

ADHERENCE TO LABORATORY FINDINGS IN THE MANAGEMENT OF MALARIA IN THE HIGH AND LOW TRANSMISSION AREAS OF NAKASONGOLA AND KABALORE DISTRICTS OF UGANDA

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Abstract

Malaria is one of the leading causes of morbidity and mortality in Africa today. It is estimated that a single bout of malaria in Africa costs a sum equivalent to earning for over ten working days. In Uganda, more than 95% of the malaria cases are due to Plasmodium falciparum, the most virulent parasite species that causes severe forms of disease. It has acquired resistance to the commonly used and cheap antimalarial medicines like Chloroquine and Sulfadoxine/Pyrimethamine (CQ/SP) combination. The Uganda Government changed the malaria treatment policy in 2005 to include Artemisinin Combination Therapies (ACTs) as first line treatment for the uncomplicated malaria. Whereas prompt and accurate laboratory diagnosis of malaria is the key to the effective management malaria, clinical syndromic diagnosis has been the most widely used approach in Uganda. This was widely advocated for in sub-Saharan Africa as a means of increasing antimalarial coverage and reducing the risk of progression to severe disease and death.

However, such practice was only tolerated in the era of inexpensive and safe antimalarial therapy of CQ/SP. An adult course of the new recommended first-line ACTs costs more than 10 times the cost of a course of CQ/SP. It is therefore difficult to afford this treatment at individual and national levels. Therefore, presumptive treatment becomes economically and clinically less acceptable and raises a need for a more accurate diagnosis. To make a definitive diagnosis of malaria, demonstration of the parasite in the blood is essential. However, it was not whether health workers have started adopting the reliance on laboratory results before making antimalarial prescriptions.

The study was an attempt to understand the practices of health workers in the health facilities with laboratory services in one high and one low malaria transmission areas of Uganda. Nine health facilities in Nakasongola and Kabalore were selected on the basis of possession of functional laboratory services and 487 patients with fever/receiving antimalarial treatment were enrolled for the survey. It was found that access to laboratory services was limited to a small population. Although the majority of patients reporting to these health facilities (over 95% for the two districts) were sent to the laboratory, only 52% and 32% of those that received their results for Nakasongola and Kabalore respectively tested positive for the presence of malaria parasites. However, all patients reporting to the health facilities with fever still received antimalarials despite health worker training and guidelines under the new first-line treatment policy. This meant that health workers have not changed their prescription practices and laboratory findings were not being used in the management of malaria.

Introduction

Malaria is one of the leading causes of morbidity and mortality in developing countries today. It also has very high costs for their national economies. It is estimated that a single bout of malaria in Africa costs a sum equivalent to over ten working days (WHO,

2005). Prompt and accurate laboratory diagnosis of malaria is the key to the effective management malaria (WHO, 2002). In Uganda, clinical diagnosis using fever as the major symptom is the most widely used approach by practitioners of all levels of training. However, though fever is a major symptom of malaria,

it can occur in other illness as well. This creates a diagnostic dilemma and reduces the accuracy of this criterion for diagnosis of malaria (MOH, 2006).

The practice of presumptive treatment of malaria has been widely advocated for in sub-Saharan Africa as a means of increasing anti-malarial treatment coverage and reducing the risk of progression to severe disease and death (Njama et al, 2007). This, however, increases chances of over-diagnosis which inflates perceived levels of malaria prevalence. In areas of high transmission, treatment of patients without parasitaemia leads to unnecessary drug pressure on the parasite by exposing new infections to sub-therapeutic drug levels during the slow elimination phase and runs the risk of increasing drug resistance. In areas of high resistance, over-diagnosis of malaria may lead to misperception of the true efficacy of antimalarials, when they appear to cure self-limiting febrile conditions mistaken for malaria (Reyburn et al, 2006).

In Uganda, Chloroquine had been used as the first line medicine in the treatment of uncomplicated malaria until 2001 when it was changed to Chloroquine + sulfadoxine/Pyrimethamine combination due to resistance. Drug efficacy studies conducted between 2001 and 2004 found a mean clinical failure of 21.4 % (range 3-45%), much higher than the WHO recommendation of 15% treatment failure for the change of the policy (MOH, 2006). Subsequently, the first line treatment for uncomplicated malaria was changed from Chloroquine + sulfadoxine/Pyrimethamine combination to a more expensive Artemisinin-based combination therapy in 2005 (MOH, 2005). However, this had serious cost implications for the health budget because the adult dose of Chloroquine + sulfadoxine/Pyrimethamine (SP) cost Uganda Shillings (UGX) 250 while the recommended adult doses of Artemisinin-based combination of Artesunate/Amodiaquine 50mg/153.1mg cost UGX 3,800 (15.2 times higher) and Artemether/Lumefantrine 20/120mg cost UGX 6,450 (or 25.8 times higher) (JMS, 2007). Whereas the general tendency of diagnosing almost all fevers as malaria and starting treatment before confirmatory diagnosis was tolerated in the era of inexpensive and safe antimalarial therapy of Chloroquine + sulfadoxine/Pyrimethamine, the introduction of the new first-line ACTs renders presumptive treatment economically less acceptable (WHO, 2006). There is need for a more accurate method of diagnosis before the new treatment can be started, in order to prevent cost-escalation.

To make a definitive diagnosis of malaria, demonstration of the parasite in the blood is essential (WHO, 2003). To effectively manage malaria, minimize misuse of therapy and early development of resistance, diagnostic modalities need to be as accurate as possible (Mishara et al 2006). Microscopic demonstration of the parasites is the most used standard method of diagnosis, although serological rapid diagnostic tests (RDTs) are also increasingly being used. Done properly, light microscopy is sensitive, can detect malaria parasites even in low parasite density blood (Njama et al, 2007). It is reported to be inexpensive and its cost, including the annualized cost of the microscope and slides (but excluding the cost to the health system and the patient) is estimated at \$0.12 to 0.40 per test (MOH, 2006). However, microscopy requires the availability of a microscope, trained personnel, regular supplies of immersion oil, reagents and slides, which are not always available, especially in rural areas of developing countries where they are needed most. For their part, RDTs which have high sensitivity but low specificity (WHO, 2006) have the potential to extend accurate malaria diagnosis to such rural and remote areas. As such, they have the potential of cutting down on the cost of treating all fevers as malaria (WHO, 2005). In the absence of widespread use of RDTs, microscopy remains the mainstay of accurate diagnosis in rural areas of developing countries. This study set out to find the extent to which health workers in selected high and low transmission areas of Uganda use laboratory diagnosis before commencing malaria treatment

Study Areas

Nakasongola District, the high transmission area, is located in central Uganda, 114 km north of the capital, Kampala. Among others, its northern border is largely formed by Apac District, with the highest annual infective mosquito bites in the world, (MOH, 2006) and the floating swamps of Lake Kyoga. Wetlands and the lake cover 9.4% of the district whose temperatures range from 25 to 35 degrees centigrade (NDDP, 2006). Its flat topography and climate make Nakasongola very suitable for malaria transmission. A major economic activity of the people of Nakasongola is cattle-keeping, which favours breeding of mosquitoes due to hoof prints which harbour water especially during the rainy season. Only seven (or 24%) of the twenty nine health centres in the district and only two private clinics have laboratory services. The district has no hospital. Malaria endemicity in the central region of Uganda ranges from 11% to 75% (Meso-Hyper endemicity) and areas on the shores of lake Kyoga are particularly prone to endemicity levels above 75% (MOH, 2003). In Nakasongola Malaria is

the leading cause of morbidity, having contributed to 51% of OPD attendance and 20% of total admissions during the Financial Year 2005/2006 (District HMIS 2006).

Kabarole District, the low transmission area, is located in the western region of Uganda, 320 km west of Kampala. It is a mountainous area and receives fairly well distributed bi-modal annual rainfall averaging 1200 mm a year with temperatures averaging between 20-30 degrees centigrade in all parts of the district, which makes the district have lower temperatures compared to Nakasongola. It is in the region prone to unstable malaria transmission. It has forty four health facilities including three hospitals situated in the same municipality. At least 75% of the population has access to health services within 5 km.

Problem Analysis

Chloroquine had been used for a long time in Uganda as the first line medicine in the treatment of uncomplicated malaria. A syndromic (instead of confirmatory) approach to malaria treatment was the national advice for treatment of malaria in order to reduce morbidity and mortality due to malaria. This was affordable due to the low costs of Chloroquine. In 2001, the first-line treatment was changed to Chloroquine + sulfadoxine/Pyrimethamine (CQ/SP) combination due to increasing resistance, with a mean clinical failure of 21.4 % (range 3-45%), much higher than the threshold of 15% recommended for change of policy by WHO. The first-line treatment for uncomplicated malaria was again changed to Artemisinin-based combination therapy (ACT) in 2005 due to increasing resistance. However, an adult dose of the recommended ACTs costs between 15 and 26 times that of CQ/SP. Due to the high costs of ACTs, it is considered no longer economically feasible to maintain the general advice of syndromic treatment without laboratory confirmation of malaria. Little effort has been put into educating health workers to be cost-conscious and start using laboratory evidence before commencement of treatment with ACTs. Uncontrolled use of ACTs in an endemic country like Uganda will greatly increase health care costs for the health system and households, as well as lead to quick development of resistance.

Objectives of the study

The study set out to find out whether health workers use laboratory findings before prescribing anti-malarial treatment. If used, the results of this study could potentially contribute to the improvement of the diagnosis of malaria and prescription practices thus leading to saving costs spent on malaria.

Its specific objectives were to determine the availability of laboratory services in a high-transmission area (Nakasongola) and a low-transmission area (Kabarole); to determine the adherence of Health workers to laboratory findings in treatment of malaria; to describe the treatment given to patients that test positive and those that test negative; to estimate the waiting time for laboratory results; and to identify the factors affecting adherence by health workers to laboratory results in the management of malaria

METHODOLOGY

A cross-sectional study was done in two districts, in June 2007, in selected purposively for having high and low transmission. The health facilities studied in each district were also selected purposively and conveniently on the basis of presence of functional laboratory services and ease of access respectively. Eligible health facilities were selected by means of multi-stage cluster sampling. In the first stage, all the three hospitals in Kabarole District were included in the study. In the second stage, a total of 9 lower level health facilities were selected in the two districts (1 health centre IV and 8 health center IIIs), with the number of each level in each district being proportionate to the total number of all health units of that level with laboratory services in the district. In each district, the District Health Officer, the person in charge of the selected health facility, staff who were writing the prescriptions and those who worked in the laboratory on the day the unit was visited were interviewed. Monthly Health Management Information System (HMIS) reports of the selected health units for the financial year 2005/06 were reviewed for data on use of laboratory results. This was the latest completed financial year data available at the time of data collection. All the twelve monthly reports (HMIS Form 105) were reviewed for each selected unit. Out-patient forms (Medical Form 5) for the out-patients who had either presented with fever as the main complaint or who had received anti-malarial treatment were studied on exit of the health unit for evidence of adherence to laboratory results in prescription. The forms of four hundred eighty seven (487) such patients were reviewed. We also reviewed the examination requests for to the laboratory for malaria parasites in blood of all those patients where the requests were made. There were 280 such patients in the two districts. The time spent before receiving the laboratory results for each patient was tracked in each health facility.

Limitations of the study

Many of the laboratories recorded as functional, were actually not or partially functional. This led to

significant reduction of the sample size. Record keeping was very poor in laboratories of lower level health units, leading to inaccurate and incomplete records. Recording of the diagnosis was inaccurate and incomplete, and in some cases missing altogether. The control of the quality of the laboratory services such as testing the accuracy of the diagnosis using a gold standard was outside the scope of this study yet this could affect the results.

Results

Coverage with laboratory services

All health units were expected to have functional laboratory services, albeit of different scope. In Nakasongola District, their sole health centre IV, 6 out of 8 (or 75%) of the health centre IIIs and only 1 out of 19 (or 5.3%) health centre IIs had a functional laboratory. In Kabarole District, the three hospitals, 1 (or 50%) of the 2 health centre IVs and 30.8% of the health centre IIIs and IIs had functional laboratory services.

Accessibility to laboratory services

Accessibility to laboratory services, in the context of this study was defined as the percentage of out-patients needing laboratory services that visited a health facility with laboratory services within 5 km from their residence. It was determined from records. A complaint of fever was taken as the proxy indicator for need for laboratory services. An individual was considered as lacking access to laboratory services if he/ she, while having a complaint of fever, visited a health facility without laboratory because that was the nearest to him/her, within 5 km from their residence.

It was found out that the proportion of patients with fever seeking health care services in health facilities with laboratory services in both districts was smaller compared to those that went to the facilities without laboratory services

This is further illustrated in table 1 below:

Table 1: Use of health facilities with laboratory services by district

	Nakasongola	Kabarole
All out-patients attending OPD in facilities with laboratory services	45.4%	34.3%
Patients with a clinical diagnosis of malaria attending facilities with laboratory services	42.4%	31.8%
Patients with fever, attending facilities with laboratory services whose fever was confirmed as malaria	16.9%	39.2%

The table shows that in both districts, only a minority of patients attend facilities with laboratory services. It also shows that only a minority of patients who eventually get a clinical diagnosis of malaria (and hence get treatment) actually attends facilities with laboratory services. Finally, it shows that in reality, only a small minority of patients with fever was actually confirmed to have malaria.

Patients' Experience in the facilities

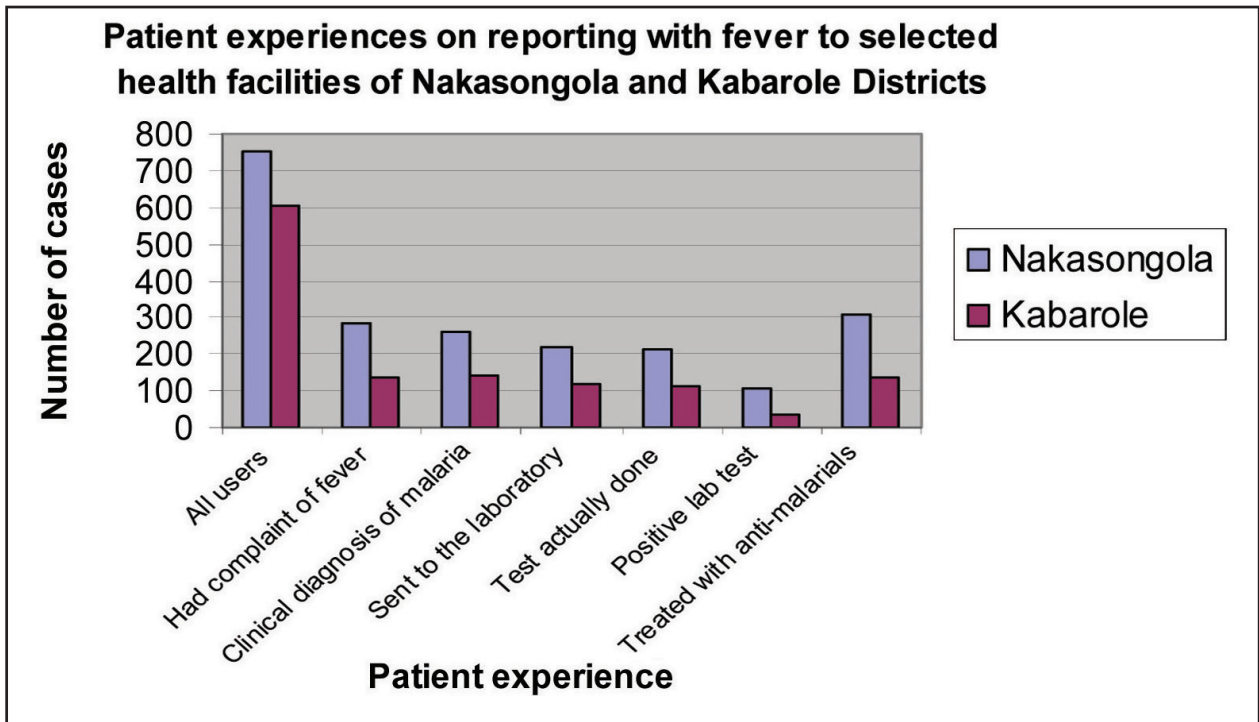
It was found out that in the health facilities with laboratory services which were studied, 37.7% and 22.6% of outpatients reported with a complaint of fever for Nakasongola and Kabarole respectively. In both districts, the majority of the patients with fever were suspected clinically to have malaria (91.2% for Nakasongola and 102.9% for Kabarole). The majority of those suspected clinically of having malaria were sent to the laboratory for a blood smear for malaria parasites (83.5% for Nakasongola and 83% in Kabarole). However, the test was positive for only 49.8% of the tested cases in Nakasongola and for only 33.6% of the tested cases in Kabarole. However, those who received antimalarials were 295% of those who actually tested positive in Nakasongola and 360% in Kabarole. In other words, all those who had a complaint of fever were treated with antimalarials in both districts (108% in Nakasongola and 100% in Kabarole), irrespective of the laboratory findings. Fig. 1 shows the trend of the findings.

Whereas there is initially a consistent downward cascade of findings along the investigative process, there is a dramatic upward turn at the point of administering treatment, which is only attributable to failure of behaviour change by the prescribers.

The prevalence of malaria among patients presenting at OPD

Of the patients sent to the laboratory on clinical suspicion of malaria, 52% in Nakasongola and 34% in Kabarole were confirmed to have malaria.

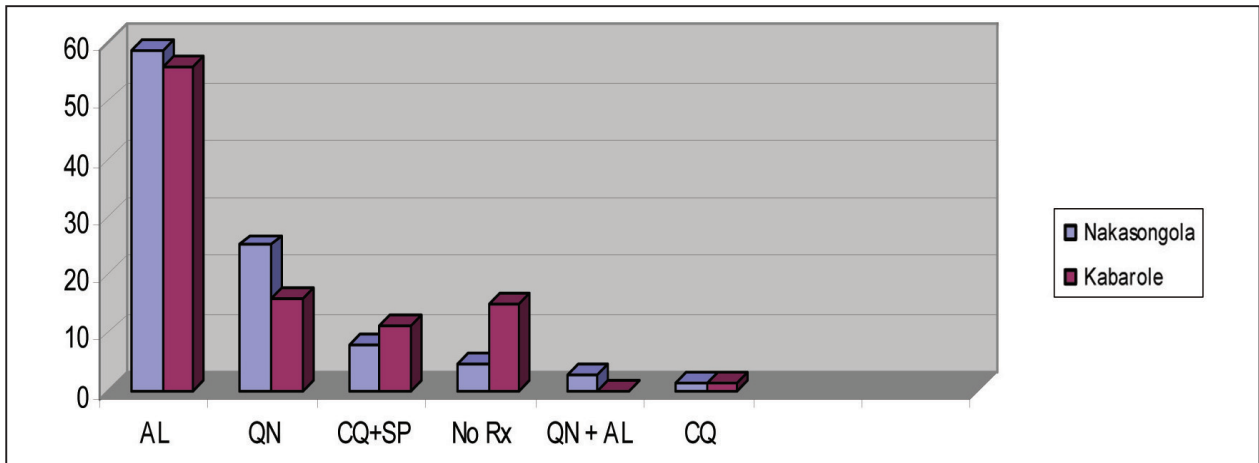
Figure 1: Patient experiences on reporting with fever, in Kabarole and Nakasongola Districts



Treatment administered to malaria patients

The graph below shows the medicines used to treat the cases diagnosed as malaria, irrespective of the method of diagnosis in the two districts.

Figure 2: Medicines used to treat malaria in Nakasongola and Kabarole Districts



In both districts, the majority of the patients who received anti-malarial treatment were prescribed the official first-line treatment, Artemether/Lumefantrine (AL) indicating that the health workers were following the recommended guidelines of the Ministry of Health. In Kabarole, some health workers also used Dihydroartemisinin /Piperaquine phosphate (Duo-Cotecxin), another Artemisinin combination medicine as the first-line treatment. These two Artemisinin

combinations contributed 56% of the anti-malarial treatment prescribed.

In Nakasongola, 58% of the patients receiving anti-malarial medicine received the official first line treatment. In Nakasongola there was also a tendency to put all the patients with a negative blood smear result on first-line treatment and those with a positive result on quinine, which is the recommended second-

line treatment for malaria. In addition, other unofficial treatment schedules were applied e.g. combinations of a single injection of quinine accompanied by a full course of treatment with either CQ/SP or Chloroquine.

Factors hindering adherence to laboratory diagnosis in the management of malaria

A total of 30 laboratory health workers and health workers prescribing treatment in the two districts were interviewed to find out the reasons for not adhering to laboratory findings. Below are some of the factors that health workers blamed or observed for the lack of adherence.

Shortage of laboratory staff

In both districts, blood smears for malaria parasites are done by laboratory staff. In Nakasongola District there were only seven laboratory staff capable of conducting the tests for 28 health units. These were one laboratory technician, five laboratory assistants and one microscopist. There was only one laboratory staff for each of the health facilities where the laboratory was functional and this made it impossible for the laboratory staff to be on duty all the time.

In Kabarole District, some facilities visited were better staffed. For example, the Regional Referral Hospital had three Laboratory Technologists, two Laboratory Technicians, three laboratory assistants and one microscopist. Other hospitals were equally well staffed. However, lower level facilities were understaffed.

Training of health workers

Out of the thirty health workers interviewed 22 (or 73%) had had training and support supervision on the new malaria treatment policy and guidelines. These were mostly in Kabarole District, where all the health workers interviewed had had training and received support supervision in implementation of the new malaria drug policy. Even the medical students in the attached Clinical Officers Training School had had similar training and laboratory personnel had received refresher training in the standard operation procedures.

Guidelines for the treatment of malaria

All health workers interviewed in the two districts were using the *Uganda Clinical Guidelines – 2003*, which is the set of national standard treatment guidelines, and *Treatment of Uncomplicated Malaria – A practical guide for health workers – 2005*, a guidebook by WHO. Although the documents do not include the use the current first-line treatment, the new malaria treatment policy was displayed in all health

facilities visited in Kabarole District and in only one in Nakasongola. All the laboratory staff was using the Standard Operation Procedure for the laboratory health workers. However the document was available and displayed in only one health unit in Nakasongola, although they all claimed to have a personal copy.

Reasons for starting treatment before laboratory confirmation

The health workers interviewed had a number of reasons for starting treatment before confirmation of the presence of malaria parasites. Many stated that presence of any danger sign for example, if a patient presented with convulsions or where severe malaria was suspected due to other signs or symptoms, then it was justifiable to start the patient on treatment before confirmation. In such cases, blood was taken off and the patient started on treatment as the results came. This was done especially in children under five years of age than in adults.

Other reasons given for starting treatment without laboratory results included the presence of signs and symptoms of malaria with no suspicion of any other differential diagnoses; delay in producing the laboratory results; high prevalence of malaria (especially used in Nakasongola); signs of malaria in pregnancy; the presence of a “typical” clinical picture of malaria (used especially in Kabarole); where a patient was in a hurry and chose not to wait for the laboratory tests; and in cases where opted not to give a specimen (especially paying patients).

Perceptions on routine use of laboratory tests for malaria

Health workers in the two districts said that making laboratory tests for malaria a routine practice would improve the diagnosis and management of malaria. If the laboratory diagnosis was accurate, they reported that it would lead to prompt and correct treatment for malaria. They further agreed that it would reduce the current wastage of anti-malarial treatment which arises from incorrect diagnosis of malaria. They also knew that misuse of drugs would lead to early development of resistance by malaria parasites to the drugs used in the management of malaria. However many said that it would only be feasible to introduce routine testing in children and some adults with confusing diagnosis but not for everyone who came with fever.

They also stated that introduction of routine laboratory testing would consume a lot time and thus increase the waiting time for the patients. They also said that production of unreliable results would also increase

because of the work pressure. They also noted that it would not make a lot of sense to test everybody with a fever since a single blood test for malaria cannot completely exclude the presence of malaria parasites in blood.

Many health workers said that despite the new malaria treatment policy, they would still treat their patients for malaria even when the blood test was negative, as long as they were convinced on clinical grounds that the patient had malaria. This would be to avoid unnecessary costs and loss of valuable time before commencing treatment.

Discussion

The Ugandan Ministry of Health recommends that all health center IIIs should have basic laboratory services which should include facilities for testing blood for malaria parasites (MOH, 1999), (MOH, 2005). Currently in the two districts of Nakasongola and Kabarole where research was carried out, not all health centre III have laboratory services for malaria diagnosis. It is recommended that diagnosis based on clinical criteria should be supplemented by detection of parasites in blood (WHO, 2006; MOH, 2006). This however, can only be achieved if laboratory services are available and accessible.

Access to laboratory services is a problem in the two districts as evidenced by the small proportion of health facility with laboratory services for blood for malaria, in the two districts. More than half of the patients that reported to the health facilities in the two districts attended health facilities without laboratory services. This implies that presumptive malaria treatment was given to the majority of the patients with fever. Although this approach can help in the treatment of all patients with malaria, it is also likely to misclassify many, resulting in the patients with other diseases receiving malaria treatment. This practice has very low specificity and contributes to the misuse of anti-malarial medicines, increased costs to the health services and patient dissatisfaction.

Shortage of laboratory staff also contributes to poor access to laboratory services. The few laboratory personnel available cannot find time to go for refresher training. This eventually affects their performance and the quality of their results. This probably explains why clinical staff sent patients to the laboratory but did not honor the results.

Prescriber behavior in treatment for malaria

Presumptive treatment of malaria has been widely advocated as a means of reducing missed opportunities

for correct and timely treatment in order to minimise the risks of progression to severe disease and possible death (Njama et al, 2007). In both districts studied, almost all fevers presenting in OPD were diagnosed clinically as malaria, the majority are sent to the laboratory for blood slide examination for malaria. However, a proportion (39%) of those patients sent to the laboratory were treated before confirmation of the results. Studies done in Uganda, Zambia and Ghana (Petit et al., 2005) found out that clinical decision-making frequently occurred in the absence of laboratory confirmation even when the capacity to do the necessary tests was available. It is not clear why the health workers still send the patients to the laboratory even when they know from the outset that they do not intend to use the results for decision-making. This practice wastes a lot of scarce resources.

One potential factor contributing to the practice of prescribing anti-malarial therapy in spite of negative blood smear results is the belief that patients may have malaria anyway (Njama et al., 2007). Some believe that if anti-malarial treatment is not given, this will lead to poor outcome (Reyburn et al, 2006, Njama et al, 2007). This affirms the finding that reliance on the clinical diagnosis is attractive in the areas with high prevalence of disease (WHO, 1999). This is because no extra cost is incurred and no special laboratory equipment or supplies are required for treatment to take place. But when you consider the cost of all the antimalarial treatment used because almost all patients reporting with fever are put on treatment, you realize that 75% of the cost would have been saved by treating only those cases confirmed to have malaria.

In a study in Zambia (Petit et al., 2005), thirty five percent of patients without parasitaemia were prescribed anti-malarial therapy. Use of anti-malarial therapy varied widely indicating that clinicians were not using standard criteria (Barat et al, 1999). In Uganda, the practice of prescription without laboratory confirmation has been promoted by the policy of syndromic treatment, which was only tenable when the first-line treatment was cheap and affordable for the health system. The policy stated that any patient with fever or history of fever within 24 hours without evidence of other diseases should be treated for malaria even with a negative blood smear for malaria parasites (MCP, MOH, 2005).

Prevalence of malaria among the patients

In 52% of patients in Nakasongola and 34% of those in Kabarole who were sent to the laboratory, blood

smear results were positive for malaria parasites. This implies that, if the laboratory readings were 100% accurate and health workers adhered to the laboratory findings over 48% of the improper treatment in Nakasongola and over 60% in Kabarole would have been averted. If the current national policy on malaria treatment is implemented, probably some considerable portion of the drug budget could be saved.

Factors affecting adherence to laboratory diagnosis in the management of malaria

The use of standard treatment guidelines was one of the factors affecting adherence to laboratory findings in the treatment of malaria in the two districts. The guidelines recommend use of a blood smear for malaria parasites if there has been incorrect use of first-line treatment or when anti-malarial treatment has been used in the preceding fourteen days. They further recommend that if the patient presents with fever and no other diagnosis is suspected, then it is justifiable to start the patient on anti-malarial treatment (MOH, 2005). However, such practice results in unnecessary use of anti-malarial therapy especially in areas of low transmission of malaria (Chandramohan et al, 2002; Amexo et al, 2004).

Other factors included severity of the condition, more so if the results were contrary to the suspicion of the health workers; delay in producing the laboratory results and fear that patients would get worse if treatment was withheld due to negative results. There was also a belief that even patients with negative blood smear results improved on treatment for malaria. This tended to suggest that even with negative blood tests, patients could still be having malaria. However, it is also possible that such patients could have been having other self-limiting conditions though they seem to improve on treatment for malaria. Continued use of anti-malarial treatment in the absence of parasitemia has high costs to the health system.

Conclusion

The study shows that there was limited access to laboratory services in the districts of Nakasongola and Kabarole. Health workers, especially those in Kabarole District had received training in the new policy of treatment of malaria, which includes the use of laboratory findings before commencement of treatment. However, there was still confusion due to conflicting policy guidelines with the recommended strategies for the control of malaria, with a persistent policy on syndromic treatment of all fevers as malaria irrespective of laboratory results.

Recommendations

In view of the above findings, it is recommended that the Ugandan Ministry of health endeavours to withdraw the old policy on syndromic treatment of all fever as malaria, in order to save unnecessary costs being spent on inappropriate antimalarial treatment. It is also recommended that district health authorities endeavour to equip all their health unit with laboratory equipment and to staff them with qualified laboratory staff. Quality assurance of malaria treatment at health unit level needs to be done by the district and ministry levels, to ensure compliance with policy guidelines.

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