment source, most respondents said that shops had the advantage over other treatment sources of being nearby.

Previous studies have found that the reliability of drug supplies at government health facilities is one factor that affects clinic attendance (Glik 1989; Ruebush *et al*. 1995). We asked respondents whether lack of medicine had ever prevented their receiving treatment from a government health facility, and 68 (19.4%) responded affirmatively. Of these, 39 (11.1%) recalled finding no medicines at a health facility during the specified recall period with 28 (8.0%) of these episodes occurring during the 1998 epidemic.

Adult and caretaker responses to malarial illness

In this epidemic-prone region, we found high rates of health facility use for malaria treatment. Nearly two-thirds of both adults (64.8%) and caretakers (61.8%) first sought treatment for malaria from a health facility; by the conclusion of their illness episode, more than 87% of adults and 80% of children had been treated at least once at a health facility (Table 3). Long delays between symptom onset and first treatment were rare: most people sought some type of treatment on the first day of symptoms, and 56% of adults and 60% of children visited a health clinic within 1 day of noting symptoms. The epidemic did not appear to alter people's behaviour as the proportions of both adults and children who sought prompt treatment from a health facility was similar both before and during the epidemic (adults 54 *vs*. 56%; children 63 *vs*. 61%).

Given the lower fees and greater proximity to most people, it is not surprising that government health clinics were more likely than private clinics or hospitals to be visited as the first source of treatment for both adults and children (Table 3). Despite the high rate of health facility attendance, shops and home remedies (usually herbs) were still the first source of treatment for a quarter of both adults and children. Surprisingly, mode of transport was not associated with severity of illness for either adults or children; transportation to the treatment source was mostly by walking. Despite the limited income of people in this rural area, more than 60% of adults and 55% of caretakers paid for their treatments with cash, although a significant proportion of both adults (19.9%)

Table 3 Treatment-seeking behaviours during the most recent episode of self-reported malaria of 351 adults and 107 children, Kabale, Uganda 1998

	Adults		Children	
Variable	N	(%)	N	(%)
First treatment at a health facility	226	(64.8)	68	(61.8)
Ever treated at a health facility	307	(87.5)	89	(80.2)
Sought treatment from 2+ sources	150	(43.0)	31	(28.2)
Days between onset of symptoms and first treatment				
0	211	(61.0)	72	(65.5)
1	67	(19.4)	24	(21.8)
2+	68	(19.6)	14	(12.8)
Days between onset of symptoms and first treatment at a health facility				
0	124	(36.2)	40	(37.4)
1	68	(19.8)	25	(23.4)
2+	111	(32.3)	24	(22.4)
No treatment ever at a health centre	40	(11.7)	18	(16.8)
Source of first treatment				
Shop	95	(27.3)	28	(25.5)
Home remedies	27	(7.8)	14	(12.6)
Private clinic	68	(19.5)	18	(16.4)
Government clinic	106	(30.5)	32	(29.1)
Hospital	52	(14.9)	18	(16.4)
Transport to first treatment				
Walking	171	(50.0)	84	(77.1)
Bicycle	30	(8.8)	7	(6.4)
Stretcher	27	(7.9)	2	(1.8)
Motor vehicle	43	(12.6)	7	(6.4)
Others went for medicines	71	(20.8)	9	(8.2)
Payment source				
Cash on hand	194	(60.2)	57	(55.9)
Sale of property	17	(5.3)	3	(2.9)
Loan	64	(19.9)	24	(23.5)
Delayed payment	17	(5.3)	5	(4.9)
Free, no payment required	26	(8.1)	11	(10.8)
Other	4	(1.2)	2	(2.0)
First treatment sources that were followed by ≥1 additional treatments				
Shop	68	(71.6)	15	(53.6)
Home remedies	16	(59.3)	7	(58.3)
Private clinic	23	(33.8)	3	(16.7)
Government clinic	33	(31.3)	2	(6.3)
Hospital	10	(19.2)	3	(16.7)

and caretakers (23.5%) reported borrowing money to make that payment.

Treatment patterns

Multiple visits for treatment during the course of an illness was more likely for adults (43.0%) than for children (28.2%). Adults who first received treatment from a shop (71.6%) or used home remedies (59.3%) were much more likely to go to at least one other source of treatment during the course of their illness than adults who first went to a private clinic (33.8%), government health facility (31.3%) or hospital (19.2%). Children were more likely to go to only one source of treatment than adults, but more than half of their caretakers who bought drugs from shops later used at least one other additional source of treatment.

The most common pattern for multiple visits for both adults (26.7%) and children (25.8%) was obtaining first treatment at a shop and subsequent treatment at a private or government clinic. Treatment from a shop followed by treatment at a hospital was found in 16% of both adults and children. A similar proportion of adults (16.0%) but not children were seen at a clinic and then a hospital, and one-fifth of adults visited two clinics in the course of their illness.

Table 4 Mean cost (UgSh)* of treating the most recent episode of malaria in 351 adults and 107 children, Kabale, Uganda 1998

Variable	Adults		Children	
	Mean	(Std dev)	Mean	(Std dev)
Total cost	9652	(14 788)	4285	(7747)
Transportation	1477	(3910)	429	(1354)
Medicines	7007	(10 976)	3441	(6853)
Doctor's fees	456	(1487)	163	(535)
Accommodation	560	(3060)	214	(984)
Other	138	(583)	31	(220)
Total cost given source of first treatment				
Shop	8012	(11 503)	4156	(6507)
Home remedies	7400	(11 475)	1608	(2262)
Private clinic	17 803	(20 929)	8912	(9549)
Government clinic	6177	(11 955)	2163	(8173)
Hospital	10 568	(13 814)	6375	(7809)
Number of treatments				
1	5695	(10 117)	2993	(5618)
2+	14 885	(18 050)	7657	(10 959)

*In 1998, approximately UgSh 1000 = US $1

Treatment costs

The total cost of treatment varied widely both for adults and children, with the cost for children less than half that for adults (Table 4). The cost of medicines was the single largest expense category, accounting for 73% of adult and 80% of child treatment costs. Despite many people reporting that they preferred to look for treatment at shops because of the low cost, both adults and children who went to a shop for their first source of treatment spent more on their total treatment than did individuals who first sought treatment at a government clinic. The use of herbs for treatment still resulted in a substantial cost for adults. The elevated costs for those seeking treatment at shops or from herbal remedies resulted from the additional treatment visits these individuals made. The cost of treatment for those who went to only one source of treatment (UgSh 5695 for adults and UgSh 2993 for children) was less than half the cost of those who visited two or more (UgSh 14 885 for adults and UgSh 7657 for children).

Associations between respondent characteristics and prompt, appropriate treatment for malaria

Within 1 day of the onset of illness, 56% of adults and 60% of children visited a health clinic for treatment. Demographic and socioeconomic variables were not strongly associated with receiving prompt, appropriate treatment for malaria (Table 5). Adults living in a house with a metal roof were 1.67 times more likely than those living under thatch roofs to seek prompt treatment at a health facility, but this relationship did not hold true for children. Easy access to a health facility was associated with a 50% and 60% increase in the odds of attending a clinic or hospital within 1 day of the onset of symptoms for adults and children, respectively, but this increase was not statistically significant. Children for whom a clinic or hospital was closer to home than a shop were 2.58 times more likely to be seen early at a health facility.

Severity of symptoms was strongly associated with prompt appropriate treatment for both adults and children. Those who were most ill were 4.12 times (adults) or 2.87 times (children) more likely to be seen at a health facility within 1 day of illness. Knowledge of the cause of malaria was positively associated with prompt appropriate treatment but this was not statistically significant. Knowledge of malaria prevention was significantly associated with early treatment in adults (Table 5).

Discussion

Malaria epidemics in the African highlands begin dramatically and conclude quickly. Although the duration of epidemic transmission is likely to be determined mostly by persistence of *Anopheles gambiae* s.l. (Lindblade *et al*. 1999), the degree to which prompt, appropriate treatment for malaria is received will influence the extent of severe morbidity and mortality in the population, as well as impacting on transmission rates. Our study has shown that a large proportion of adults and children in an epidemic area received treatment within 1 day of the onset of symptoms, and more than 80% of both groups eventually sought treatment at a medical facility. These findings are in marked contrast with rural, malaria-endemic regions of Africa where

Table 5 Odds ratios and 95% confidence intervals for associations between prompt treatment at a health facility and characteristics of 351 adults and 107 children and their caretakers, Kabale, Uganda 1998. Bold results are statistically significant

	Adults		Children's caretakers		Children	
Variable	(95% CI)	OR	OR	(95% CI)	OR	(95% CI)
Female*	1.13	(0.73–1.76)	0.31	(0.04–2.79)	1.34	(0.60–2.98)
Age (years)						
0–1					1.00	
1–2					0.45	(0.17–1.22)
2–5					0.36	(0.12–1.11)
15–25	1.00		1.00			
25–35	0.84	(0.47–1.49)	1.38	(0.58–3.27)		
35 +	0.89	(0.53–1.50)	2.14	(0.69–6.68)		
Education						
None	1.00		1.00			
Primary	1.49	(0.95–2.35)	1.19	(0.53–2.66)		
Secondary or above	0.62	(0.81–3.27)	4.75	(0.53–52.9)		
Wealth index (UgSh)						
Q1	1.00		1.00			
Q2	1.69	(0.88–3.27)	0.69	(0.22–2.14)		
Q3	1.01	(0.54–1.90)	1.07	(0.35–3.20)		
Q4	1.81	(0.95–3.48)	1.38	(0.32–6.03)		
House with metal roof	**1.67**	(**1.02–2.71**)	0.63	(0.26–1.53)		
Easy access to health facility	1.51	(0.98–2.32)	1.61	(0.73–3.58)		
Health facility closest	0.94	(0.60–1.45)	**2.58**	(**1.09–6.11**)		
Severe symptoms	**4.12**	(**2.62–6.46**)	**2.87**	(**1.29–6.41**)		
Knowledge of cause of malaria						
None	1.00		1.00			
Some	1.05	(0.59–1.88)	1.96	(0.63–6.06)		
Good	**1.66**	(**1.01–2.74**)	0.76	(0.31–1.85)		
Knowledge of malaria prevention						
None	1.00		1.00			
Some	**2.88**	(**1.26–6.62**)	5.04	(0.59–42.78)		
Good	1.92	(0.93–3.98)	1.44	(0.34–6.14)		

drugs purchased in shops are the major source of treatment for malaria, and a small proportion (ranging from 20 to 52%) of malaria episodes are never treated within the formal medical system (Deming *et al*. 1989; Glik 1989; Snow *et al*. 1992; Slutsker *et al*. 1994; Mwenesi *et al*. 1995; Ruebush *et al*. 1995; Ahorlu *et al*. 1997; Molyneux *et al*. 1999). Our results suggest that the formal health care system can play an important role in effective prevention of severe morbidity and a reduction of transmission during highland malaria epidemics.

Severity of illness was the most important predictor of rapid treatment at a health facility. The most severely ill adults were more than four times as likely to receive prompt treatment at a health facility than those with mild symptoms, while severely ill children were almost three times more likely to be seen. This is not a surprising finding and may help to explain the marked differences in treatment-seeking behaviours between this region of unstable transmission and other endemic transmission areas. Because populations from highland areas lack sufficient immunity due to infrequent exposure to the malaria parasite, malaria infection is likely to produce more severe symptoms in all age groups, prompting quicker treatment at a health facility. Although shops and herbal remedies are still very popular, primarily due to their proximity to people's homes, the health care system is extensively used. Most fever cases are treated eventually at one of the health facilities in the area.

Knowledge of the causes of malaria and methods of prevention was weakly associated with prompt presentation at a health facility in adults (not in children). Overall, more than half of adults knew that mosquitoes 'caused' malaria, but approximately 80% of adults could not name any method to prevent malaria. Previously, we found no evidence of any anti-mosquito measures in a sample of houses monitored for 8 months (Lindblade *et al*. 2000). Given the limited historical exposure of this population to malaria, it is

not surprising that so few people were aware of personal protection measures. This aspect of malaria education urgently needs to be addressed.

The cost of treating a malaria episode represents a huge burden on households that subsist on the sale of cash crops (the case for most families in this area). We found that the total treatment cost for each episode averaged around US $9 for adults and US $4 for children. Given that approximately 77% of the population of Uganda subsists on $2 a day or less (World Bank 2000), the amount spent for treating even one bout of malaria is a substantial proportion of their income. Consequently, about a quarter of households had to sell property or take a loan to pay treatment costs. One practice resulting in increased costs was first treating the illness with shop-bought drugs in the hope that such treatment would be sufficient. For adults, additional treatment at a health facility was required in more than 71% of cases, thus increasing overall treatment costs. It is not clear whether this indicates that most treatments bought at shops were not curative or whether those for whom the shop-bought treatment was sufficient retrospectively decided their illness was not malaria. However, only about half of the children who were first treated at a shop were treated again at a health facility. This finding may be due to the inability of mothers to distinguish malaria fevers in their children from other common childhood fevers that can be treated with analgesics or resolve on their own, such as teething fevers. In any case, a malaria education campaign could include information on the average cost of treatment, with warnings about the financial pitfalls of seeking treatment first from a shop rather than an appropriate medical establishment. Alternatively, an education campaign geared towards shop owners to train them to prescribe the correct dosage of anti-malarials also could be effective in delivering appropriate treatment (Marsh *et al*. 1999).
Although a high proportion of self-diagnosed malaria fevers were treated in the health care system, we did not collect any information to gauge the quality of the treatment received or patient adherence to prescribed drugs. A study from a holoendemic site in Malawi demonstrated that even treatment at a health facility did not guarantee either prescription of anti-malarials or prescription of the correct dosage (Slutsker *et al*. 1994). Although lack of medicines did not appear to be a serious issue in the study area, as only 11% of respondents reported failing to receive drugs at a government clinic within the last year, approximately 16% of respondents sought another source of treatment after visiting a government or private health clinic. Whether this indicates a failure of the treatment regimen, and thus improper prescription or administration of anti-malarials, or another reason requires further study.

A more serious problem associated with our data set may be survivor bias. Our sample contained only those individuals who had survived their bout of malaria and it is possible that the treatment behaviours of those who died were different from our sample in important characteristics. This is a problem common to many retrospective studies of treatment behaviours. The lack of information on case fatality rates for severe malaria in this region makes it difficult to assess the extent of this possible bias.
There is concern that malaria epidemics are becoming more frequent in the highlands of Africa above 1500 m (Lindsay & Martens 1998; Mouchet *et al*. 1998). The public health strategy to mitigate these emergencies must include better tools for forecasting, early warning of epidemics (Lindblade *et al*. 2000), vector control measures, and timely administration of adequate antimalarials. Our results indicate that the formal health care system can play a key role in controlling morbidity, mortality and transmission during an epidemic. This is an opportunity for malaria control rarely afforded endemic regions.

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