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Assessment of the clinical management of children suspected of having malaria in Lusaka District, Zambia.

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1. suspected malaria
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3. test and treat
4. Artemisinin Combination Therapy
5. malaria microscopy test
6. rapid diagnostic test
7. resistance to chloroquine
8. Integrated Management of Childhood Illness
9. presumptive treatment
10. fever

List of Acronyms

ACT: Artemisinin-based Combination Therapy

DHO: District Health Office

DRC   : Democratic Republic of Congo

HMIS: Health Management Information System

IMCI   : Integrated Management of Childhood Illnesses

IRS   : Indoor Residual Spray

ITNS: Insecticide Treated Nets

MIS: Malaria Indicator Survey

NMCC: National Malaria Control Centre

PHO: Provincial Health Office

RDT: Rapid Diagnostic Test

TDR: Tropical Disease Research

UNDP: United Nation Development Programme

UNICEF: United Nations Children's Fund

WHA: World Health Assembly

WHO: World Health Organization

Table of contents

List of figures

List of tables

ABSTRACT

In Zambia, there had been a large scaling up of new interventions to control malaria since 2003, which included the distribution of rapid diagnostic tests (RDTs), used to immediately determine if someone with symptoms suggestive of malaria actually has malaria; training of health workers in the use of the RDTs; and the prescription of artemisinin-based combination therapy (ACT) to which the malaria parasite is sensitive, rather than the old treatment regime of chloroquine to which the malaria parasite had become resistant. The use of RDTs to confirm the presence of malaria before treating for it with ACT became known as the 'test and treat' policy. Previously, since the 1960s, in malaria endemic areas such as Zambia, children presenting with fever (the commonest symptom of malaria) without any obvious other cause for the fever, were assumed to have malaria and were hence treated for it with chloroquine. This was known as 'presumptive treatment' of malaria. The combination of 'presumptive treatment' and the use of a single medication led to the development of high levels of resistance to chloroquine, to the extent that it is now no longer an effective treatment for malaria.

Years after the introduction of the 'test and treat' policy, it was still unclear to what extent it was being implemented, as there was initial reluctance by health workers to test all children presenting with fever for malaria and if they did test they may not have followed the management guidelines of treating those who test positive with ACT and further investigating those who test negative for the cause of the fever. It seemed that staff had gotten used to the 'presumptive treatment' approach to malaria over almost 4 decades and hence were quite reluctant to abandon it. The conflicting guidelines for malaria treatment in children between IMCI and 'test and treat' has promoted a paradox between presumptive treatment for malaria and "test and treat" approach as IMCI teaches health workers to treat febrile children presumptively for malaria whereas the "test and treat" approach requires them to first make a definitive diagnosis before treating. Hence although the "test and treat" approach was instituted to overcome the problems with presumptive treatment approach it now had to contend with the competing and contradictory influence of the IMCI approach. This study therefore aimed to assess what proportion of children aged five years and younger who presented with fever were managed via the 'test and treat' guidelines and which factors were associated with this, in Lusaka District, Zambia.

Methodology:

A cross sectional analytical study design was used based on a review of medical records. A sample

size of 800 medical records of children presenting with fever was selected from 10 out of the 23 health care facilities in Lusaka, using a multistage stratified random sampling technique. Four hundred records were sampled from 2008 records (five years after commencement of the 'test and treat' policy) and 400 from 2011 records (eight years after commencement of the 'test and treat' policy). Trained data collectors used a data extraction tool to transcribe demographic and clinical data from the medical records in a standardized manner.

Data Analysis:

Univariate descriptive statistics analysis was performed using measures of central tendency and measures of dispersion to analyze numerical (continuous) variables such as age, weight and body temperature; and using frequencies for categorical variables such as gender, area of residence, RDTs/microscopy malaria tests conducted, received ACT if RDT positive, presence of an ACT treatment chart on the health centre wall and availability of a weighing scale. To determine the relationship between variables, bivariate analysis via the prevalence ratio was conducted.

Results

Just over half (55%) of all children with fever were tested for malaria in 2008 and this gratifyingly increased to (73%) in 2011. Overall, the proportion of children correctly and appropriately treated with ACT, which means that those who tested positive for malaria were given ACT, was 85% in 2008 but regrettably dropped to 72% in 2011. Although "presumptive treatment" decreased from 24% in 2008 to 11% in 2011, the proportion of children with fever not tested for malaria, and although not treated for malaria, but left without a definitive diagnosis of their fever being made, remained high but dropping (22% in 2008 and 16% in 2011). Similarly the proportion of children who tested negative for malaria but then did not undergo any further investigation also unfortunately remained very high and rising (57% in 2008 and 89% in 2011). A combination of the above poor clinical management practises resulted in only 38% of children with fever in 2008 and unfortunately dropping to only 33% in 2011 being correctly managed (tested for malaria via RDT or microscopy and treated with ACT if positive, while further investigated for the cause of fever if negative). On preparedness of the health facility to implement the 'test and treat' policy, it was noted that only 4 out of 10 health facilities were at least minimally prepared to do so, but paradoxically on bivariate analysis those minimally prepared were less likely (PR 0.62; 95% CI 0.41-0.94) to correctly manage

the patients in 2011 than those who were unprepared. A similar paradox occurred for those correctly treated with ACT after testing positive, with facilities which were minimally prepared being less likely to do so (PR 0.28; 95% CI 0.14-0.58) in 2011 than those facilities which were unprepared to implement the 'test and treat' policy. However these associations were inconsistent over time, as the associations were not present in 2008. Similarly all other factors such as staff category (doctor, nurse, clinical officer) and type of presenting symptoms besides fever (anorexia, lethargy, pallor) assessed, were not consistently associated with testing for malaria in both 2008 and 2011. The same applied for the other two main outcome variables of 'treated with ACT after test positive for malaria' and 'correctly managed child with fever', in that there were no factors that showed a consistent association with them in both 2008 and 2011.

Conclusion

Testing of children with fever for malaria is at a low level but rose between 2008 and 2011. Paradoxically the proportion of those diagnosed with malaria who were correctly treated with ACT dropped between 2008 and 2011, as did the proportion of children with fever who were correctly managed. No factors assessed in this study were found to be consistently associated in both 2008 and 2011 with either testing for malaria, or treating confirmed malaria cases with ACT, or managing patients with fever correctly.

Recommendations

In order for health workers to correctly implement the 'test and treat' policy, which involves a series of complex steps, they ought to be formally trained to do so, mentored and constructively supervised. Additionally health facilities should be adequately equipped to enable health workers to fully implement the policy. Further studies to assess factors associated with the correct management of malaria via the 'test and treat' policy are warranted.

Acknowledgement

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DECLARATION

I declare that *Assessment of the clinical management of children suspected of having malaria in Lusaka District, Zambia* (full title of thesis, in *italics*) is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: Evans Landilani Mwale   Date: 23rd November, 2015

Signed..

Introduction

Back ground Information

Malaria Situation

Malaria is a major global public health problem. It is a leading cause of morbidity and mortality accounting for over one million deaths worldwide, of which more than 50% occur in Africa (WHO, 2006; Nyarango, 2011). Malaria, though on the decline, has remained a major cause of admissions to hospitals among children under five years of age in Zambia. Admissions for malaria account for 20% to 50% of all admissions, although only 8% to 25% of persons with malaria visit health services (Ministry of Health, 2010d). It is responsible for the occurrence of approximately 40% of fever cases, and has a 5 per 1000 population per year mortality rate (Ministry of Health, 2010d).

The disease imposes a severe social and economic burden on communities as malaria transmission season generally coincides with the planting and/or harvesting season, and brief periods of illness exact a high cost on the country`s poorest communities, due directly to the illness and indirectly to the loss in productivity. Additionally caring for the sick not only results in a loss of already meagre family resources, but also results in mental and physical exhaustion of the caregivers, with further negative impacts on productivity (Ministry of Health, 2009c).

Malaria is endemic in Zambia with seasonal and geographical variations (Ministry of Health, 2010b). Transmission is stable throughout the year with a peak period in the rainy season (November to March). The Plasmodium falciparum type of malaria parasite accounts for 90% of all infections. The major vectors are Anopheles Gambiae and Anopheles Fenestus mosquitoes (Ministry of Health, 2010a). For decades since the 1960s, initially with the backing of the World Health Assembly (WHA) and later by the World Health Organization (WHO), presumptive treatment of malaria with chloroquine as the drug of choice had been widely practiced by both health workers and caregivers in resource poor nations (WHO, 1993). Presumptive treatment functioned as follows: any patient presenting with a fever in a malaria endemic area for which there was no easily identifiable cause, was presumed to have malaria and was therefore treated for malaria using chloroquine as a first line drug. The objective of this approach was to cover the majority of the population with prompt access to good quality antimalarial treatment within 24 hours of onset of symptoms, thereby reducing the risk of progression to severe illness and death in those patients who truly suffered from malaria

(WHO, 2004b; Njama et al., 2007). While presumptive treatment of malaria identified and treated most patients who truly needed antimalarial treatment, the problem is it misclassified and treated for malaria many patients who did not have malaria (Talisuna et al., 2004). This caused unnecessary over-treatment with chloroquine, a factor thought to have contributed to the malaria parasite developing resistance to chloroquine. Furthermore presumptive malaria treatment resulted in a lack of treatment for the real cause of the presenting illness that mimicked malaria (Kallander et al., 2000). Clinically presumed malaria was a common diagnosis made in most malaria endemic countries, including Zambia (Kyabanyinze et al., 2010). However, the low specificity of symptoms and signs of malaria, coupled with a low enthusiasm for searching for alternative diagnoses for fever, the commonest presenting symptom of malaria, resulted in presumptive malaria treatment for any and every fever being commonly practiced and studies have suggested that this led to a large overuse of chloroquine (Reyburn et al., 2007; Kyabanyinze et al., 2010).

The decision to change from the previous presumptive treatment of malaria to an evidence based one in Zambia was arrived at in 2003, following well documented reports of chloroquine resistant cases of malaria and rising morbidity and mortality amongst the population in Zambia, and elsewhere in Africa, due to malaria (Ministry of Health, 2008a; WHO, 2008). The process of change commenced at the central level with a revision of the national guidelines to incorporate changes in treatment recommendations and the development of job aids, charts and guidelines. This was followed by in-service training at central level and rapidly cascading training programmes to provinces, districts and health centres (Ministry of Health, 2008a; WHO, 2008). This prepared health workers to shift from the previous policy that recommended presumptive treatment of malaria to the new evidence based treatment policy in 2003 (called the 'test and treat' policy). The World Health Organization, 2006 and 2010 malaria diagnosis and treatment guidelines emphasized testing for the malaria parasite using a rapid diagnostic test (RDT) and/or traditional microscopy for the identification of the parasite in the blood and then prescribing artemisinin-based combination therapy (ACT)[1] to patients who test positive for malaria (WHO, 2006; WHO, 2010). Following chloroquine treatment failure due to widespread resistance, the World Health Organization recommended replacement of chloroquine with the artemisinin-based combination therapy (ACT) as the first-line of treatment for malaria

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[1] ACT is composed of the following drugs: Artemisinin derivatives including dihydroartemisinin, artesunate and artemether.

(WHO, 1993). Further clinical evaluation and/or laboratory investigations should then be undertaken on patients who test malaria negative in order to determine alternative diagnoses explaining their symptoms (WHO, 2006a; WHO, 2010a).

Emerging evidence from national surveys, routine information systems and focused studies have consistently shown a decline in malaria infection in Zambia between 2000 and 2009 (Ministry of Health, 2012).The national annual incidence of malaria in 2006 was estimated at 412 per 1,000 population with 4.4 million confirmed and unconfirmed (clinically diagnosed only) cases, and 3,871 deaths were reported in the same year via the routine health management information system (Ministry of Health, 2010a). In 2007, the incidence rate dropped to 358 cases per 1,000 populations and in 2008, the incidence rate dropped further to 252 with 3.2 million confirmed and clinically diagnosed cases. In 2009 over 3 million clinical and laboratory confirmed cases of malaria and 3,000 deaths were reported (Ministry of Health, 2010b). In the children under five years of age category, there were 170,000 inpatient malaria cases and 7,000 deaths in 2001 which reduced to 120,000 in 2007 with 2,600 deaths and then to 70,000 in 2008 with 1,700 deaths (Ministry of Health, 2010b).

Regarding the changes in the malaria burden of disease in Zambia, Kamuliwo et al (2013) notes that the Director of Public Health at the National Malaria Control Centre in Zambia reported that, in 2006, 4.98 million cases of malaria were reported in Zambia. Using 2006 as baseline, a sharp decline in the number of reported cases was observed through 2009 followed by an increase in malaria cases in 2010 that continued through 2011 (Figure 1). In 2011, a total of 4.54 million cases of malaria were reported (Figure 1). From 2008 to 2011, an increasing number of districts reported low malaria prevalence, ranging from < ten to 100 cases per 1,000 population. Despite this improvement, 37 districts reported resurgence towards the 2006 baseline level or higher levels of malaria incidence in 2011. No clear trend in the incidence of malaria cases among children less than five years and individuals more than five years was apparent (Figure 2). From 2006 to 2011, the rate of severe malaria was more than five times higher among children of less than five years (50 severe malaria cases per 1,000 population) compared with those more than five years old (nine severe malaria cases per 1,000 population) and the mortality rates were more than five times higher among children less than five years (1.3 deaths per 1,000 population) compared with those of more than five years of age (0.2 deaths per 1,000 population). Reporting of clinical diagnoses and confirmed cases by RDT or microscopy, started in Zambia from 2009, yet only half (50.2%) of the reported cases were confirmed by either microscopy or RDT in 2011 (Figure 1).
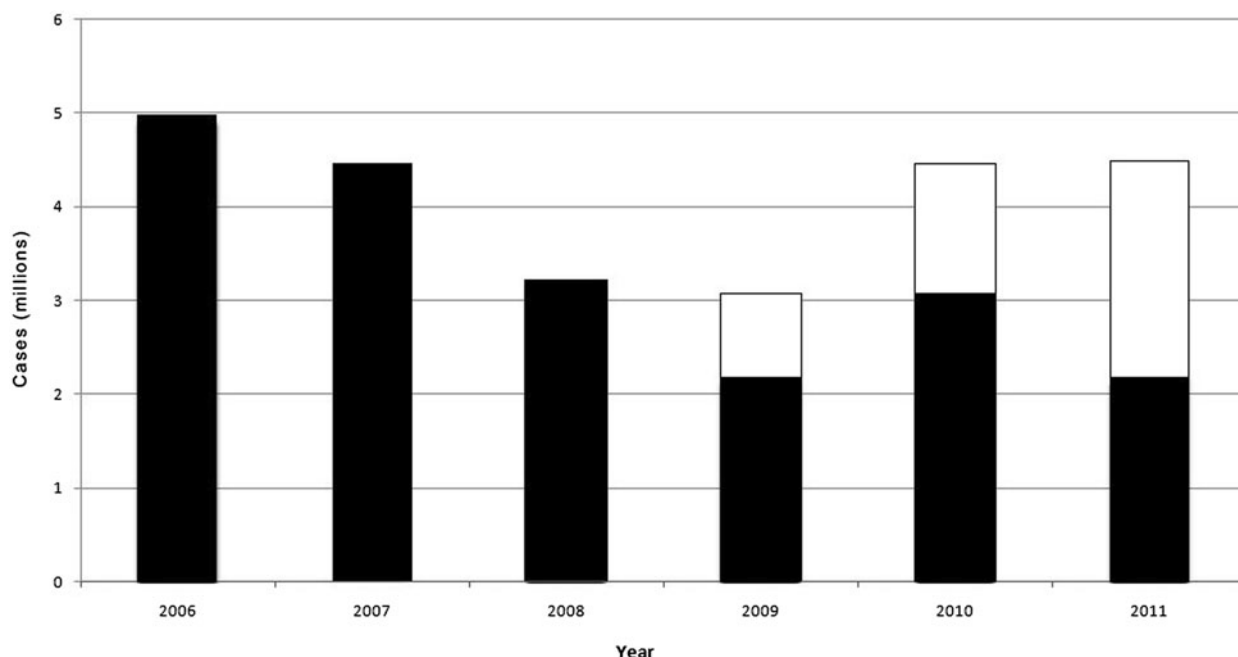
Figure 1: Trends in malaria cases and method of diagnosis in Zambia, 2006 to 2011. (Black bars indicate clinical cases, open bars indicate cases confirmed by microscopy or RDT).
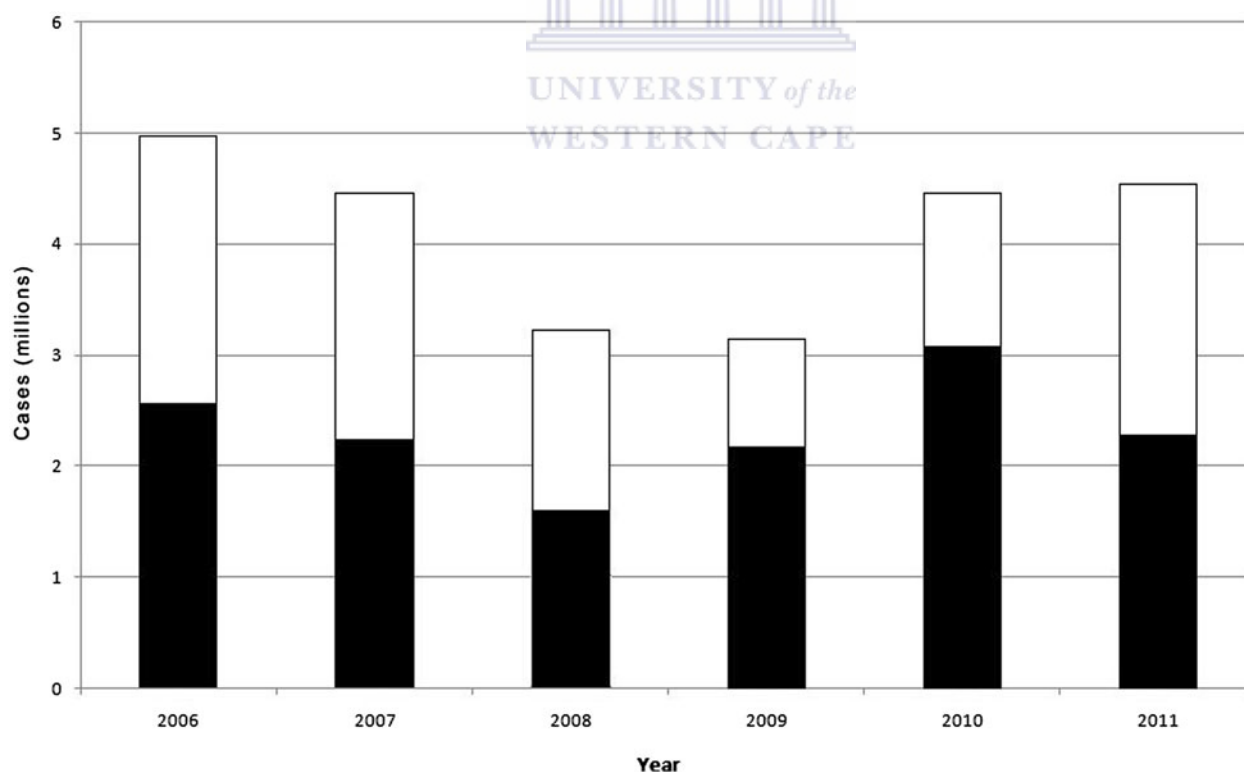

Figure 2: Malaria in Zambia by age groups, 2006 to 2011. (Black bars indicate cases less than five years, open bars indicate cases equal to or more than five years).

The declining incidence of malaria has been attributed to a combination of malaria reduction interventions. These include the use of Rapid Diagnostic Tests (RDTs) and microscopic parasitological examination where available to confirm malaria and rule out fevers not related to malaria, effective case management, mass distribution of insecticide treated nets (ITNS), indoor residual spraying (IRS) of pesticides, and community involvement in various malaria control strategies such as environmental management (Ministry of Health, 2012). Community demand driven programmes involve community members in cleaning their environments to eradicate breeding sites of mosquitoes and sensitization programmes that aim at increasing uptake of malaria prevention activities (Ministry of Health, 2009b; Ministry of Health, 2012).

 As the incidence of malaria described by the routine information system is measured via the proxy of 'treated cases of malaria', it would be reasonable to assume that a substantial proportion of the decline in incidence could in fact be due to the 'test and treat' policy being progressively implemented, as under this policy a much lower proportion of people (especially children) with fever would be treated for malaria than with the 'presumptive treatment' of malaria. However despite the documented decline in malaria incidence rates via the routine information system noted above, the 2010 Malaria Indicator Survey (MIS) reported an increase in confirmed malaria parasitemia in children under the age of five years, from 10% in 2008 to 16% in 2010 (Ministry of Health, 2010b). This is quite strange, because, if there were a decline in treated malaria cases then one would expect a decrease in incidence of confirmed malaria cases. A possible explanation for this discrepancy is that, although there is a decrease in reported malaria treatment rates due to the 'test and treat' policy, many children are still receiving presumptive treatment. Given this scenario, there would be no direct correlation between the reported incidence in treated cases of presumed malaria and the incidence of laboratory confirmed malaria parasitemia. Indeed, a brief review of medical records showed inconsistency in management of malaria according to the new 'test and treat' protocol. The brief review entailed conveniently selecting and reviewing medical records from three health care facilities in Lusaka district. These records showed that several children were prescribed ACT based on clinical history and/or fever only, without any form of testing to determine if they had malaria. However, the extent of these inconsistencies in malaria management in Lusaka and indeed in Zambia is unknown (Ministry of Health, 2010b; Ministry of Health, 2012).

Health service provision

In Zambia, the government provides the majority of free health care services via hospitals and primary health care facilities. Malaria services reach the public through Provincial Health Offices (PHO) and District Health Offices (DHO) respectively. At district level, the District Health Office provides overall planning, coordinates, monitors and evaluates health care delivery activities including that of malaria treatment. The District Medical Officer coordinates a malaria task force on policy and guidelines issues and supports a malaria focal point person who coordinates malaria activities. At the health centre level, that serves a catchment area of about 10,000 residents, the team leader works with members to prioritise resource allocation and implementation of health policies and guidelines. Health centres are expected to be staffed by a doctor, clinical officers, nurses and environmental health technicians (Ministry of Health, 2008a; Ministry of Health, 2009a).

Specific regions in Zambia have been classified into zones according to the intensity of malaria transmission. Zone 1 comprises areas that recorded less than 1% incidence of malaria per year in young children. Zone 2 are those regions that have been graded between 1% and 10% and zone 3 comprises of areas which recorded malaria parasitemia incidence of greater than 10% annually (Ministry of Health, 2012).
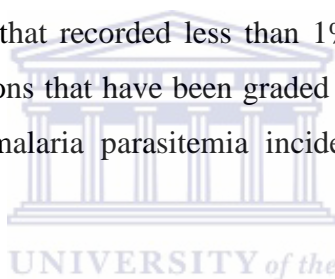
Lusaka district, centred around the capital city of Lusaka, has been classified under zone 1. The district has 23 health centres that serve a population of approximately 2.2 million people. Sixteen urban health centres serve about 1.5 million people and seven rural health centres serve a population of about 500,000. Staffing levels in health care facilities are low. For example, in the year 2010, the national authorised staff establishment for nurses was 8,165, while the estimated required number was 14,053. This translated into a 42% shortfall and a staff to population ratio of 1:1,526 instead of the World Health Organisation recommendation of 1 nurse per 700 people. Similarly, the authorised staff establishment for clinical officers and environmental health technicians were 2,657 and 1,276 while the human resources needed for these staff categories were 3,737 and 2,555 respectively, translating into a 29% and a 50% percentage shortfall (Ministry of Health, 2008a; WHO, 2010). Despite the shortage of health care workers, both urban and rural health centres offer 24 hours health services. Periodically, senior health officials from the district conduct supervisory visits to the health centres. Following the implementation of the 'test and treat' policy after cascade training of cohorts of staff to implement it, health workers are expected to arrive at specific diagnoses for the patients

who present with fever (Ministry of Health, 2012). In particular, as noted, above patients with fever are expected to be tested for malaria via use of a RDT or via microscopy. A review of literature on the diagnosis and treatment of malaria in Zambia indicates that, so far, no studies have been conducted to evaluate the utilization of RDTs and microscopy for testing for malaria parasites in patients who presented with fever, and similarly no studies have assessed to what extent ACT prescriptions are being provided to those with confirmed malaria. A study to quantify the proportion of children who were definitively diagnosed with malaria and appropriately treated with ACT would therefore be a useful starting point in contributing this kind of information to the national malaria programme.

Problem

Widespread resistance of the malaria parasite to first line therapy with the drug chloroquine, had developed in the 1990s, due mainly to a policy of treating anyone suspected of having malaria with chloroquine, without confirming whether they actually have malaria or not (presumptive treatment). In line with international recommendations, Zambia shifted from the presumptive treatment policy and the use of the now ineffective chloroquine, to a 'test and treat' policy (only treat for malaria after confirming the presence of malaria) with the use of artemisinin-based combination therapy (ACT) as the first line drug of choice, in 2003. Eight years after the adoption of the 'test and treat' policy and the rollout of training, with RDT kits, microscopy and efficacious ACT drugs readily available, routine national malaria surveys of 2006, 2008 and 2009 reported high though declining numbers of people treated for malaria, most of whom were children. It is assumed therefore that health workers are adopting the 'test and treat' policy, however, a national survey in 2010 showed that the incidence of confirmed cases of malaria in children under 5 years of age had increased from 10% in 2008 to 16% in 2010. This absolute lack of correlation between confirmed cases and treated cases of malaria suggests that to a certain extent, health workers are still practicing presumptive treatment of malaria. This may pose a threat due to the potential development of ACT resistant strains and result in a repeat of the chloroquine resistance experience. In addition, no assessment of the extent to which health workers implement the 'test and treat' policy has been undertaken yet, therefore the assessment of the management by health workers of patients who present with suspected malaria (especially children who are most vulnerable to malaria) is an important undertaking.

Purpose of the study

The findings from this study will be shared with stakeholders such as health practitioners, the Ministry of Health, malaria control agencies and non-governmental organizations working in the area of health improvement, with the view to contributing to improving the quality of malaria diagnosis and treatment and strengthening the health care systems.

Literature Review

Since the identification of the causative organism of malaria in 1880 by Laveran, extensive information on malaria has been discovered. This knowledge has contributed to remarkable improvements in malaria diagnosis using microscopy and treatment with potent antimalarial drugs (Kallander, (2004). Despite this knowledge, decisions on subsequent management of the disease continued to be based on signs and symptoms that are poorly specific and would vary across transmission regions that range from low-to-moderate, stable and unstable and high transmission settings. Each type of malaria parasite from different regions manifests with a diversity of signs and symptoms that makes malaria a complex disease (WHO, 2002); Kallander, 2004). Since the abandonment of the malaria eradication programme by the World Health Assembly in 1969, the emphasis has been on control of the disease through chemotherapy, chemoprophylaxis, personal protection and vector control (WHO/WHA, 1973).

Presumptive treatment of malaria

Chemotherapy and chemoprophylaxis as interventions to control malaria laid emphasis on the reduction of morbidity and mortality by treatment of fever cases as probable malaria in endemic areas (presumptive treatment) and prevention of malaria infection via prophylactic medication (WHO, 1996a). The drug of choice in the treatment and prevention of malaria since its introduction in the 1940s, and which later became the most widely used therapeutic antimalarial, has been chloroquine (Bruce-Chwatt, 1988). Both interventions had been undertaken through presumptive treatment, self-medication, mass treatment campaigns, home management of fevers and self-directed prophylaxis (Mac Cormack et al., 1983).

Over the years, the World Health Organization conducted several assessments regarding the effectiveness of presumptive treatment of malaria and provided appropriate guidelines for diagnosis and treatment. It promoted the policy of presumptive treatment in sub Saharan African countries because malaria is holoendemic or hyperendemic and microscopic diagnosis of malaria was rarely available (WHO, 1992). This policy was easily adopted by many African countries, partly because caretakers at household level where formal health care was difficult to access, traditionally practiced presumptive treatment of fevers and especially for children with fever (Deming, 1989; Kafle, (1992). Caretakers of children understood that malaria disease was lethal as it easily progressed to severe illness and complications, leading to death within 48 hours to a few days. This knowledge coupled

with the awareness of difficulties in accessing quality health care services, compelled caretakers to acquire a rare skill that enabled them to recognize the symptoms associated with uncomplicated malaria. They developed a traditional treatment package for management of febrile children at home that comprised of interventions such as tepid sponging, steam inhalation, herbal applications to the body and extracts of herbal concoctions given orally as well as resorting to simple fever drugs such as paracetamol and aspirin before taking the child to the health centre (Sirima et al., 2003; McCombie, 1996; Nsabagasani, 2007; Deming, 1989; Kafle, 1992; WHO, 2000a; Eriksen, 2010; Greenwood, 1987; WHO, 1997). Dunyo et al. (2000) asserted that in one community in Nigeria and two in Ghana, mothers` recognition of signs and symptoms of malaria were very closely correlated with the diagnosis made by the medical assistant and with a positive blood slide for malaria. Studies have shown that presumptive treatment of malaria, through home management of fever had been widely practiced (Breman, 2001). More than 70% of malaria episodes in rural areas and more than 50% in urban areas of Africa were presumptively treated in 1995 (Mc Combie, 1996). Luxembourger (1998) observed that resource poor nations without health infrastructure practiced more presumptive treatment of malaria than evidence based treatment, despite the availability of methods for rapidly and accurately distinguishing malaria from other febrile illnesses. Owing to its widespread practice, the World Health Organization supervised several studies to demonstrate the feasibility and efficacy of presumptive treatment for malaria (Kidane, 2000; WHO, 2002; Sirima, 2003). In an influential study to assess the effect of teaching mothers to promptly provide antimalarial drugs to their sick children at home, Kidane (2000) conducted a large randomized controlled trial in two clusters of villages in districts with hyperendemic malaria in Ethiopia. Village populations of more than 70,000 were paired according to their mortality rates of children under the age of five years. Random numbers allocated one village from each pair to the intervention group and the other was allocated to the control group. Mothers in the intervention villages were trained to treat children presenting with fever presumptively with chloroquine. In both control and interventions villages all births and deaths of children under the age of five years were recorded monthly. After one year of intervention, 190 out 6,383 (29.8 per 1000) children under the age of five years died in the intervention villages compared with 366 out of 7,294 (50.2 per 1000) children who died in the control villages. There was a 40% reduction of mortality rate in the intervention villages (95% CI from 29-51) and the authors concluded that the reduction in mortality of children under the age of five years was achieved in these hyper endemic malaria areas due to presumptive treatment (Kidane, 2000).

In a rural province of Burkina Faso, in 1994, the National Malaria Control Centre established a community based programme to provide prompt and adequate presumptive treatment of malaria in children. Mothers were trained to recognize the signs and symptoms of malaria amongst their children and to treat them presumptively with chloroquine. Baseline data on the morbidity and mortality of children under five years of age were collected prior to implementation of the programme. After one year of implementation, an evaluation of the impact was undertaken using routine data from the health information system to determine the proportion of malaria cases that were recorded as severe at health centres, as an indicator. Results revealed that the proportion was lower than the average of the 4 preceding years, yielding 3.7% versus 4.9% previously, giving a clinically significant difference of 1.2%. The authors concluded that a low cost community based programme was successful in providing children under the age of five years with prompt, adequate treatment of a presumptive episode of clinical malaria (Pagnoni, 1997). In another study in Burkina Faso, Sirima (2003) showed that provision of early treatment within the community reduced progression to severe malaria episodes by 50%.

In another study to determine the effectiveness of community based malaria presumptive treatment, Eriksen et al., (2010) conducted a cluster randomized controlled study in rural Tanzania aimed at improving early case management of malaria in children under the age of five years. After 12 months of intervention, results showed a significantly lower prevalence of anaemia than on baseline amongst the intervention group. In a continued effort to authenticate home management of malaria as an effective strategy in the treatment and control of malaria, Greenwood et al. (1988) and Menon et al. (1990) conducted a community-based programme in an area with seasonal malaria transmission in The Gambia in 1982–85 with follow- up assessments in 1986–87. Forty-one villages were stratified according to population size. Larger villages were selected to participate in a national primary health care scheme, which began in 1983, while the smaller villages served as a control group. The study compared two strategies for malaria control. In the initial evaluation, presumptive treatment of children with fever with chloroquine was found to have no impact on morbidity or mortality. However, provision of pyrimethamine/dapsone prophylaxis in addition to presumptive chloroquine treatment led to a significant decrease in mortality, decreased incidence of clinical malaria, a fall in spleen parasite rates and an increase in packed cell volume. Similar findings were observed in the follow-up evaluation, conducted 3–4 years later (Greenwood et al., 1988; Menon et al., 1990).

Evidence based information, experiences and lessons learnt from the home management of malaria that exists from research settings and demonstration projects from diverse areas such as Burkina Faso, Ghana, Kenya, Nigeria, Uganda, The Gambia, Zaire (DRC) and Zambia showed that presumptive treatment of malaria was both feasible and effective in ensuring prompt access to appropriate treatment in the African region (Pagnoni, 1997; Kidane, 2000; Sirima, 2003; WHO, 2004b). This valuable evidence was used as the basis for the scaling up of presumptive treatment of malaria in 1994 (WHO, 1994; Sirima et al., 2003; WHO, 2004b). The objective of the scale up of the presumptive treatment of malaria in endemic countries was to cover the majority of their population with prompt access to good quality antimalarial drugs, at appropriate dosages, within 24 hours of onset of symptoms, especially in the most remote areas of Africa (WHO, 2004b). In low transmission areas, clinical diagnosis was based on the possibility of exposure to malaria and a history of fever in the previous 3 days, while in high malaria transmission areas, diagnosis was based on the history or presence of fever in the previous 24 hours (WHO, 2002). The strategy required that caretakers in high malaria transmission areas receive only minimal training at community level, to administer chloroquine to febrile children or children who presented with signs and symptoms suggestive of malaria disease (WHO, 2001a; WHO, 2001b; WHO, 2007). The practice was further strengthened by the World Health Organization`s recommendation of the concept of community-based treatment of febrile children with antimalarial drugs (WHO, 2001a; WHO, 2001b). The guidelines explicitly encouraged treatment of any childhood fever with no obvious alternative cause as malaria (WHO, 2001a; WHO, 2001b). The presumptive treatment policy became the cornerstone of the World Health Organization treatment plan for malaria and has been practiced from the late 1970s through to the 1990s (WHO, 2002; WHO, 2006b; Eriksen, 2010).

Individual countries translated the World Health Organization guidelines to fit their own environments and workforce and they prepared national guidelines that catered for all categories of health workers in the presumptive treatment of patients (WHO, 2004a). The presumptive treatment strategy was so well entrenched that Nanyingi (2008) asserted that in 2008 in malaria endemic settings, clinical diagnosis using fever as the major symptom is still the most widely used approach by health practitioners of all levels of training in Uganda.

The presumptive treatment of malaria concept has also been promoted through the Integrated Management of Childhood Illness (IMCI) approach, which is a strategy for reducing mortality among children under the age of five years through following outlined steps that allow one to easily classify

an illness using only basic clinical criteria and to provide effective treatment for that illness (Tulloch, 1999). The IMCI initiative was developed by the World Health Organization (WHO) with the aim of reducing childhood mortality. It is a widely practiced strategy in the treatment of febrile children and many developing countries, including those in malaria endemic settings, adopted IMCI as a policy (Reyburn, 2004; Ministry of Health, 2005). The strategy aims at integrating management of common conditions that children present with at health facilities, to improve the quality of care of children. The IMCI strategy recommends that every child presenting with fever at a health facility be treated as malaria, in malaria – endemic areas, based on the fact that the health system is weak in malaria endemic countries and the capacity to conduct parasitological tests to confirm malaria was very limited. However, in 2010, the World Health Organization –Global Malaria Programme (WHO-GMP) revised guidelines stating that, regardless of age of the patient and endemicity of malaria, case management of malaria should be test based and that IMCI guidelines needed to be revised in accordance with the new policy to address the challenge posed by IMCI to successfully implementation of the new 'test and treat policy'.

Discontinuation of presumptive treatment of malaria

Talisuna (2004) observed that, despite presumptive treatment having achieved prompt treatment and demonstrated effectiveness by making chloroquine widely available and easily accessible to patients suspected of having had malaria, several potential downsides to it were noted (Talisuna et al., 2004). Use of antimalarials to treat all febrile episodes delayed treatment of other illnesses, causing high mortalities associated with the wrong diagnoses and inappropriate treatment (Kallander et al., 2000). Considerable overlaps exist between the signs and symptoms of other common diseases such as acute lower respiratory tract infections, which increased the frequency of misdiagnosis and treatment (Redd et al., 1992). Presumptive treatment was undertaken concurrently with the Integrated Management of Childhood Illnesses (IMCI) programme, which had an algorithm that provided for presumptive treatment of malaria of every febrile child living in a 'high-risk' area. 'High risk' has been defined in the IMCI adaptation guides as being any situation where as little as 5% of febrile children between the ages of 2 and 59 months are parasitaemic (WHO, 1997). This definition led to a significant over-diagnosis of malaria in areas with low to moderate malaria transmission and increased the distribution and consumption of large quantities of chloroquine in Sub- Saharan Africa (Talisuna et al., 2004). The good side of this approach was that it identified most patients who truly needed antimalarial treatment, while the bad side of it was that it misclassified many who did not have

malaria and yet received antimalarial drugs (Oliver et al., 1991; WHO, 2004a). Attempts to improve the specificity of clinical diagnosis for malaria by including signs and symptoms other than fever or history of fever, however met with minimal success and the continued unnecessary over-treatment that inevitably resulted was one factor that contributed to drug resistance (Smith et al., 1994; Talisuna et al., 2004).

Studies showed that chloroquine resistance developed from different sites whose common denominator was the long-term use of chloroquine through mass distribution for either prophylaxis or for treatment of malaria in programmes such as the presumptive treatment of malaria (Payne, 1998). The first study to report failure of chloroquine to cure Plasmodium falciparum came in 1960 from Venezuela (Wernsdorfer & Payne, 1991). This was followed by reports from Colombia in 1961 and from the Thai–Cambodia border in 1962 (Hartinuta et al., 1962). By 1980, chloroquine resistance had spread throughout South America (Wernsdorfer & Payne, 1991). From 1970 through to 1989 reports of chloroquine resistance covered areas in Asia, Bangladesh and the Philippines and later India and Iraq (Moore & Lanier, 1961).

The first chloroquine resistance case in Africa was reported in 1977 when the first sentinel case from Kenya occurred (Fogh et al., 1979). This was followed by another sentinel case from Tanzania in 1978 and then one from Madagascar in 1980 (Campbell et al., 1979; Aronsson et al., 1981). The first confirmation of clustering of chloroquine resistance in Africa was made in 1981 from Tanzania (Kihamia et al., 1981). By 1985 chloroquine resistance had spread from East Africa throughout Sub-equatorial Africa, affecting 24 African countries (Payne, 1988). By 1989 chloroquine resistance was firmly established in the majority of Sub-Saharan countries across the whole width of the continent (Payne, 1988; Bloland et al., 1998).

Studies in Kenya, Malawi, Mali and Bolivia observed a positive correlation between the pattern of drug use and in-vitro parasite resistance (Diourte et al., 1999; Nzila et al., 2000). In Uganda, Talisuna (2002), observed that the prevalence of chloroquine resistance was higher in sites with high frequency of chloroquine use - measured as the percentage of people with detectable chloroquine metabolites in the urine, Other studies suggested that resistance rates were highest in urban and peri-urban areas where access to and use of chloroquine was greater, rather than rural communities (Ettling et al., 1995). Increased consumption of chloroquine resulted in increased selective pressure on the parasite populations that could have contributed to the rapid emergence of drug resistance, as

sub-therapeutic doses of chloroquine eliminated susceptible parasites, while those that tolerated the drug survived and reproduced (White, 1999; Wernsdorfer, 2001). Eventually, this could have led to continued selection for parasites that tolerated higher chloroquine doses (Warhurst, 2007). White (1999) hence speculated that mass drug administration consequent on presumptive treatment in high transmission intensity areas, resulted in sub-therapeutic drug levels and subsequently enhanced the development of drug resistance (White, 1999). The dawning realisation that presumptive treatment of malaria had been the decisive factor in the development of chloroquine resistance convinced many that this policy had to be abandoned and replaced with one where only proven malaria should be treated with antimalarials (Wernsdorfer, 2001; Hastings et al., 2002; Warhurst, 2007; White, 1999).

Impact of chloroquine resistance on morbidity and mortality

A study conducted in Senegal from 1984 to 1995 to measure malaria specific mortality in childhood before, during and after the emergence of chloroquine resistance, revealed a 5.5 fold increase in mortality associated with chloroquine resistance, (Trape et al., 2001). Results of a study conducted in Tanzania to investigate mortality rates and causes of death among children under the age of five years, during the early years of emergence of chloroquine resistance between 1984 and 1985, showed unchanged overall child mortality (Mtango et al., 1986). A similar study conducted ten years later in 1994, after chloroquine resistance had been established, showed a 2-fold increase in deaths attributed to malaria (Premji et al., 1997). Hospital based studies showed a remarkable increase in hospital admissions and deaths as the chloroquine resistance era progressed (Trape et al., 2001). In Malawi, during 1978-1983, national health statistics of hospital admissions and deaths showed a twofold increase in the incidence of admissions for malaria among children under the age of five years, but case fatality rates remained relatively constant at 5% (Khoromana et al., 1986). Data from mission hospitals in Tanzania during the 1960s through to the 1970s showed a consistent 10% proportion of admissions being due to malaria. However, from 1968 to 1985, admissions due to malaria reached 23%. Similarly, the percentage of death due to malaria remained around 3% during the 1970s, but increased constantly since 1981 to reach 14% in 1985 (Kilama et al., 1991). In the Democratic Republic of Congo, data from the country`s largest hospital revealed an incremental trend of malaria associated illness among paediatric admissions and deaths (Greenberg et al., 1989). On further investigation it was found that from 1982 to 1986 the morbidity and mortality rates remained relatively constant, but the proportion of malaria admissions increased remarkably from 29.5% in 1983 to 41.7% in 1984, and then to 45.6% in 1985 and continuing on to 56.4% in 1986. The

proportion of malaria deaths increased in tandem from 4.8% in 1982 to 7.0% in 1983, to 7.9% in 1984, to 8.9% in 1985 and to 15.3% in 1986 respectively, (Nguyen-Dinh et al., 1985). Chloroquine resistant malaria related morbidity and mortality studied at four hospitals in Brazzaville Congo, during 1983-1989 revealed an increase in paediatric malaria admissions and cerebral malaria deaths rose from 22% to 54%, with cerebral malaria deaths more than doubling during the period 1986-1989 compared to the period 1983-1985 (Carme et al., 1992). In Nigeria, a study conducted during 1986-1988 to determine the impact of chloroquine resistance on morbidity and mortality revealed an upsurge of malaria related convulsions in an emergency room of one of the major hospitals. The number of cerebral malaria cases more than doubled during this period, which corresponded with the emergence of chloroquine resistance. Chloroquine resistance was measured at one of these hospitals and it was found that 81% of children admitted in 1988 for malaria related convulsions, did not respond to chloroquine treatment (Asindi et al., 1993).

In Kenya, Zucker (1996) conducted a study to determine the risk of death of children suffering from malaria and treated with chloroquine. The risk of dying increased with younger age and severe anaemia and was decreased by treatment with an effective antimalarial drug (RR = 0.33). Treatment of malaria with chloroquine was associated with a 33% case fatality rate compared with 11% for children treated with more effective regimens such as pyrimethamine/sulfadoxine, quinine, or trimethoprim/sulfamethoxazole. The author concluded that, effective drug therapy for malaria with regimens that are parasitocidal in areas with a high prevalence of severe anaemia and chloroquine resistance, can significantly improve the survival of children in Africa (Zucker, 1996).

Further studies indicated that prior to the introduction of chloroquine as the drug of choice for treatment of malaria before the 1940s, many children in Africa died of malaria related anaemia. However, the incidence decreased considerably when chloroquine became widely used. Malaria related anaemia was observed in less than 10% of hospitalized patients from the 1940s onwards, when chloroquine became available (Trape et al., 1987). Trape (1987) further notes that from the late 1940s until the early 1980s, during which time chloroquine remained effective, anaemia was not mentioned as a severe complication of malaria. Then as chloroquine resistance emerged anaemia became more and more pronounced as a complication of malaria (Trape et al., 1987). Most malaria related anaemias were treated by blood transfusion. Greenberg et al. (1988) conducted a retrospective cohort study to investigate an association between chloroquine resistance, severe anaemia, blood

transfusion and HIV seropositivity in a large hospital in Kinshasa in Zaire. The findings showed that the annual number of blood transfusions from 1982 to 1985 remained unchanged, but doubled in 1986 after the emergence of chloroquine resistance. A strong association between blood transfusion and HIV seropositivity was detected compared with children who did not receive a blood transfusion. Children who received 1 transfusion were 2.8 times more likely to be HIV seropositive, those who received 2 transfusions were 7.9 times more likely and those who received 3 transfusions were 21.9 times more likely to be HIV seropositive respectively (Greenberg et al., 1988). Similarly Brewster & Greenwood (1993) conducted a prospective cohort study of 9,584 consecutive paediatric admissions to the Royal Victoria Hospital in the Gambia for 3 years, from 1988 to 1990 during the period when chloroquine resistance was emerging. The results showed a 27% annual increase in severe anaemia related to malaria (Brewster & Greenwood, 1993).

Transition from presumptive treatment with chloroquine to 'test and treat with ACT as first line treatment for Malaria

Control of malaria was previously anchored on the principal of early diagnosis and prompt treatment (WHO, 2001). The effectiveness of this intervention depended on using chloroquine, which was safe, effective, easily available, affordable and acceptable to the population at risk (WHO, 2001). For more than a decade, no resistance to chloroquine was seen, leading to optimism that none would arise, and chloroquine formed the pillar of a worldwide campaign to eradicate malaria, (Wellemss & Plowe 2001). Years later, data from malaria endemic countries revealed the emergence and rapid spread of plasmodium falciparum resistance to not only chloroquine, but also to other commonly used antimalarial drugs, such as fansidar and amodiaquine (WHO, 2001a; WHO, 2001b; WHO, 2007a). In response to mounting evidence produced by several studies across the malaria endemic countries on the increased burden of malaria and the negative impact of parasite resistance to conventional antimalarial medication on morbidity and mortality rates, the World Health Organization convened a meeting to discuss the use of antimalarial drugs (WHO, 2001a; WHO, 2001b; Barbiker et al., 2004; WHO, 2007a). The WHO (2001) eventually recommended the use of artemisinin-based combination therapies (ACTs) as the first line treatment of malaria as ACT was shown to provide the highest cure rates (WHO, 2001; Barbiker et al.,2004), Bosman & Mendis, 2007). In addition this meeting noted that presumptive treatment hastened the development of resistance to chloroquine and hence they recommended that a definitive diagnosis of malaria be made before treatment was commenced as this would inhibit the development of resistance to ACT (WHO, 2001; Barbiker et al., 2004; Bosman &

Mendis, 2007; Olliaro et al., 1996; Barbiker et al., 2004). This became known as the 'test and treat' policy.

Over time all malaria endemic countries eventually adopted the WHO 2001 recommendations which proposed the shift of the malaria treatment policies of their countries from presumptive treatment using chloroquine, to a definitive 'test and treat' approach where use of microscopy and/or Rapid Diagnostic Tests (RDTs) were used to diagnose malaria (WHO, 2001a; WHO, 2001b; WHO, 2006b). RDTs detect malaria parasite specific antigens or enzymes and hence are able to differentiate species. Microscopy is used to isolate parasites, specify and quantify them and can also be used to identify other causes of fever (WHO, 2001a; WHO, 2001b). Most malaria endemic countries adopted the new 'test and treat' policy and ACT as their first line treatment of malaria between 2001 and 2004 (WHO, 2006b).

The new guidelines strongly discouraged the mass distribution of ACT through presumptive treatment, prophylaxis and home management of malaria, as occurred during the chloroquine era (WHO, 2006b). It was noted that the mass distribution of chloroquine was made possible because chloroquine was affordable and safe (WHO, 2004b). While ACT is also safe for mass use, an adult treatment course of ACT costs 1.35-2.40 US dollars making it 40 times more expensive than chloroquine and therefore the need to prescribe it only for patients who really needed it was emphasised not only to minimize drug resistance but also to reduce wastage of resources (UNDP/World Bank/WHO, 1999; Mendis, 2007). The high cost of ACT along with the need for massive investment in training of human resources to implement the 'test and treat' policy, posed an economic challenge to many malaria endemic poor countries (Foster & Phillip, 1998; Proux et al., 2001; Bosman & Mendis, 2007; WHO, 2006b).

The economic challenge was however mitigated by financing institutions and donors who pooled their resources together to procure ACT for malaria endemic poor countries. Financiers included the World Bank, the United Nations Development Programme (UNDP), the eight most industrialized countries (G8), the United Nations Children's Fund (UNICEF), the Global fund for HIV/AIDS Tuberculosis and Malaria, the Gates Foundation and the Roll Back Malaria initiative under the leadership of the World Health Organization Africa region (WHO/UNDP/World Bank, 2005).

Widespread implementation of the new 'test and treat' policy began in 2003 after the securing of finances and training of health workers in the usage of RDTs and prescription of ACT (WHO, 2006b; Bosman & Mendis, 2007). In Zambia the revision of the national treatment guidelines to be in line

with the 'test and treat' policy, the procurement of ACTs, RDTs and the training of staff occurred between 2003 and 2004. Initially, 260 health workers were trained as 'trainers of trainers', who then cascaded training to other health workers within the 72 districts across the country. (MOH, 2004; Reyburn et al., 2007).

A review of the uptake of the new malaria 'test and treat' policy undertaken in 2007, four years after adopting the policy, revealed that parasitological confirmation of malaria by either microscopy or Rapid Diagnostic Tests (RDTs), were hampered by weak quality control systems, especially in peripheral settings. At the central level, RDTs were procured from the World Health Organisation`s recommended manufacturers who met the good manufacturing practices benchmarks. Once in the country, each lot of RDTs were tested to ensure that they were not exposed to extreme temperatures or other conditions that may affect performance. RDT performance was measured by testing known dilutions of parasites (typically 200 and 5,000 parasites per micro litre) and a negative control. At the peripheral level, the World Health Organisation recommended post deployment testing at the health facilities, which included sentinel site monitoring, increased training and supervision and teaching health care workers problem solving skills when RDTs are not performing well, but these were not adopted in Zambia. The World Health Organization also provided guidance on RDT sensitivity, specificity and stability in the field, based on reported practical experience and operational evidence gleaned from the implementation of RDT in various settings (MOH, 2010). To some extent, the sensitivity and specificity of the RDT has had an influence on health workers` adherence to test results. Two meta-analyses have shown that RDT specificity and sensitivity stands at 91% and 90% compared to microscopy, which is at 87% and 82% (Craig et al., 2002; Uzochuku, 2008). This provides for a 10% chance of a false negative and a 9% chance of a false positive malaria test when testing via the use of a RDT and worse when testing using micoscopy. The World Health Organization (2010a) guidelines have in the light of this permitted clinicians to consider prescribing antimalarial drugs for patients they strongly suspect to have malaria based on clinical symptoms, regardless of a RDT or microscopy negative test result (WHO, 2010a). The low level of sensitivity and the guidelines provision for clinical judgement to override a negative test result could potentially influence clinicians to disregard RDT negative tests for large numbers of patients and treat them for malaria without first fully exploring an alternative diagnosis, when they test negative for malaria, (Batwala et al., 2010)

Furthermore, the cool-chain distribution system for RDTs was not effective in several instances which further weakened clinicians' confidence in the validity of the RDT results. Given the above, it is understandable that health workers had difficulties in changing from presumptive treatment of malaria regardless of malaria parasitological test results (Bosman & Mendis, 2007). This observation was reported from several studies and led the WHO in 2010 to issue the latest malaria treatment guidelines, in which although greater emphasis was still placed on malaria parasitological confirmation to be undertaken in all settings where there is clinical suspicion of malaria, it allowed for some flexibility (WHO, 2010a). This 'most times test and treat' approach was recommended in high transmission areas, as it was considered as an effective and cost saving approach since the probability of treating the right patient (malaria positive) was higher than treating the patient without malaria (WHO, 2006b; Graz et al., 2011). In addition, the complex nature of malaria could have presented a challenge in developing clinically useful guidelines on its management. Varied local transmission levels according to seasons, age, individual immunity levels, place of residence and travel, are some of the common factors that influence rates of transmission. Health workers at local level are therefore encouraged to evaluate these factors when prescribing antimalarial drugs (Lubell et al., 2008; Graz et al., 2011).

Graz (2011) however contends that, although the 'all times test and treat' approach means well, local epidemiological patterns and individual patients` factors will guide clinicians to make good sense of the clinical encounters without predisposing patients to the danger of ACT resistance or drug reactions and without frustrating the future of the malaria global strategy and hence 'most times test and treat' is more appropriate. Differing with this assertion, Lubell (2008) and Masanja (2010) argued that health workers are more likely to prescribe antimalarial drugs for children under the age of five years without a test, or with a negative test result and are likely to adhere to the 'test and treat' results of all patients above five years. Masanja (2010) and Lubell (2008) further suggested that, arising from the evidence from studies that health workers were not fully adhering to the test results, despite adequate sensitisation, the 'all times test and treat' policy should formally be applied to children older than five years and adults, whereas the 'most times test and treat' approach should apply to children under the age of five years.

Adherence by health workers to new policies/guidelines in general
Several studies in child health, family planning, obstetrics, psychiatry, and the medical-surgical

disciplines have reported on health workers` inadequacy in adherence to treatment guidelines (World Bank, 2004; Bitera et al., 2010). These studies have pointed out that, despite the availability of effective lifesaving interventions, millions of lives are lost due to poor performance by all cadres of health workers through disregard of treatment guidelines (WHO, 2003; Bruce, et al., 2003).

Development of new drugs, diagnostic equipment and procedures, accompanied by new treatment policies and guidelines arising from medical research, poses a challenge to health workers` adherence to new treatment guidelines (Kotters, 2002). Changing from a traditional set of practices to new guidelines could be a challenge on the part of implementers, as the old ways of practices could have been performed for a long period of time, and the procedures became part of the health workers daily routine (Kotters, 2002). The process of change according to Kotters (2002) requires thoughtful planning, consultation, training and implementation. Guidelines and policies coming into effect must, as a basic pre-requisite, be absolutely clear, in order to maximise the proportion of health workers likely to adhere to the new policies, because studies have shown that ambiguous guidelines are often the root cause of non-compliance (Kotters, 2002).

For decades, poor adherence to new guidelines has been attributed to a lack of knowledge of the guidelines and a lack of skills to implement them (Brugha & Zwi, 1998; Rowe, 2003). To effect organizational change that demands new actions, objectives and processes, workers should formally be trained so that they understand the plans, agree with actions to be undertaken and accept the level of commitment required of them (Tipke et al., 2009). During the 1980s and 90s, more than 2000 training courses were offered to thousands of health workers across 120 countries with the goal of improving adherence to diarrhoea treatment guidelines and the use of oral rehydration solutions. Twenty-two evaluations conducted in selected countries revealed that only 20% of dehydrated children were correctly rehydrated, reflecting poor adherence to guidelines (Brugha & Zwi, 1998). In many other settings, training has been conducted to enhance work performance of staff, but findings have revealed that routine training seldom yielded positive results (Rowe et al., 2001; Rowe et al., 2002; Rowe et al., 2003; WHO, 2001; Ross-Degnam et al., 1997; Naimol et al., 2006; Osterholt et al., 2006; Zurovac & Rowe, 2006).

In the theory on the concept of individual policy and its influence on learning, Gilson (2005) indicated that personal, administrative and economic factors could influence health workers` practices. The author argued that even if health workers were taught how to perform a health intervention according to new guidelines, they would simply not replace their pre-existing individual

policies with the new guidelines (Gilson et al., 2005). This assertion was shared by Rowe (2005) who observed that despite adequate training in which health workers passed the examinations on new policies, their new knowledge did not replace existing personal policies, which was demonstrated through persistent non-adherence to the new guidelines, despite adequate knowledge of them. Ofori-Adjei (1996) asserted that the theory could explain the reason why correct knowledge often did not translate into correct performance.

Other studies conducted on strategies for improving heath workers` performance through adherence to guidelines revealed that dissemination of guidelines without additional interventions was ineffective, and suggested that the most effective approach to improve performance would be training with supervision, which addresses multiple determinants of performance rather than a single intervention (Ross-Degnam et al., 1997; Brigg et al., 2001a; WHO, 2001b). However, although supervision as an intervention has shown that it can improve performance in the short term, learners are more likely to tend to regress when supervision ends and hence long term benefits are uncertain (Ross-Degnam et al., 1997). Conversely it has been noted that supervisors often lack skills, tools, transportation and incentives, besides being overburdened with other administrative duties. The above then predictably results in intermittent and poor supervision that provides space for the health workers to regress to undesirable practices (Ofori-Adjei et al., 1996; WHO, 2001a; Tavrow et al., 2002).

Compounding the above is that new policies and guidelines are constantly being developed as standards change, as new diseases emerge and as existing technologies become obsolete or new technologies outshine them (Rowe et al., 2005). For instance, an evaluation of 17 clinical guidelines in the United States of America revealed that the median lifespan for guidelines was 5.8 years (Shekelle et al., 2001). In addition, adherence or non-adherence to guidelines varies according to different settings (Ross-Degnam et al., 1997). These settings include place of contact (in-patient, outpatient or community settings), non-profit versus profit settings, type of health worker (doctor, nurse, clinical officer, environmental health technician) and general level of development (urban or rural areas).

Adherence by health workers` to the new 'test and treat" malaria policy.

The inception of (RDTs) along with the new malaria 'test and treat' policy has put testing and clinical decision making in the hands of the prescriber (Hamer et al., 2007). In spite of this empowerment, studies conducted around the world in malaria endemic countries show that some health workers do not treat patients according to RDTs or microscopy test results as outlined in the new 'test and treat' policy (Hamer et al., 2007). Over-diagnoses of malaria, arising mainly from ongoing presumptive treatment, has been widely reported from across the malaria endemic countries six years after the implementation of the 'test and treat' protocol (Van Eijk et al., 2007; Chandler et al., 2008).

In Africa, clinical diagnosis of malaria in most patients presenting with fever is common in both primary and secondary level health care settings (Chandler et al, 2007). Anti-malarial treatment is frequently prescribed despite a negative malaria test or is prescribed without recourse to malaria testing even if the probability of malaria is very low (Barat et al, 1999). Over-treatment of malaria resulting from non-adherence to the policy to withhold malaria treatment from patients with a negative test, has continued to be reported in several African countries six years after the change of policy from presumptive treatment to 'test and treat', with several studies demonstrating a seeming reluctance by health workers to adhere to the policy (Ndyomugyenyi et al., 2007; Eriksen et al., 2007; Reyburn et al., 2009).

 An exploratory study conducted in Tanzania revealed that 139 (20%) of the 669 patients were presumptively treated for malaria and 62 (37%) of the 169 patients who tested malaria negative, were treated for malaria despite their negative tests (Chandler et al., 2007). Findings in a 2010 national malaria case management survey, undertaken to review malaria diagnosis and treatment in Kenya who adopted the 'test and treat' policy in 2004, showed that although prescriptions of ACT were largely provided only after malaria testing, most test negative patients were still treated for malaria (Juma and Zurovac, 2011).

In a cross-sectional cluster survey conducted by Rowe (2009) in Huambo Province in Angola, to determine the quality of malaria case management in line with the 'test and treat' policy, he found a moderate lack of adherence to the policy with 83.6% of patients managed according to the policy (Rowe et al., 2009). Lack of adherence was however ascribed to the ambiguity of the policy, which was overly complex and imprecisely communicated, which is a sentiment also echoed by Hamer et al, (2007). A study conducted by Okebe (2011) in the Gambia on prescribing practices for malaria

following implementation of the 'test and treat' policy in 2004, showed that despite the availability of microscopy equipment and trained personnel at health centres, a microscopy test was only requested in about 1 out of 3 of the cases diagnosed with malaria. In Burkina Faso, febrile patients were recruited and randomized either to be submitted to RDT or to be managed presumptively. No significant difference was found between the two randomized groups in the frequency of antimalarial treatment, as a large proportion (81%) of patients with a negative RDT test result were nevertheless diagnosed and treated for malaria (Bisoffi et al., 2009). Zurovac (2008) conducted a study in Kenya on the effect of the revised diagnostic recommendations on malaria treatment practices across age groups. The findings revealed that ACT was largely prescribed after conducting malaria tests; however 75% of children under the age of five years and 61% of those above 5 years of age who tested negative still received anti-malarial drugs.

A study conducted in Zambia aimed at determining the ability of community health workers (CHWs) to prescribe ACT according to RDT test results, found that when CHWs are adequately trained and appropriately resourced they can perform and interpret RDTs and prescribe treatment for malaria in accordance with the guidelines (Yeboah-Antwi et al., 2010). In another study conducted by Borat (1999), to determine whether microscopy blood slide results influenced antimalarial prescriptions, they found that despite overall accuracy of microscopic diagnosis being high with a predictive negative value of more than 90% and predictive positive value of higher than 76%, 20-54% of patients with reported negative blood slides were prescribed antimalarial drugs. Febrile children under five years of age were more likely to receive malaria microscopy testing, but their test results were more likely to be disregarded, and antimalarials were prescribed to almost all these patients regardless of their microscopy result. Overall, despite existing guidelines on malaria management, microscopy test results had minimal impact on antimalarial treatment and antimalarial drugs were prescribed with equal frequency in febrile patients referred for microscopy test and in those patients whose treatment was based solely on clinical findings (Borat et al., 1999).

Hamer (2007) conducted a large (1717 patients) cross-sectional cluster sample survey in Zambia to assess the association between the use of microscopy and/or RDT and the prescription of antimalarials in 76 health care facilities all of whom had access to either microscopy tests, or RDT or both. Fifty one percent of febrile patients suspected of having malaria were tested for malaria via either microscopy or RDT, with zero patients receiving both tests. Almost all of those who tested positive for malaria (98%) received ACT, however ACT was also prescribed to a large proportion of

patients who tested negative for malaria, contrary to the new policy guidelines (Hamer et al., 2007).

As noted above, failure to follow the process of change will result in poor adherence to any new treatment, or policy, or guideline, however, despite having implemented the recommended process of change to enhance uptake of the new test and treat malaria guidelines, several studies conducted to determine health workers` level of adherence to the new test and treat malaria protocol, several years after its implementation, revealed no significant improvement (Tipke et al., 2009; Ngasala, 2008; Wijesinghe et al., 2011; Zurovac, 2008; Wasunna et al., 2010). In Kenya, Wasunna et al. (2010) conducted a study in which 48 workers underwent in-service training, however after training low. the findings showed no significant improvements in adherence to the new protocol. In a survey conducted in Somalia to determine health service providers' provision of malaria case management in line with the new 'test and treat' policy, Tipke et al. (2009) found that only 62% of health workers complied with the treatment guidelines in spite of an orientation course being provided to all health workers prior to the introduction of ACT and the new 'test and treat' policy. In Tanzania, Ngasala (2008) randomly allocated sixteen primary health centres in rural regions to short training of health staff in clinical algorithms and microscopy. A follow up to assess case management of febrile children was conducted. Nine hundred seventy three (973), 1058 and 1,100 children were enrolled in arms I, II, and III respectively. Arm I included health staff with training in the clinical algorithm plus microscopy techniques, while arm II received health staff trained in the clinical algorithm only and arm III included health workers who did not receive any training. The findings were that, prescription of antimalarials to children presenting with fever had significantly reduced in Arm-1 (61.3%) compared to Arm II (95.3%) and Arm III (99.5%) (Ngasala et al., 2008).

However, in the Solomon Islands, an exploratory study conducted to understand prescribers` perceptions and acceptability of the new diagnostic treatment guidelines in the 'test and treat' policy, found that health workers lacked confidence in RDTs accuracy and therefore did not adhere to the guidelines (Wijesinghe et al., 2011). Lack of confidence in RDTs arose from inadequate training on and knowledge about the procedures involved in using the new diagnostic tool. Despite the shortcomings reported in enhancing health workers ability to adhere to guidelines, Ngasala (2008) and Wijesinghe (2011) argue that further training and supportive supervision of health workers in implementing new guidelines are essential, as it greatly contributes to adherence to any new treatment procedure and or guideline, however they are not in themselves sufficient to ensure mass adherence. In a study in Uganda, Zurovac (2008) observed a trend among the health workers that

showed variation in adherence to guidelines according to health workers` qualifications and supervision levels. Zurovac (2008) noted that health workers who adhered to treatment guidelines were less qualified and received more supervision, while the more qualified and less supervised health workers were more likely to disregard the guidelines. These findings are similar to those reported by Rowe (2003), Zurovac (2004) and Chanda (2011) where community health workers were more likely to adhere to guidelines than health facility staff. Zurovac (2008) and Rowe (2005) speculated that the reason why higher qualified health workers were more likely to disregard guidelines, was that higher qualified health workers possessed a broader knowledge and hence were more confident in their ability to make a clinical diagnosis of malaria. Recent studies conducted between 2011 through to 2016, approximately thirteen years after the introduction of the 'test and treat policy', reported health workers` poor adherence to diagnostic and treatment guidelines in several settings. The poor adherence according to the authors was mainly in terms of inconsistent use of confirmatory tests (RDT or microscopy) for malaria cases, prescribing antimalarials which are not recommended in the national guidelines such as Fansidar and prescribing antimalarials to cases testing negative for malaria (Batwala et al. 2011; Mubi et al. 2013; Chanda-Kapata 2014; Ochodo et al. 2016).

Ochodo et al (2016) further reported that presumptive treatment is still rife in several settings studied in sub-Saharan Africa. The reasons attributed to resistance to change by health workers according to the author included shortages of RDT, high patient workload in the wake of staff shortages and false positive RDT results. In another scenario, Ochodo et al (2016) attributed prescription of malaria drugs to those who test negative as being due to health workers lack of trust in the accuracy of the RDT, fear of consequences of missing a true malaria case, confusion about change from the previous recommendation, pressure to prescribe from patients and uncertainty about how to manage the other causes of fever.

Other studies conducted by Chandler et al (2010); Ezeoke et al (2012) and Chandler et al (2012) reported a lack of trust in RDT accuracy by health workers, conflicting advice from different health organisations and reports from patients of "feeling better" after taking antimalarial drugs even when malaria tests were negative. The authors concluded that universal testing for malaria was a major policy shift that will take time and extensive resources to fully implement across sub-Saharan Africa, Success will require different interventions across public, private and retail sectors.

Contextualising health workers adherence to the new 'test and treat' malaria policy

Presumptive treatment of malaria was associated with chloroquine resistance, considerable drug expenditure (due to the high volumes of drugs prescribed despite an individual course of medication being relatively cheap), unnecessary adverse drug reactions and inappropriate treatment of patients free of malaria. The resistance to chloroquine, as noted above, contributed to a dramatic increase in the overall morbidity and mortality rates and based on this evidence, the World Health Organization introduced the 'test and treat' policy (WHO, 2006a). However, adherence levels to the new 'test and treat' policy were low. Imprecise messages which instructed clinicians not to rule out malaria in patients with a negative test but without any other obvious cause of fever, was cited as one of the reasons for non-adherence (WHO, 2006a). In the 'test and treat' policy guidelines, other conditions such as cerebral malaria, pneumonia, otitis media, viral infection, infected injuries, infected burns and gastroenteritis, all of which also commonly present with fever, were expected to be diagnosed based on their presenting symptoms and clinical findings . Although the policy provided general guidance on diagnosis of malaria, some issues remained unclear. For example, it was not clear whether children over five years of age presenting with fever should be tested or not. Clarity was provided by World Health Organization-Global Malaria Program (WHO-GMP) in the recently revised 2010 guidelines stating that regardless of age of the patient and endemicity of malaria, case management of malaria should be test based (Febir et al, 2015).Additionally, there was no clarity on how non-fever related malaria signs and symptoms should be used to decide which patients should be tested (D'Acremont et al., 2007). The other contentious point was that it was not clear which non-malaria causes of fever should be ruled out, before treating febrile patients who test RDT or microscopy negative with an antimalarial drug (D'Acremont et al., 2007). Initially indistinct guidelines were thought to be one of the major reasons why widespread poor adherence to RDT and/or microscopy tests occurred. However subsequent studies have shown that despite clarification of the ambiguous guidelines, non-adherence to test results and presumptive treatment has continued (Lubell et al., 2008; Masanja et al., 2010; D'Acremont et al., 2007). A study conducted by Ochodo et al. (2016) observed that, in the most extreme example, health workers prescribed antimalarial drugs to 81% of people with negative malaria test results and several qualitative studies conducted to explore the reasons for health workers ignoring test results (Chandler et al., 2010: Chandler et al., 2012: Ezeoke et al., 2012; Ansa et al.,2013) cited lack of trust in the accuracy of the tests, fear of the consequences

of missing a true malaria case; confusion about the change from previous recommendations and uncertainty about how to manage the other cause of fever.

The ambiguous messages were clarified in the second edition of the World Health Organization malaria treatment guidelines. Emphasis was placed on the confirmation of clinical suspicion of malaria with malaria parasitological diagnosis in all settings (D`Acremont et al., 2007). However, in the absence of both microscopy and RDT tests, clinicians are permitted to prescribe antimalarial drugs based on clinical diagnosis (WHO, 2010a). In addition, where either microscopy or a RDT test are negative, but clinicians strongly suspect a patient to have malaria, the revised WHO guidelines encourage clinicians to consider the possible risk of a false negative test and to prescribe an antimalarial drug and or consider other causes of fever (WHO, 2010a).

Although definitive malaria diagnosis is optimal and there is widespread evidence that a strategy based on documented diagnosis is safe and has reduced mortality rates, to a certain extent presumptive treatment is still being practiced (D`Acremont et al., 2007; Njama-Meya et al., 2007). Several studies undertaken to measure levels of acceptability and adherence to the 'test and treat' policy found moderate uptake of new guidelines by health workers (Lubell et al., 2007; Njama-Meya et al., 2007; Bastiaens et al., 2011; Graz et al., 2011).

Despite low specificity and hence the tendency to over-treat patients, clinical judgement based treatment has been recommended for uncomplicated malaria in both low and high malaria transmission settings. In both settings the criteria for diagnosis includes history of fever in the previous 3 days and presence of anaemia in children (WHO, 2010a). This recommendation is in part in response to several calls from researchers who advocated for the formalization of clinical judgement based treatment in view of the continued practice of presumptive treatment in different settings, despite adequate sensitisation and orientation to the new 'test and treat' policy (Graz et al., 2010).

The shift from presumptive to definitive diagnosis enshrined in the 'test and treat' policy has been supported by the necessary logistics. RDTs are simple to use. Any category of health worker in a rural or urban setting once oriented to use it should be able to do so with ease and they do not require electricity or any special equipment (Rolland et al., 2006). RDTs are additionally manufactured to retain potency in tropical weather conditions (Rolland et al., 2006). Success in the implementation of the 'test and treat' policy lies in the clinicians` perceptions of a negative test to which clinicians according to recent studies conducted by Ochodo et al (2016) lack trust in the accuracy of the test.

Studies have shown that after years of upholding the notion that fever equals malaria, health workers tended to disregard RDTs and or microscopy negative tests and prescribed antimalarial drugs anyway (Hamer et al., 2007; Amexo et al., 2004, Reyburn et al., 2007). Insufficient training has however also been identified as one factor contributing to the resistance by some clinicians to consider RDTs results and their continued practicing of presumptive treatment (Hamer et al., 2007).

Lubell et al. (2007) argued that definitive diagnosis and treatment with ACT according to the test results versus presumptive treatment with ACT, is cost effective in all current malaria-endemic situations. Indeed the increased usage of RDTs is evidence that the practice of definitive diagnosis of malaria is gradually being accepted, although large pockets of resistance to the policy remain (Hopkins et al, 2007).

Definitive diagnoses of malaria targets ACT to patients who truly need it. This will improve adherence to treatment because patients will have clear evidence of malaria infection and it will reduce wastage of drugs and resources (Wernsdorfer, 1994). Research in four African countries and several other studies conducted on presumptive treatment of malaria, demonstrated that misdiagnoses and over-diagnoses not only caused adverse drug reactions and increased drug resistance but also wasted resources at national level and drained resources at household level, with heaviest impact on the poor (Payne, 1998; WHO/TDR, 2007; Hopkins et al, 2008).

The World Health Organization special programme for research and training in tropical diseases and the UNICEF initiative both promote the use of RDTs in its community-integrated management of malaria, pneumonia and diarrhoea (Lemma et al., 2008). In addition, WHO asserted that definitive malaria diagnosis will enable health information systems to report more accurately whether patients consulting with fever or treated for malaria actually had evidence of being parasitaemic. For example, there has been a decrease in reported malaria cases in Senegal partly due to definitive diagnosis being the criterion for recording that someone has malaria (WHO, 2009a).

Factors associated with adherence to the new 'test and treat' policy

Inadequate staffing has been associated with poor adherence to RDTs and microscopy testing due to the increased workload that malaria testing imposes on an already under-resourced staff component (Ministry of Health, 2003). The WHO (2010) recommended nurse patient ratio is 1:700 patients, but general staffing levels in the health sector in Africa ranges from 1:2000 to 1:2500. An adequate staffing level at health care facilities reduces workload, thus creating ample time for clinical staff to attend to diagnostic tests hence avoiding having to rely solely on clinical judgement when diagnosing

malaria (Ministry of Health, 2003; WHO, 2010a).

Malaria is managed at various levels within the health care system and by different cadres of health workers at various types of health care facilities. Therefore, formal training and/or adequate orientation of health workers at all levels to any new protocol is theorised to be a pre-requisite for adherence, as noted above. Detailed orientation of clinical staff has been linked to improved adherence to the 'test and treat' policy (Mudondo et al., 2002). Studies have shown that, in countries where health workers have undergone intensive training in malaria testing using RDTs and prescription of ACT, success in adherence to guidelines has been reported, (Hopkins et al., 2008). However as noted previously, while training messages are likely to promote adherence to RDT results, some countries have reported non-adherence to RDT testing despite training having being provided to health workers (Ansah et al., 2010). Ochodo et al (2016) attributed non-adherence to RDT testing despite training, to previous long standing training and guidance to health workers which emphasized the danger of missing a case of malaria and sending a child home without treatment. This ingrained belief, according to the author is likely to take time to change and health workers will require evidence based reassurance that the new 'test and treat' policy is safe.

In one study in Burkina Faso, despite health workers having undergone training in RDTs testing and the interpretation of results and how to respond to an RDT negative test and ACT treatment, they prescribed ACT to as much as 85% of patients who tested RDT negative at health centres (Bisoffi et al., 2009). Shillcutt (2008) and D`Acremont (2008) attributed health workers` non-adherence to the new malaria treatment protocol to the long term practice of presumptive treatment, which spanned over 50 years. The authors advised that in addition to training on the new "test and treat' policy mechanics, training to address and change perceptions around the management of malaria and the provision of consistent supervision are crucial in order to improve adherence. New evidence on health workers` beliefs and behaviour shows that clinicians are beginning to trust and act upon RDT results. Studies conducted under programmatic conditions in Tanzania during 2011 showed that 2%-10% of all patients with negative results were prescribed antimalarials compared to earlier studies done in Tanzania in 2009, which showed that 50% of the patients who tested negative were prescribed antimalarial drugs (McMorrow et al., 2008). This illustrates that behaviour change can be achieved through training and the trust gained through field practice of procedures within a new policy (McMorrow et al., 2008).

Msellem (2009) and Chandler (2010) assert that regular supportive supervision provides for a

discussion with other health workers and allows shared experiences and pooled solutions to problems in practice, that influences staff's conceptualization and practice of new policies. Consequently, the interaction could lead to greater confidence in the policy. However, in a study conducted in Tanzania to determine why clinical staff over-diagnosed malaria, peer and patient pressure was found to influence prescribers to avoid the use of RDTs, despite their acquisition of increased confidence in conducting RDTs tests (Chandler et al., 2010; Chandler et al., 2008). Health workers trained in various health courses for a specified number of years have been linked to varied levels of adherence to test results (Chinkhumba et al., 2010). Studies have shown that different health cadres adhere differently to RDTs and or microscopy negative results in various health care facilities (Chinkhumba et al., 2010; Chanda et al., 2011). Health workers who held a diploma qualification with three years health training (clinical officers, registered nurses, health assistants, environmental health technicians) were more likely to disregard RDT negative tests than were enrolled nurses with two years training and community health workers with six weeks of basic health training (Chinkhumba et al., 2010; Chanda et al., 2011; Chandler, 2010; Kojo Yeboah-Antwi, 2010).

A cross sectional study conducted in Malawi to evaluate the sensitivity and specificity of RDTs and prescribers' adherence to RDTs result found that, RDTs specificity was lower when performed by a community health worker versus a laboratory technician. Furthermore, community health workers correctly prescribed antimalarials for patients with positive RDTs results, but frequently disregarded negative RDTs results with 58% of patients with negative RDTs being treated with ACT (Chinkhumba et al., 2010). These results are in polarity with the results of a study conducted in Zambia, where community health workers were found to adhere to RDTs results and prescribed antimalarials appropriately compared to higher ranking health workers in health facilities, whose non-adherence to malaria diagnostic test results` behaviour had already been documented to be a problem (Chanda et al., 2011).

Study Aim

To assess what proportion of children aged five years and younger who presented with fever (temperature of 37.5 degrees Celsius and above) were tested for malaria and to assess the adherence by clinicians to the 'test and treat' management guidelines in Lusaka health care facilities, in 2008 and 2011.

Specific objectives

The 'test and treat' management algorithm for suspected malaria has several correct and incorrect, as well as appropriate and inappropriate outcomes. These outcomes form the objectives listed below.

1. To calculate the proportion of all febrile children of five years of age and less who were tested for malaria using RDT and/or microscopy.
2. To assess the proportion of febrile children who were correctly treated with ACT after testing positive for malaria.
3. To assess the proportion of febrile children who were inappropriately treated for malaria (i.e. test negative for malaria but got treated and not tested for malaria but got treated).
4. To assess the proportion of febrile children who test negative for malaria but who then did not receive correct further management (test negative for malaria but not assessed for other illness).
5. To assess factors associated with the correct treatment of suspected malaria compared to those incorrectly or inappropriately treated.
6. To assess the proportion of febrile children who were presumptively treated for malaria.

METHODOLOGY

Study Design

Cross sectional Analytical Study

A cross-sectional analytical study involves the observation of a population or a representative subset with information being collected on a disease/outcome and the risk factors for that disease/outcome at a point in time (Katzenellenbogen et al., 1999). The representative subset in this study are the medical records of children of five years of age and below, who presented to a health care facility with suspected malaria. Information that was initially collected and recorded for the purpose of patient assessment, diagnosis and treatment was collected retrospectively through a review of medical records for the years 2008 and 2011. A cross-sectional study involving the measurement of several exposures is a convenient way of investigating any associations between risk factors and outcomes and thus is helpful in assessing health service provision and the outcomes of that service provision (Beaglehole & Bonita, 1993). Hence a cross sectional study design was an appropriate design for this study because it assessed the appropriateness of the management of suspected malaria by staff amid the availability of RDTs, microscopy, ACT and malaria diagnosis and treatment guidelines.

Study Population

The research setting was all primary health care centres in Lusaka city in Zambia, of which there were 23. The study population was limited to patients attending these health centres and the staff who work in them. All clinical staff who attended to children with fever at the health facilities and all the facility managers were included in the study population. All medical records of children under the age of five years who attended the healthcare facilities in Lusaka district during 2008 and 2011and met the inclusion and exclusion criteria below, were included in the study population.

Inclusion criteria for records

Records of children under the age of five years who presented with fever of 37.5 degrees Celsius or higher.

Exclusion criteria for records

Records of children under the age of five years who had symptoms of unconsciousness, neck stiffness, inability to eat, drink or breast-feed, vomiting copiously, inability to sit or stand due to

severe weakness, severe dehydration and convulsions, all of which are characteristic of severe and/or cerebral malaria were excluded. Other exclusion criteria were all children who had clear symptoms of other common diseases, which also have fever as a symptom. These other diseases and their defining symptoms are;

- Pneumonia: This manifests with chest pains, coughing and hyperventilation.
- Otitis media: characterized by pain and pus discharging from the infected ear.
- Upper respiratory tract infections: characterized by coughing, congested nostrils, nasal discharge and inflamed pharynx.
- Infected burns and infected wounds.
- Gastroenteritis with fever.

Sample Size

The sample size was determined by 4 factors which were: i) the study population size, ii) the estimated prevalence of suspected malaria cases, iii) the desired level of confidence and iv) the acceptable margin of error.

The Health Information Management System reported that on an annual basis approximately 30,000 children aged five years and below were treated for suspected malaria in Lusaka primary health care centres. Arising from the information listed in the introduction and the literature review, I suspected that only 30% of the 30,000 children were properly diagnosed and treated in line with the World Health Organization (2004) 'test and treat' policy. I accepted a margin of error of 2% and a 80% confidence interval for precision. These parameters were used in the "statcalc" function of Epi Info version 3.5.1 and it calculated a required sample size of 398 medical records. In order to equalise the number of records to be selected from each facility for a particular year and to assess if there had been a change in practices between 2008 and 2011, I settled for a sample size of 400 for each year assessed, with a total sample for both years of 800. All clinical staff who attended to children with fever at the 10 randomly selected health facilities (see below) and the ten managers of those facilities were included in the sample.

Sample Type and Sampling Procedures

We performed a multistage stratified random sampling procedure to select medical records to include in the sample. We had opted for this procedure because it was not practical to conduct simple random sampling, because we would have needed to number all the records for each month and then randomly sample them, which would have been very labour and time intensive. Using the multistage stratified random sampling procedure, the 23 health centres located in Lusaka district were first stratified into urban and rural clinics. There were 16 urban and 7 rural clinics. Using a simple random sampling procedure, we selected 10 health facilities, 7 from urban areas and 3 from rural areas, respectively. Selection of the medical records was then conducted for the years 2008 and 2011. Those years had been selected because it was envisaged that at 4 and 7 years since the inception of World Health Organization, (2004) malaria 'test and treat' policy, health workers should not only have acquired knowledge and skills in implementing the protocol, but should also by then be treating patients appropriately by adhering to the guidelines in the policy.

The two years, 2008 and 2011 selected for study, were divided into 10 months. The months of June and July were excluded because although the risk of malaria is high throughout the year, malaria incidence tends to decline in these months of the cold season (Ministry of Health, 2010a). Four hundred medical records were selected from each year, with 40 records being selected from each of the 10 selected health centres. Medical records and cards in Lusaka district are filed according to file numbers, month and year of attendance at the health centres. These records are kept for five years in the record room after which they are removed and kept in a general storage facility in readiness for destruction. Therefore, 2008 and 2011 records were located in the record room. To select 40 records from each of the two years and from each of the 10 health centres meeting the inclusion and exclusion criteria, we randomly selected 4 folders per month from all the folders filed in that month. If a folder was selected which did not meet the criteria then, we discarded that folder and randomly selected another folder to replace it. If the new folder randomly selected also didn`t meet the criteria then we discarded that one as well and selected again and so on, until we got a folder which did meet the criteria. In this way, we selected the required 4 records from each of the 10 months of the years 2008 and 2011 in each of the 10 health centres, which gave us a sample of 800 medical records.

Data Collection

Data collection was via a review of medical records, following Mann's (2003) advice that pre-existing records provides an excellent and convenient source of data and allows large samples to be collected retrospectively, using minimal time and resources. Specific variables that were recorded from the patients` medical records included demographic data (gender, age, area of residence); signs of malaria as observed by the clinician (weight, temperature, pallor, febrile to touch, dehydration, weakness); symptoms as described by the caregiver (poor appetite, vomiting, restlessness, cough, diarrhoea, malaise and irritability); category of staff member who examined the child (doctor, nurse, clinical officer, environmental officer, laboratory technician, pharmacy technician and community health worker); details of the findings of the clinical evaluation; laboratory tests and or RDTs requested; results of the tests, and the type of drugs prescribed (if any). In addition, data on factors associated with the management of malaria (staff establishment, caseloads, training in RDT/microscopy, frequency of supervision by district health officials, availability of equipment and medicines) was obtained via a questionnaire posed to the facility managers and all the clinical staff at the selected facilities. Ten data collectors were recruited from among those who had participated in a previous (2010) large scale survey on malaria (Malaria Indicators Survey). (MIS), as they were experienced in data collection. We however trained them for 3 days to orient them to our data collection needs. The training curriculum included exclusion and inclusion criteria, multistage sampling and the final selection of medical records through random selection, selecting those records that would meet the criteria, discarding those records that would not meet the criteria, identification of variables from the selected medical records, and recording them correctly on the data extraction sheets. We further trained the data collectors on interviewing techniques to prepare them to administer questionnaires to the health facility managers and staff. To ensure standardization of data collection, we piloted our data extraction tool and questionnaire. As a result of the piloting we modified questions that were deemed ambiguous or unclear, in order that we would elicit valid responses and we reformatted the data extraction tool to make it more user-friendly.

Data Analysis

Raw data was coded and summarized on a master sheet in preparation for statistical calculation using Epi Info version 3.5.1. Univariate descriptive statistical analysis was performed using measures of central tendency and measures of dispersion to analyze numerical variables such as age, weight and

body temperature, and using frequencies for categorical variables such as gender, area of residence, RDTs/microscopy malaria tests, presence of an ACT treatment chart on the health centre wall and availability of weighing scales and thermometers. Numerical variables were also converted to categorical data. Specific univariate analyses for various outcomes within the suspected malaria management algorithm, were calculated as explained and listed in detail below.

To determine the association between variables and key outcomes, bivariate analysis via the prevalence ratio was performed. To assess whether any association found was statistically significant we used the Chi-Square test and its associated 95% confidence interval. Numerical variables were converted to categorical data and then compared with the outcome variables via the prevalence ratio and associated 95% confidence intervals. Multivariate logistic regression analysis, to obtain adjusted prevalence odds ratios, was planned, but ultimately deemed unnecessary and hence was not conducted.

Univariate Analyses undertaken specific to the suspected malaria management algorithm

1. Calculation of the proportion of all febrile children of five years of age and less who tested for malaria using RDT or microscopy (prevalence of malaria testing amongst suspected cases). This analysis sought to provide information on the number of children of five years and below who were offered a malaria test out of the total sample of 800 that presented to the health care facilities with suspected malaria (fever of 37.5 Celsius and above).

2. Calculation of the proportion of febrile children who tested positive for malaria following RDT and/or microscopy test (proportion of confirmed malaria). This analysis sought to gather information on the prevalence of malaria amongst febrile children.

3. Calculation of the proportion of febrile children who were correctly treated with ACT after testing positive for malaria (proportion of confirmed malaria correctly treated). Using this analysis, we determined the percentage of those who tested positive for malaria who received ACT treatment

4. Calculation of the proportion of febrile children inappropriately treated for malaria (proportion of inappropriate treatment of suspected malaria). Using this assessment, we determined the percentage of those who tested negative but still received ACT treatment and those not tested but who also got ACT treatment.

5. Calculation of the proportion of febrile children who tested negative for malaria and were appropriately not treated for malaria and assessed for other illnesses (Proportion of appropriate management of malaria negative cases). Calculation of the proportion of febrile children who test negative for malaria but who then did not receive correct further management; i.e. test negative for malaria but not assessed for other illnesses (proportion of inappropriate management of malaria negative cases). This assessment sought to search for information on health practitioners` ability to provide alternative diagnoses by conducting further investigations to discover other causes of fever other than malaria.

6. Calculation of the proportion of children confirmed to have malaria but were not treated for malaria; i.e. test positive for malaria but then did not get treated (proportion of confirmed malaria cases incorrectly treated).

7. Calculation of the proportion of febrile children not tested for malaria and not treated for malaria (proportion of suspected malaria cases inappropriately managed).

Validity

A cross sectional study design was appropriate for the objectives of the study. Precision was adequate and the effect of chance was reduced to an acceptable level. Selection bias was unlikely because the selection of records was conducted through a multistage random sampling of health records. Non-differential measurement error was however likely to be present because several variables could be missing from the medical record files or incorrectly documented.

Engaging and training experienced fieldworkers who had participated in previous malaria surveys enhanced validity. They were additionally trained on data extraction from the records and the application of the inclusion and exclusion criteria in a standardized manner.

Measurement bias was mitigated through random crosschecking of completeness and accuracy of the data collected with the records from which the data was extracted. In addition, daily reviews with enumerators were conducted to learn about difficulties they encountered in reviewing the records.

The fact that information on medical records was written without any influence from researchers and without prior knowledge that the information will in future be used for research purposes, made the medical record data relatively devoid of measurement bias related to the knowledge of the outcome.

Generalisability

The prevalence of appropriate management of suspected malaria is generalisable to public health care facilities in Lusaka. However, due to inadequate sample sizes of medical records selected from individual clinics, generalization of the prevalence was not applicable at individual clinic level. However, any associations with the appropriate management of suspected malaria are probably generalisable to all public health centres in Zambia, as they have similar contexts and influences.

Piloting

The data extraction tools was pre-tested in one urban and one rural health centre, both of which were not included in the study sample, to assess the appropriateness of the tool and to determine if there would be any procedural difficulties in extracting the required data from the records.

Ethics

Ethical approval for the study was obtained from the Research Committee of the University of the Western Cape of South Africa and from the Central Ethical Committee of the Ministry of Health in Zambia. The Ministry of Health in Lusaka permitted us to conduct the study and as custodian of the

medical records, provided consent for us to use the records for the purposes outlined in the study methodology. Participation in the study was voluntary via informed consent from the participants after a clear explanation of the purpose of the study had been provided to them. An information sheet outlining the purpose of the study was provided to the participants. Furthermore, participants were informed that participating in the study would not cause any harm and that there would be no adverse consequences if participants refused to participate in the study. Participants were assured that confidentiality would be strictly maintained and no patients' names, staff names and names of the selected health centres would be revealed in any reports. Participants were also informed that they had the right to discontinue participation in the study at any time they wished to do so, without the need to explain their choice to discontinue.

RESULTS

Sample Realisation

Figure 3: Flow Diagram of inclusion and exclusion criteria
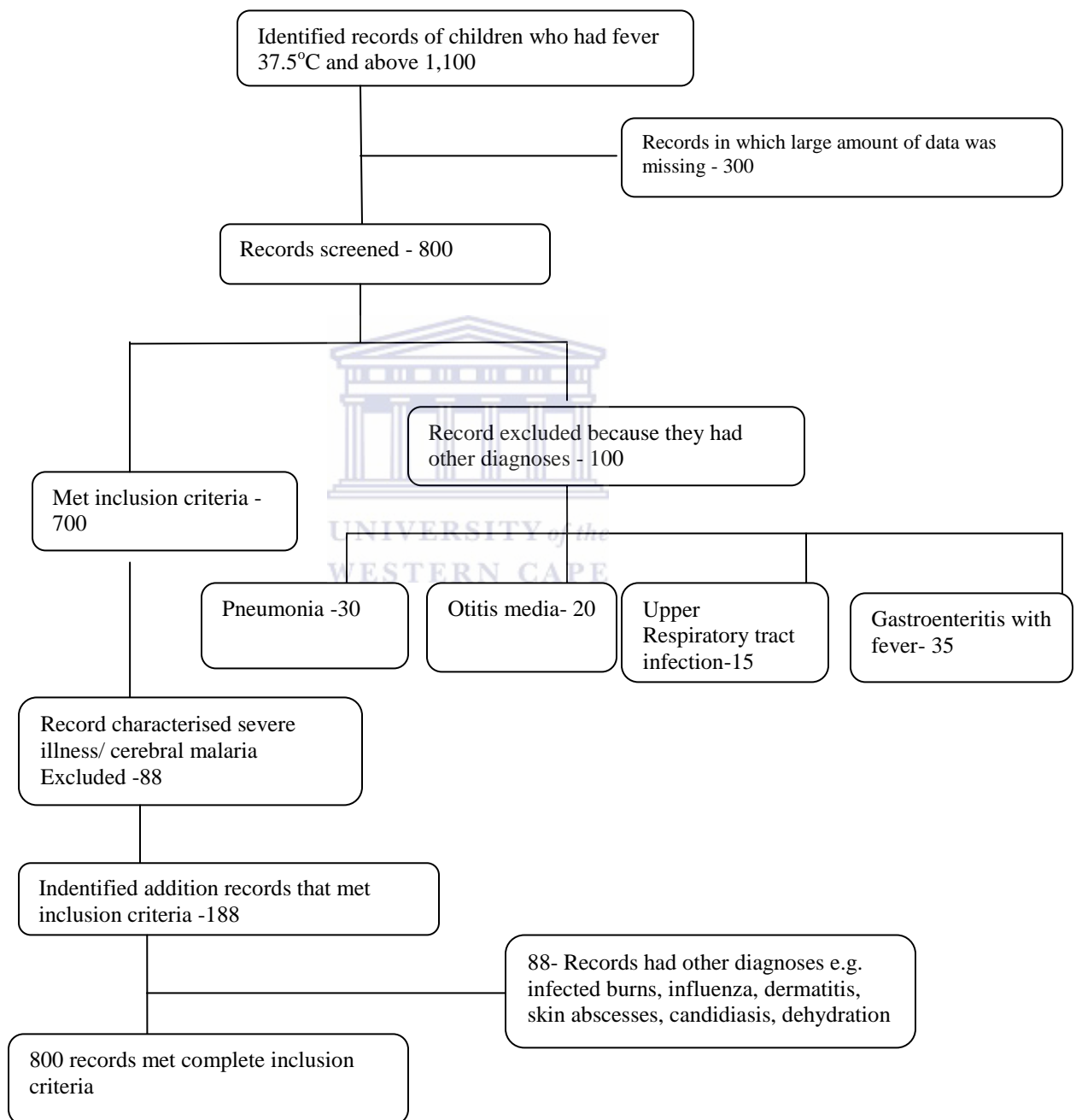
The process of data collection took 3 months, from February to May 2013. All 800 records required by the sample were obtained in the manner shown below. All staff opted to be included in the study when requested to be interviewed upon production of the letter of authority to conduct research from the District Health Office and from the University of the Western Cape.

Outcome of Suspected Malaria Investigation

Figures 1 to 3 shows the flow diagrammes of suspected malaria investigation outcomes for the years 2008 and 2011 combined, and the years 2008 and 2011 separately, respectively. The diagrammes show all the potential management pathways for children suspected of having malaria by virtue of presenting with fever (temperature of 37.5^o C. or more). It starts with whether they were tested for malaria or not (via either RDT or microscopy) and then follows them down the management trunks of tested or not tested, with its varying branches and sub-branches. Those who tested and were positive for malaria could then either be treated for malaria or not, and if treated what treatment they were given is noted; while those who test negative could despite the test result also have been treated for malaria, and if so with what is noted; or else they could have been further investigated to determine an alternative diagnosis (or not). Similarly those who were not tested for malaria could despite the lack of a malaria test result still have been treated for malaria (presumptive treatment), or not (thereby rendering them inappropriately not investigated for malaria). The figures show that the percentage tested via RDT or microscopy for malaria rose from 54.5% in 2008 to 73.3% in 2011, representing an absolute 18.8% percentage increase in patients offered a malaria test over the 3 years. In addition, the number of patients who received ACT despite being tested RDT/microscopy negative reduced from 13.2% in 2008 to 9.6% in 2011. Presumptive treatment for malaria decreased from 24% in 2008 to 11.3% in 2011.

Figure 4 Flow Diagramme of suspected malaria investigation outcomes for the years 2008 and 2011 combined

Suspected malaria fever and inclusion and exclusion criteria 800 (100%)

Tested via RDT or microscopy 511(63.9%)

Not tested by RDT or microscopy 289/800 (36.1%)

Tested positive 190/511 (37.2%)

Tested negative 317/511(62.0%)

Unknown 4(0.78%)

Positive treated with ACT 145/190 (76.3%)

Negative but treated with ACT 36/317 (11.4%)

Not tested and not treated with antimalarials but treated with other drugs 148/289 (51.2%)

Hence not investigated nor treated for malaria 148/800 (18.5%)

Not tested but treated with ACT 115/289 (39.8%)

Positive and treated with Fansidar 2/190 (1.1%)

Negative but treated with Fansidar 27/317(8.5%)

Not tested but treated with Fansidar 21/289 (7.3%)

Positive and treated with Quinine 7/190 (3.7%)

Negative but treated with Quinine 4/317 (1.3%)

Not tested but treated with Quinine 5/289 (1.7%)

Positive but treated with Antibiotics 32/190 (16.8%)

Negative but treated with Antibiotics 190/317(59.9%)

Positive but treated with Analgesics 4/190 (2.1 %%)

Negative treated with Analgesics 60/317(18.9%)

Presumptively treated for malaria 141/800 (17.6%)

Positive but not treated with antimalarials 36 (18.9%)

Negative not treated with antimalarials 250 (78.8%)

Tested negative, not treated with antimalarials and NOT assessed further for the cause of fever 177/250 (70.8%)

Tested negative, not treated with antimalarials and assessed further for the cause of fever 63/250 (25.2%)

Unknown 10/250 (4.0%)

Figure 5 Flow Diagramme of suspected malaria investigation outcomes for the year 2008

Suspected fever inclusion and exclusion criteria 400 (100%)

Tested via RDT or microscopy 218/400 (54.5%)

Not tested by RDT or microscopy 182/400 (45.5%)

Tested positive 65/218 (29.8%)

Tested negative 151/218 (69.3%)

Unknown 2 (0.92%)

Positive treated with ACT 55/65 (84.6%)

Positive and treated with Fansidar 1/65 (1.5%)

Positive and treated with Quinine 5/65 (7.7%)

Positive but treated with Antibiotics 1/65(1.5%)

Positive but treated with Analgesics 3/65 (4.6%)

Positive but not treated with antimalarials 4 (6.1%)

Negative but treated with ACT 20/151 (13.2%)

Negative but treated with Fansidar 21/151 (13.9%)

Negative but treated with Quinine 4/151 (2.6 %%)

Negative but treated with Antibiotics 85/151 (56.3%)

Negative treated with Analgesics 21/151(13.9%)

Negative and not treated with antimalarials 106(70.2%)

Not tested and not treated with antimalarials but treated with other drugs 86/182 (47.3%)

Hence not investigated nor treated for malaria is 86/400 (21.5%)

Not tested but treated with ACT 80/182 (44.0%)

Not tested but treated with Fansidar 15/182 (8.2%)

Not tested but treated with Quinine 1/182 (0.5%)

Presumptively treated for malaria 96/400 (24.0%)

Tested negative, not treated with antimalarials and not assessed further for the cause of fever 49/106 (46.2%)

Unknown 10/106(9.4%)

Tested negative, not treated with antimalarials and assessed further for the cause of fever 47/106 (44.3%)

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Figure 6 Flow Diagramme of suspected malaria investigation outcomes for the year 2011

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                          ┌──────────────────────────────────────────────┐
                          │ Suspected fever inclusion and exclusion       │
                          │ criteria 400 (100%)                           │
                          └──────────────────────────────────────────────┘
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Suspected fever inclusion and exclusion criteria 400 (100%)

Tested via RDT or microscopy 293/400 (73.3%)

Not tested by RDT or microscopy 107/400 (26.8%)

Tested positive 125/293 (42.7%)

Unknown 2/293(0.7%)

Tested negative 166/293 (56.7%)

Not tested and not treated with antimalrials but treated with other drugs 62/107 (57.9%)
Hence not investigated nor treated for malaria 62/400 (15.5%)

Positive treated with ACT 90/125 (72.0%)

Negative but treated with ACT 16/166 (9.6%)

Positive and treated with Fansidar 1/125 (0.8%)

Negative but treated with Fansidar 6/166 (3.6%)

Not tested but treated with ACT 35/107 (32.7%)

Positive and treated with Quinine 2/125 (1.6. %)

Negative but treated with Quinine 0/166 (0%)

Not tested but treated with Fansidar 6/107 (5.6%)

Positive but treated with Antibiotics 31/125(24.8%)

Negative but treated with Antibiotics 105/166 (63.3%)

Not tested but treated with Quinine 4/107 (3.7%)

Positive but treated with Analgesics 1/125 (0.8%)

Negative treated with Analgesics 39 /166(23.5%)

Positive but not treated with antimalarials 32 (25.6%)

Negative and not treated with antimalarials 144 /166 (86.8%)

Presumptively treated for Malaria 45/400 (11.3%)

Tested negative, not treated with antimalarials and NOT assessed further for the cause of fever 128/144 (88.9%)

Tested negative, not treated with antimalarials and assessed further for the cause of fever 16/144 (11.1%)

Socio-demographic description and clinical features of children seen with suspected malaria

Table 1 describes the socio-demographic and clinical features of children seen with suspected malaria and shows the univariate analysis of the patients' data. Slightly more (53%) female patients` medical records were reviewed more than those of males (47%). The majority of the children (51.9%) lived in informal houses and most caretakers (68%) reported that their children had clinical fever to the health worker. In addition, most caretakers (76%) had treated their children at home using mostly an unnamed home remedy, with only a small proportion of those treating (6.6%) having given the children an antimalarial.. Although prior home treatment decreased dramatically from 98% in 2008 to 54% in 2011, the proportion providing antimalarial home treatment increased from 4% to 12%.

Table 1: Socio-demographic description and clinical features of children seen with suspected malaria: univariate analysis of patients' data.

Group	Description	2008	2011	Both Years 2008 and 2011
Sample size		400	400	800
Sex	n	400	400	800
	Males	195 (49%)	184 (46%)	379 (47%)
	Female	205 (51%)	216(54%)	42(53%)
Age	n	400	400	800
	Age 1 - 12 months	116 (29%)	104 (26%)	220(27.5%)
	Age 13 - 24 months	106 26.5%)	88(22%)	194(24.25%)
	Age 25 - 36 months	77(19.25%)	76(19%)	153(19.125%)
	Age 37 - 48 months	54(13.50%)	70(17.5%)	124(15.50%)
	Age 49 - 60 months	47(11.75%)	62(15.5%)	109(13.625%)
Distance	n	400	400	800
	Distance from health centre < 1km	184 (46%)	193 (48.25%)	377(47.125%)
	Distance from health centre 1 - 2 km	98(24.5%)	100(25%)	198(24.75%)
	Distance from health centre 3 -4 km	59(14.75%)	50(12.50%)	109(13.625%)
	Distance from health centre > 4km	59(14.75%)	57(14.25%)	116(14.50%)
Housing	n	400	400	800
	Formal House	174(43.50%)	148 (37%)	322 (40.25%)
	Informal House	187(46.75%)	220(55%)	407(50.875%)
	Traditional House	39(9.75%)	32(8%)	71(8.875%)
Treated at Home	n	400	400	800
	Given treatment at home	393 (98%)	217 (54%)	610 (76%)
	Not treated at home	7(1.75%)	183(45.75%)	190(23.75%)
Type of Home Treatment	n	393	217	610
	Malaria drugs	14 (3.56%)	26 (11.98%)	40 (6.56%)
	Antibiotics	80(20.36%)	41(18.89%)	121(19.84%)
	Herbs	21(5.34%)	57(26.27%)	78(12.79%)
	Analgesics	20(5.09%)	51(23.50%)	71(11.64%)
	Other	117(29.77%)	42(19.35%)	159(26.07%)
	Unknown	148(37.66%)	183(84.33%)	331(54.26%)
Clinical signs	n	400	400	800
Fever*	38.0ºC and above	374(93.50%)	292 (73.0%)	666 (83.25%)
	Below 38.0ºC	26(6.50%	108(27.0%)	154(16.75%)
Diarrhoea	Yes	217 (54.25%)	86 (21.50%)	303 (37.88%)
	No	183 (45.75%)	314 (78.50%)	497 (62.12%)
Vomiting	Yes	192 (48.0%)	102 (25.50%)	294 (36.75%)
	No	208 (58.0%)	298 (74.50%)	506 (63.25%)
Anorexia	Yes	72 (18.0%)	121 (30.25%)	193 (24.12%)
	No	328 (82.0%)	279 (69.75%)	607 (75.88%)
Weakness	Yes	45(11.25%)	55 (13.75%)	100 (12.50%)
	No	355 (88.75%)	345 (86.25%)	700 (87.50%)
Pallor	Yes	36 (9.0%)	13 (3.25%)	49 (6.12%)
	No	364 (91.0%)	387 (96.75%)	751 (93.88%)
Lethargy	Yes	13 (3.25%)	32 (8.0%)	45 (5.62%)
	No	387 (96.75%)	368 (92.0%)	755 (94.38%)
Type of Staff who attended to the patient	n	400	400	800
	Doctor	23(5.76%)	15 (3.83%)	38 (4.80%)
	Registered Nurse	70(17.54%)	53 (13.52%)	123(15.55%)
	Enrolled Nurse	55(13.78%)	35 (8.93%)	90(11.38%)
	Clinical Officer	251(62.91%)	297 (74.25%)	548(68.50%)
Provisional Diagnosis before malaria test	Suspected malaria	263 (65.75%)	265 (66.25%)	528 (66.0%)
	Other childhood Illnesses	137 (34.25%)	135 (33.75%)	272 (34.0%)

*Although the inclusion criterion for the study was a temperature of 37.5 degrees Celsius or more, the clinical cut-off of 38 degrees Celsius was used here as a separate variable as a proxy for the point at which a child would be noticeably warmer than usual.

Description of the health facilities and their staff

Table 2 provides a description of the 10 health facilities focusing on their preparedness to implement the 'test and treat' policy. It shows that, of the 10 health facilities assessed, 3 (30%) had received and displayed an ACT policy on the walls of the consultation rooms, although all 10 (100%) had displayed an ACT dosage guide. Notably, 5 and 8 years (in 2008 and 2011 respectively) after implementation of the 'test and treat' policy in Zambia, only 1 out of 4 doctors (25%), 5 out of 84 nurses (6%) and 5 out of 16 clinical officers (31%) had training in the use of ACT and RDT. Shortages of staff across all categories were reported by all 10 health facilities (100%) and this impacted negatively on service delivery, as all 10 health facilities (100%) reported that health workers had insufficient contact time with their patients.

Table 2: Description of the health facilities and their staff

Characteristics	All health facilities Number (%)
Wall Chart in Consultation rooms n = 10	
ACT Job Aid	0(0%)
ACT Policy	3(30%)
Suspected Malaria Management Algorithm	0(0%)
RDT Job Aid	0(0%)
ACT dosage guide	10(100%)
Health worker`s Training in RDT and ACT	
Doctors n = 4	1(25%)
Nurses (registered and enrolled) n = 84	10 (6.0 %)
Clinical Officers n =16	5(31.25%)
Supervisory visits by District Health Office to Health centers n = 10	
Monthly	2(20%)
Quarterly	4(40%)
6monthly	1(10%)
Annually	3(30%)
Bi-annually	0(0%)
Impact on service delivery due to staff shortages N = 10	
Health workers have less contact time with patients	10 (100%)
Health workers conduct only few essential procedures	10(100%)
Present shift does not complete all tasks (Handovers)	10(100%)
Facilities shortages of any category of staff n = 10	10(100%)
Facilities with Staff Shortages in categories n = 10	
Doctors	10 (100%)
Nurses (Registered and Enrolled)	10 (100%)
Clinical Officers	10(100%)
Environmental Health Technicians	10(100%)
Community Health Workers	10(100%)
Ways in which Facilities handled staff shortages n = 10	
Decrease contact time with patients	10(100%)
Handover patients to next shift	10(100%)
Do most vital procedures only (take shortcuts)	10(100%)
Delegate clinical work	3(30%)
Turn Patients away	10(100%)

Facility analysis of number and categories of health staff, median years of service, number and percentage of staff trained in RDT and ACT use, number of staff requiring refresher course and number of patients seen by each staff member per day.

Table 3 provides a description of staffing levels, in 4 broad categories of staff, at each of the 10 health facilities, showing numbers of staff, years at the facility, training related to the 'test and treat' policy and clinical workload measured as patients seen per staff member per day. There was a distinct shortage of health staff across the 10 health centres relative to the national staffing norm. The ministry of health staff establishment norm provides for 2 doctors, 5 clinical officers, 12 nurses and 2 environmental technicians per health centre. None of the facilities had that full complement of staff and only 2 health centres had doctors present. Overall regarding the nursing staff, there were 84 (70%) out of the required 120. This number of nurses was however, unevenly distributed across the 10 health centres. Two health centres had the required number of 12 (100%) and 2 health centres had 6 and 2 surplus nurses respectively, while the other health centres had a shortage of nurses. The total number of number of staff that were trained in RDT and ACT use was 11(10.2%) out of 108 and all the 11 members of staff indicated that they required a refresher course in RDT and ACT use. Despite the facilities claim of being under-staffed and having insufficient time to spend on patients, as shown in table 2 above, the actual measurement of clinical workload of the staff seems low for all categories of staff, except for clinical officers, amongst whom it seems to be at a comfortable level.

Table 3: Facility analysis of the number and categories of health staff, median years of service, number and percentage of staff trained in RDT and ACT use, number of staff requiring a refresher course and number of patients seen per staff member per day

Facility No.	1				2				3				4			
	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T
No of staff	0	18	1	0	0	14	1	0	0	12	2	0	0	2	1	1
# median yrs of service	0	7	7	0	0	5	5	0	0	4.5	4.5	0	0	4	4	4
No trained on RDT& ACT use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
# median time since training (yrs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nos. requiring refresher course	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patients seen per staff member per day	0	18	21	0	0	17	27	0	0	16	29	0	0	36	48	18

Facility No.	5				6				7				8			
	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T
No of staff	0	2	1	1	2	10	5	2	2	12	5	0	0	10	0	0
# median yrs of service	0	4.5	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	0	0	6	0	0
No trained on RDT& ACT use	0	0	0	0	0	0	2	0	1	2	3	0	0	3	0	0
# median time since training (yrs)	0	0	0	0	0	0	1	0	1	1	1	0	0	1.5	0	0
Nos. requiring refresher course	0	0	0	0	0	0	2	0	1	2	3	0	0	3	0	0
Patients seen per staff member per day	0	33	41	19	25	16	35	9	20	11	25	0	0	18	0	0

Facility No.	9				10				All 10 Facilities Combined			
	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T	Drs	Nurses	C.O	E.H.T
No of staff	0	1	0	0	0	3	0	0	4	83	16	4
# median yrs of service	0	5.5	0	0	0	4.5	0	0	11	52	36	14
No. trained on RDT& ACT use	0	0	0	0	0	0	0	0	1	5	5	0
# median time since training (yrs)	0	0	0	0	0	0	0	0	1	2.5	2	0
Nos. requiring refresher course	0	0	0	0	0	0	0	0	1	5	5	0
Patients seen per staff member per day	0	40	0	0	0	38	0	0	23	18	31	14

Level of preparedness and adequacy of health facilities to implement the 'test and treat' guidelines based on strategy, workload and training on RDT and ACT.

Table 4 shows the overall rating of the level of preparedness and adequacy of the health facilities to implement the 'test and treat' guidelines. Each of clinics were allocated the score of either "0" or "1" for each variable based on whether they were compliant for the variable (0) or not (1). Hence the score of "1" signifies the existence of the item or staffing level that is required for the facility to be adequately prepared to implement the 'test and treat' policy.

It shows that only 3 (30%) health centres, which scored 4 or more points, were 'minimally ready' to implement the new policy. A score of 4 out of the maximum possible of 9 (each category was allocated a score of 1), was deemed the minimum required to be classified as 'minimally prepared to implement the new 'test and treat' policy'.

Table 4: Level of preparedness and Adequacy of the health facilities to implement the 'test and treat' guidelines based on staffing, workload and training on RDT and ACT.

Facility	At least 2 types of wall charts are present	Supervisory visits occur quarterly or more frequently	At least one Doctor is present in the facility	Workload of Nurses are less than 24 patients per Nurse per day	Workload of Clinical Officers are < 32 patients per CO per day	Managers report adequate staffing of Nurses	Managers report adequate staffing of Clinical Officers	At least one Nurse trained on RDT and ACT	At least one Clinical Officer trained on RDT and ACT	Total score	Scored 4 or more
1	0	1	0	1	1	0	0	0	0	3	No
2	0	1	0	1	1	0	0	0	0	3	No
3	0	1	0	1	1	0	0	0	0	3	No
4	0	1	0	0	1	0	0	0	0	2	No
5	0	1	0	0	0	0	0	1	0	2	No
6	0	0	1	1	0	0	0	1	1	4	Yes
7	0	0	1	1	0	0	0	1	1	4	Yes
8	1	1	0	1	1	0	0	0	0	4	Yes
9	1	1	0	0	0	0	0	0	0	2	No
10	1	1	0	0	0	0	0	0	0	2	No

Key outcomes

Table 5 shows the final outcomes of the investigation of the children with suspected malaria in 4 categories of outcome for 2008, 2011 and for both years combined. The main outcome categories shown are: the 'proportion of suspected cases tested for malaria'; the 'proportion correctly and appropriately treated with ACT'; the 'proportion inappropriately but not incorrectly treated with ACT'; and the 'proportion correctly managed'.

"Proportion of suspected cases tested for malaria"

This outcome comprises of all those with fever who were tested for malaria. This is a very important outcome as it is the first step in the management of a child suspected of having malaria. Hence if this step is not enacted then the management of the child will be incorrect.

"Proportion correctly and appropriately treated with ACT"

The description of this outcome comprised of those who tested positive for malaria and were given ACT and those who tested negative for malaria and were and were given ACT. It is axiomatic that if a patient tests positive for malaria then one would treat them with the appropriate antimalarial medication. An unexpected result therefore was that in 2008, only 55(84.61%) and in 2011, only 90(72.0%) of those who tested positive were given ACT. Although the absolute number of patients increased by 35 in 2011, comparatively it shows a percentage decrease by 12.6%. Conversely, the number of patients who tested negative for malaria and were given ACT (allowed as the sensitivity of the test is 90%, Chandler et al, (2010) decreased from 20 (13.3 %) in 2008 to 16 (9.6%) in 2011 representing a percentage decrease of 3.7%. Nevertheless, the total number and percentage of children who were correctly treated with ACT increased from 75(34.72%) in 2008 to 106 (36.43%) in 2011, representing a number and percentage increase of 36 (1.71%)

"Proportion presumptively treated for malaria"

The description of this outcome comprised of those who were not tested for malaria but were given antimalarials. This is not necessarily incorrect as many of those so treated might have malaria, but it is inappropriate as the policy dictates that malaria must be proven before implementing treatment, rather than continuing presumptive treatment practices. In 2008, 96 (24%) were presumptively treated compared to 45 (11%) in 2011.

"Proportion Correctly Managed"

The final outcome of the "proportion correctly managed" was described by seven depictions or scenarios. These are those who tested positive for malaria and were given ACT, tested negative for malaria and were given ACT, tested positive for malaria but were given quinine and those who tested positive for malaria and were given fansidar. Others are those who tested negative for malaria and were given quinine, those who tested negative for malaria and were give fansidar and those who tested negative for malaria and were further investigated to establish the cause of fever. All of these management procedures are rationally compliant with scenarios in the policy and hence all are deemed correct management.

The total correctly managed reduced slightly from 153 (38%) in 2008 to 131 (33%) in 2011.

Table 5: Depiction of the Final Outcomes of the investigation of the children with suspected malaria in 4 categories of Outcome for 2008 (n=400), 2011 (n=400) and for both years combined (n=800).

Final Outcome	Description of Final Outcome (also see flow diagramme in figure 1)	2008 n =400	2011 n=400	2008 and 2011 Combined n=800
Proportion of suspect cases Tested for malaria	All those with fever who were tested for malaria	218/400 (54.50%)	293/400 (73.25%)	511 /800 (63.88%)
Proportion Correctly and Appropriately Treated with ACT	Those who: 1). Tested positive for malaria and were given ACT.	55/65 (84.61%)	90/125 (72.0%)	145 /190 (76.31%)
	2). Tested negative for malaria and were given ACT (allowed as sensitivity of test is only 90%)	20/151 (13.24%)	16/166 (9.67%)	36/317 (11.36%)
	Total Correctly and Appropriately Treated with ACT	75/85 (88%)	106/141 (75.18%)	181/226 (80.0%)
Proportion Presumptively Treated with antimalarials	Those who were not tested for malaria but were given an antimalarial	96/400 (24%)	45/400 (11.3%)	141/800 (17.6%)
Proportion Correctly Managed	Those who: 1). Tested positive for malaria and were given ACT	55/65 (84.61%)	90 /125 (72.0%)	145/190 (76.31%)
	2). Tested negative for malaria and were given ACT (allowed as sensitivity of test is 90%)	20/151 (13.24%)	16/166 (9.60%)	36/317 (11.36%)
	3). Tested positive for malaria but were given quinine (appropriate as they might have had a contraindication to ACT).	5 /65 (7.69%)	2/125 (1.6%)	7 /190 (3.68%)
	4). Tested positive for malaria but were given fansidar (appropriate as they might have had a contraindication to ACT)	1/65 (1.53%)	1/125 (0.8%)	2/190 (1.05%)
	5) Tested negative for malaria and were given quinine (allowed as sensitivity of test is 90% and they might have had a contraindication to ACT)	4/151 (2.65%)	0/166 (0%)	4/317 (1.26%)
	6) Tested negative for malaria and were given fansidar (allowed as sensitivity of test is 90% and they might have had a contraindication to ACT)	21/151 (13.91%)	6/166 (3.61%)	27/317 (8.52%)
	7). Tested negative for malaria and were further investigated to establish the cause of the fever	47/131 (35.88%)	16/150 (10.70%)	63/280 (22.50%)
	Total Correctly Managed	153/400 (38.25%)	131/400 (32.75%)	284/800 (35.72%)

BIVARIATE ANALYSIS FOR EACH MAIN OUTCOME FOR BOTH 2008 AND 2011

The Excel dataset was transported into Epi Info version 7 in which variables which had more than two responses were transformed and recoded into two categories to allow for bivariate analysis. Using 2x2 tables I calculated the prevalence ratios with their concomitant 95% confidence intervals and used the chi-squared test to determine two tailed P values.

Each Risk factor was compared with the 3 main outcomes according to the flow diagram. The three main outcomes and descriptions in this study are:

1. Proportion of suspect cases (children with fever) tested for malaria (table 6).

2. Proportion children with fever correctly and appropriately treated with ACT (table 7).

3. Proportion children with fever correctly managed (table 8).

Table 6: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients were tested for malaria or not.

Risk Factor	Category	2008					2011				
		Malaria Test		Prevalence Ratio	95% CI	P-Value	Malaria Test		Prevalence Ratio	95% CI	P-Value
		Yes	No				Yes	No			
Sex	Male	108	86	1.04	0.872-1.247	0.3251	139	45	1.06	0.942 - 1.192	0.1710
	Female	110	96				154	62			
Age	<24months	113	109	0.86	0.722-1.031	0.0540	135	57	0.93	0.821 - 1.043	0.1025
	>24months	105	73				158	50			
Residence	Formal Housing	97	77	1.04	0.870-1.246	0.3311	110	38	1.02	0.907-1.155	0.3574
	Informal Housing	121	105				183	69			
Distance	< 1Km	100	84	0.99	0.831-1.191	0.4775	136	57	0.93	0.823 - 1.047	0.1137
	>1Km	118	98				157	50			
Temp (Fever)	below 38.0°C	13	13	1.10	0.738 – 1.628	0.3192	91	30	0.96	0.849 – 1.091	0.2834
	Above 38.0°C	205	169				202	77			
Treated at home	Yes	215	178	1.28	0.540 – 3..017	0.2795	151	66	0.89	0.797 – 1.006	0.0362
	No	3	4				142	41			
Type of treatment given at home	Malaria drugs	5	9	0.65	0.319 -1.315	0.0829	68	41	0.81	0.687 – 0.945	0.0017
	All other treatment	213	173				225	66			
Provisional Diagnosis before malaria test	Suspected malaria	144	119	1.01	0.839 -1.225	0.4439	189	76	0.93	0.821 – 1.043	0.1120
	Other illnesses	74	63				104	31			
Diarrhoea	Yes	115	102	0.94	0.787 -1.126	0.2564	71	15	1.17	1.035 -1.317	0.0126
	No	103	80				222	92			
Vomiting	Yes	100	92	0.92	0.767 -1.099	0.1767	73	29	0.96	0.843 – 1.14	0.3.3269
	No	118	90				220	78			
Anorexia	Yes	42	30	1.09	0.873 -1.354	0.2377	91	30	1.04	0.916 – 1.177	0.2834
	No	176	152				202	77			
Weakness	Yes	24	21	0.98	0.731 -1.303	0.4333	34	21	0.82	0.663 -1.022	0.0232
	No	194	161				259	86			
Pallor	Yes	22	14	1.13	0.860 – 1.498	0.2059	293	107	Undefined	Undefined	Undefined
	No	196	168				0	0			

Table 6: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients were tested for malaria or not

Risk Factor	category	2008					2011				
		Malaria Test					Malaria Test				
		yes	No	Prevalence Ratio	95% CI	P-Value	yes	No	Prevalence Ratio	95% CI	P-Value
Lethargy	Yes	10	3	1.43	1.048 -1.955	0.0533	20	12	0.84	0.639 – 1.109	0.0832
	No	208	179				273	95			
Type of staff who treated patient	Treated by Doctor	14	9	1.12	0.800 – 1.581	0.2699	11	4	1.00	0.733 – 1.366	0.4873
	Treated other Health workers	204	173				282	103			
Type of staff who treated patient	Treated by Nurse	66	59	0.96	0.785 – 1.163	0.3233	79	9	1.31	1.180 -1.450	0.0000
	Treated by other Health workers	152	123				214	98			
Type of staff who treated patient	Treated by Clinical. Officer	138	114	1.01	0.841 – 1.220	0.4454	203	94	0.78	0.703 – 0.870	0.0000
	Treated by others health workers	80	68				90	13			
	Treated by Dr plus C.Officers	152	123				214	98			
Preparedness for facility to implement test and treat	Minimally prepared	30	30	0.90	0.690 -1.185	0.4835	58	32	0.85	0.720 – 1.003	0.0182
	Unprepared	188	152				235	75			

Table 7: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients who Tested positive for Malaria were given ACT or not.

		2008					2011				
		Malaria Test positive					Malaria Test positive				
Risk Factor	Category	Given ACT	NOT Given ACT	Prev. Ratios	95% CI	P-Value	Given ACT	NOT Given ACT	Prevalence Ratios	95% CI	P-Value
Sex	Male	35	7	0.96	0.778 – 1.180	0.3657	40	16	0.98	0.790 – 1.228	0.4489
	Female	20	3				50	19			
Age	<24months	25	6	0.91	0.739 – 1.129	0.2120	33	17	0.87	0.685 – 1.099	0.1163
	>24months	30	4				57	18			
Residence	Formal Housing	14	3	0.96	0.751 – 1.236	0.3776	18	20	0.57	0.403 – 0.811	0.0000
	Informal Housing	41	7				72	15			
Distance	<1Km	14	4	0.80	0.590 – 1.090	0.0587	38	26	0.70	0.554 - 874	0.0006
	>1Km	41	6				52	9			
Temp	Below 38.0°C	5	2	1.20	0.747 – 1.949	0.1796	26	14	1.15	0.895 -1.499	0.1217
	Above 38.0°C	50	8				64	21			
Treated at Home	Yes	54	10	0.84	0.759 – 0.937	0.4230	51	16	1.13	0.904 – 1.416	0.1398
	No	1	0				39	19			
Type of treatment at home	Malaria drugs	1	13	0.84	0.759 – 0.937	0.4230	6	1	1.20	0.871 – 1.664	0.2303
	All other treatments	51	0				84	34			
Diarrhoea	Yes	34	5	1.07	0.863 -1.348	0.2523	28	17	0.80	0.621 – 1.037	0.0378
	No	21	5				62	18			
Vomiting	Yes	33	4	1.13	0.907 -1.419	0.1339	22	7	1.07	0.840 – 1.364	0.3084
	No	22	6				68	28			
Anorexia	Yes	8	3	0.83	0.573 – 1.217	0.1382	25	6	1.16	0.936 – 1.451	0.1125
	No	47	7				65	29			
Weakness	Yes	7	0	1.20	1.074 – 1.358	0..1457	9	5	0.88	0.586 – 1.322	0.2522
	No	48	10				81	30			
Pallor	Yes	6	0	1.20	1.073 – 1.351	0.1754	90	35	undefined	undefined	undefined
	No	49	10				0	0			
Lethargy	Yes	1	2	0.38	0.077 – 1.901	0.0310	3	0	1.40	1.253 – 1.569	0.1848
	No	54	8				87	35			
Type of staff who treated patient	Treated by Doctor	4	1	0.94	0.599 – 1.477	0.3723	1	4	0.26	0.046 – 1.561	0.0114
	Treated by other Health workers	51	9				89	31			

Table 7: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients who Tested positive for Malaria were given ACT or not.

		2008					2011				
		Malaria Test positive					Malaria Test positive				
Risk Factor	Category	Given ACT	NOT Given ACT	Prev. Ratios	95% CI	P-Value	Given ACT	NOT Given ACT	Prevalence Ratios	95% CI	P-Value
Type of staff who treated patient	Treated by Nurse	12	4				36	9			
	Treated other Health workers	43	6	0.85	0.632 – 1.155	0.1283	54	26	1.18	0.959 – 1.463	0.0701
Type of staff who treated patient	Treated by Clinical Officer	39	5	1.16	0.895 – 1.511	0.1126	53	22	0.95	0.766 – 1.189	0.3471
	Treated by other Health workers	16	5				37	13			
Further investigated	Yes	4	2				17	25			
	No	51	8	0.77	0.434 – 1.370	0.1349	73	10	0.46	0.316 – 0.669	0.0000
Preparedness for Facility to implement Test and Treat	Minimally prepared	17	1	1.16	0.977 – 1.396	0.0974	6	19	0.28	0.141 – 0.577	0.0000
	Unprepared	38	9				84	16			

Table 8: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients were correctly managed or not.

Risk Factor	Category	2008					2011				
		Correctly Managed	Incorrectly managed	Prevalence Ratio	95% CI	P-Value	Correctly Managed	Incorrectly managed	Prevalence Ratio	95% CI	P-Value
Sex	Male	85	109				60	124			
	Female	68	138	1.32	1.032 – 1.706	0.0134	71	145	0.99	0.748 – 1.315	0.4783
Age	<24months	79	143				57	135			
	>24months	74	104	0.85	0.667 – 1.097	0.1116	74	134	0.83	0.628 – 1.108	0.1061
Residence	Formal Housing	75	99				36	112			
	Informal Housing	78	148	1.24	0.974 – 1.600	0.0407	95	157	0.64	0.466 – 0.895	0.0028
Distance	Less than 1Km	85	99				66	127			
	Over 1Km	68	148	1.46	1.141- 1.886	0.0013	65	142	1.08	0.822 – 1.442	0.2768
Temp	Below 38.0^{o}C	9	17				54	104			
	Above 38.0^{o}C	144	230	1.11	0.645 – 1.915	0.3544	77	165	1.07	0.808 – 1.427	0.3119
Treated at Home	Yes	152	241				84	133			
	No	1	6	2.70	0.439 – 16.690	0.1067	47	136	1.50	1.118 -2.030	0.0028
Type of treatment at home	Malaria drugs	1	13				8	17			
	All other treatments	152	234	0.18	0.027 – 1.204	0.0056	123	252	0.97	0.541 – 1..759	0.4763
Diarrhoea	Yes	79	138				31	51			
	No	74	109	0.90	0.702 – 1.154	0.2054	100	218	1.20	0.871 – 1.658	0.1393
Vomiting	Yes	78	135				37	65			
	No	75	112	0.91	0.712 – 1.171	0.2381	94	204	1.15	0.846 – 1.562	0.1911
Anorexia	Yes	33	39				32	89			
	No	120	208	1.25	0.938 – 1.672	0.0744	99	180	0.74	0.532 – 1.043	0.0383
Weakness	Yes	20	25				15	40			
	No	133	222	1.18	0.833 – 1.688	0.1847	116	229	0.81	0.513 – 1.280	0.1790
Pallor	Yes	15	23				131	269			
	No	138	224	1.03	0.683 – 1.568	0.4321	0	0	undefined	undefined	undefined

Table 8: Bivariate analysis of socio-demographic and facility factors potentially associated with whether patients were correctly managed or not.

Risk Factor	Category	2008					2011				
		Correctly Managed	Incorrectly managed	Prevalence Ratio	95% CI	P-Value	Correctly Managed	Incorrectly managed	Prevalence Ratio	95% CI	P-Value
Lethargy	Yes	6	18				7	19			
	No	147	229	0.63	0.316 – 1.293	0.0865	124	250	0.81	0.424 – 1.554	0.2655
Type of staff who treated patient	Doctor	8	15				2	13			
	Other Health workers	145	232	0.90	0.509 – 1.605	0.3706	129	256	0.39	0.108 – 1.457	0.0511
Type of staff who treated patient	Nurse	41	84				46	42			
	Other Health workers	112	163	0.80	0.603 – 1.074	0.0658	85	227	1.91	1.465 – 2.512	0.0000
Type of staff who treated patient	Clinical Officer	104	148				83	214			
	Other Health workers	49	99	1.24	0.949 – 1.636	0.0529	48	55	0.59	0.455 – 0.790	0.0003
Preparedness for Facility to Implement Test and Treat	Minimally prepared	23	37				20	70			
	Unprepared	130	210	1.00	0.707 – 1.420	0.4912	111	199	0.62	0.410 – 0.939	0.0072

Bivariate analysis (Table 8) of whether patients presenting with fever were correctly managed or not shows that although there were some tentative statistically significant predictors of the correct management of patients with fever, namely: type of staff (nurses performed better than other staff with PR 1.9); gender (males were more often treated correctly PR 1.3); preparedness of facility to implement test and treat (strangely those attending facilities which were more prepared to implement test and treat were less likely to be correctly managed PR 0.6); type of residence (strangely those living in formal housing were less likely to be correctly managed PR 0.64); distance patient lived from facility (those living closer were more likely to be correctly managed PR 1.4) and treatment at home (those who had prior presumptive treatment at home were more likely to be correctly managed PR 1.5); none of them had high strength of association and none of the associations were consistently present in both 2008 and 2011. Hence it is unlikely that any of them were causal associations. The same scenario was present for bivariate associations for whether febrile children were tested for malaria or not and whether those who test positive were given ACT or not. Therefore it was not necessary to perform the multivariate analysis since the bivariate analysis had not showed any associations that were consistently significant in both 2008and 2011.

Discussion

1. Testing of Children with Fever for Malaria

Testing and correctly managing children with suspected malaria is a complex procedure, because it involves a series of steps that health workers must correctly perform (see figure 1 in the results section). However the availability of a RDT allows the critical first step in suspected malaria case management, of testing for malaria, to be theoretically a simple exercise. Despite this presumed simplicity, and despite health workers having been trained in RDT testing, and despite studies having confirmed that the policy of definitive diagnosis of malaria is a method that can improve rational provisional of malaria treatment and avoid exposing children to unnecessary drug reactions and guard against resistance developing to ACT (Olusimbo).

 et al., 2014; Yukich et al., 2012), the study revealed that only a little over half (55%) of all febrile patients suspected of having malaria were actually tested for malaria in 2008, and just under three quarters (74%) were tested for malaria in 2011. These low rates of testing occurred even though rapid diagnostic tests were available to clinical staff. These less than optimal testing rates for malaria, although improving over time, are of concern as testing for malaria is the first step in the process of the 'test and treat' procedure for malaria. Given that malaria is endemic in the area and that the incidence rates are high, it is imperative that all febrile children presenting to health facilities suspected of having malaria are tested. While the underlying reasons for staff failure to test for malaria were not assessed in this study, several studies have reported that the explanations that staff provided for not testing, were almost equally split between reverting to the previous policy of presumptive treatment and not presuming that the child might have malaria (Bosman & Mendis, 2007; WHO, 2006b; Lubell et al., 2008; Graz et al., 2011). The former, as discussed above in the literature review, suggests staff are still not following an established policy, while the latter could arise due to a lack of awareness of the importance of ruling out malaria as a diagnosis amongst febrile children. Alternatively the latter could have been a reasonable response if the staff member had strongly suspected some other diagnosis explaining the fever, but had not properly recorded this suspicion in the folder. These results are consistent with many other study`s results undertaken elsewhere as reviewed by Littrell et al. (2013), where it was found that blood testing for suspected malaria in children below 5 years ranged between 61%-71%. The authors note that the benefits of compliance to the test and treat guidelines outweighed the reasons advanced by the health staff for not complying. The reasons advanced by the staff were, that it was difficult to persuade health workers that RDTs were more reliable than clinical diagnosis and that some health workers did not

believe negative RDT test results and hence prescribed antimalarial treatment regardless of the test result. Hence it is clear that the WHO contention that testing before treating is important to avoid treating febrile children for malaria when they don't have malaria, and hence avoiding the twin evils of escalating resistance to ACT and potentially leaving undiagnosed and untreated a serious illness, is not resonating with many staff (WHO, 2008; WHO, 2013). Other factors that may have contributed to the slow uptake of the new 'test and treat' policy might include resistance to change. Shifting from presumptive treatment of malaria, which was the traditional practice for a long period of time, to the new test and treat policy seems to be posing a challenge on the part of health workers who got used to treating malaria based on the previous malaria treatment guidelines as the procedure probably became part of their daily routine. To abruptly change to a new practice appears to be difficult as presumptive treatment placed agency/authority and control in the hands of health workers, while the test and treat policy dilutes their agency/authority to correctly undiagnosed and treat malaria.

The study found that patients treated by nurses were significantly more likely (PR = 1,31) to be tested for malaria than those treated by other health workers. This finding, although only present in 2011 and not in 2008, implies that nurses who occupy a lower rank in terms of depth of training compared to clinical officers and doctors were more likely to follow the guidelines than the clinical officers and doctors. This finding is consistent with studies conducted elsewhere in Africa by Steinhardt et al. (2014), in Malawi and Bisoffi et al. (2009) in Burkina Faso, in which the authors found that lower level cadres of health workers are more likely to adhere to treatment procedure guidelines such as the malaria treatment one, than highly qualified ones, who may rely more on their clinical experience and intuition. The children presenting with lethargy (PR 1.43) and diarrhoea (PR 1.17) were statistically significantly associated with a higher prevalence of testing for malaria and those children who had received anti-malaria drugs at home were statistically significantly associated with a lower prevalence of testing for malaria, but none of these associations occurred in both 2008 and 2011. No other factors were associated with testing for malaria.

While the malaria testing rate is not too bad and importantly increased by a large proportion (19%) between 2008 and 2011 from 54% to 73%, gaps still exists. These gaps could be attributed to several barriers. Some prominent barriers to the test and treat policy which were identified in this study included the absence of national guidelines and job aids within the health centres. In our study only two health facilities had national guidelines and job aids displayed on the walls in the consultation rooms. These are essential documents which must readily be available to health workers for ease of

referencing when undertaking a multi-step procedure like RDT testing and interpretation of the results, especially considering that the test and treat policy was a new concept that was being introduced into the health system, that had predominantly operated on a policy polarized to the one being introduced. As an alternative to help health workers internalise the multiple steps involved in RDT testing and ACT prescription, in the absence of consistent supervision from senior health personnel, reference materials in the form of guidelines and wall job aids could and should have been provided to every health centre.

Our study revealed that only 20% of the staff had received formal training on RDT and ACT use. The first five years of the introduction of the test and treat policy was a critical learning period in which senior health workers had a duty to mentor health workers in health facilities on how to proceed with the new test and treat policy. To the contrary, our study revealed that supervision from experienced senior health personnel during this critical period was sporadic. Whether the health workers were formally trained in RDT and ACT use or not, constant supervision from senior health workers within the crucial first five years of the introduction of the test and treat policy, could have been sufficient to provide informal training to health workers in health centres. Supportive supervisory visits coupled with on-the-job training could be a suitable opportunity to display the charts at health facilities and strengthen case-management. Supervision from senior health personnel could have inculcated a sense of confidence in the learners and quicken the attainment of proficiency, as they could have repeatedly practised under observation and have had errors pointed out and immediately corrected. Proper training of health workers and equipping health facilities with the capacity to manage patients with both positive and negative RDT results are likely to motivate health worker to test patients, since they will have the capacity to treat unexpected results of non-malarial causes of fever (WHO, 2010). Although a pre RDT and ACT rollout training program for provincial healthcare worker representatives did occur at the central level, the cascade training system implemented by the malaria programme had not reached many of the health workers of the peripheral health facilities that participated in this study. Petit   (2004) criticizes this approach to training which involves dissemination of knowledge through multiple levels until it reaches peripheral healthcare workers, as ineffective, due to the dilution of key messages and its lack of continuation. A previous study conducted by Stanback et al. (2007), on the effectiveness of 'cascade training' has shown that although initially it is more cost-effective and can provide some improvements in quality of care and access, it had less impact than supportive supervision to reinforce guideline dissemination over time. The extent of provincial-level training of healthcare workers in RDT use is not known and hence it is recommended that this be reviewed prior to national scale-up of this intervention.

2. Presumptive Treatment for Malaria of Children Presenting with Fever

This study found a large proportion of presumptive treatment of malaria practices among health workers still occurred 5 years after the introduction of the 'test and treat' policy, even though RDT was available in the facilities. However this practice did decrease by 11% from 24% of children in 2008 to 11% in 2011, which might suggest a gradual phasing out of the practice is taking place. The slow uptake of the 'test and treat" policy (and the persistence of presumptive treatment) could be partially attributed to the revised WHO,(2010) guidelines, which allow prescription of antimalarials to patients for whom there is a clinical suspicion of malaria, but a negative test result. In this instance, the treatment decision depends on the health care worker`s trust in the quality of the test and fear of the implications of a missed malaria diagnosis. The implication then is that if they are going to treat for malaria anyway irrespective of what the RDT test result is (since they clinically presume the child has malaria) then they see little point in conducting the RDT test (Nanyingi, 2008; Ndyomugyenyi et al., 2007). The other challenge could also be attributed to the impact of programmes such as the integrated Management of Childhood Illness (IMCI) which in contradistinction to the test and treat policy, advocates for presumptive treatment of malaria (WHO/UNICEF, 2008). These contradictory guidelines being issued by the same global health authority unsurprisingly does not instil staff confidence in the guidelines issued by the WHO (Wijesinghe, 2011). Although the influence of the IMCI guidelines on the test and treat policy was not directly measured by this study, a quick excursion in the folders of children who were presumptively treated for malaria, revealed that IMCI danger signs were recorded in the children's' folders and hence following the IMCI guidelines might have been the basis for prescribing antimalarials drugs. It is likely that the recommendation to perform RDT/microscopic diagnosis is perceived primarily as an extra additional layer of measures rather than as a basic step in the management of a febrile child amongst a high risk population. Similar findings have been reported by Okebe et al. (2011) in West Africa who commented on IMCI programmes as influencing the smooth implementation of the new test and treat policy on children of less than five years of age, as they found that health workers are more likely to utilize the IMCI approach to febrile children. The IMCI guideline that recommends presumptive treatment of malaria in children under five years of age should be modified appropriately to include RDT, and/or parasitological confirmation of malaria, where the tools are available. The implementation of the WHO's universal parasitological confirmation of malaria as adopted by Zambia and most African countries, creates an opportunity to improve health delivery services in a more positive way by

instituting evidence-based practices.

While health workers could have heard about and agreed with the new test and treat policy, our study revealed that only a few workers were trained on RDT and ACT. The majority who were not conversant with RDT and ACT were not yet trained. Ideally, before a change of policy is undertaken, and to enhance workers` adherence to new policies, thoughtful planning and preparation of clear guidelines is required, and crucially in addition training of health workers should occur before implementation begins. The discord between rates of implementation of the new policy compared to the number of trained health workers almost certainly adversely affected the smooth uptake of the policy. In our study, only 30% of facilities had access to a written ACT policy and none had RDT job aids. This, yet again, reflects inadequate planning for the uptake of the new policy.

Although our findings revealed staff shortages in that most of the health facilities fell below the WHO and MOH recommended staffing levels of 2 doctors, 5 clinical officers, 12 nurses and 2 environmental technicians per health centre, most staff except for clinical officers had sufficient time to properly manage patients according to the test and treat guidelines, as they saw very few patients per day. The inability to test these patients despite having had sufficient contact time with them could either be attributed to non availability of test equipment, or lack of knowledge thereof. The proper management of non-malarial febrile illnesses depends highly on the availability of diagnostic facilities and professional health workers. Professional, as discussed above, in the sense that meticulous assessment in terms of history, examination and laboratory investigation should be conducted to avoid gaps in any tasks which may be detrimental to the children. Given that our study did not encounter any RDT or ACT stock outs, the inability to fully implement the test and treat policy could be attributed to lack of training on the new policy. Similar findings have been found from studies conducted by Chipwaza et al. (2014) in Tanzania and Uganda, where health workers not trained in the correct clinical assessment procedures erratically implemented the test and treat policy.

An additional barrier to fully implement the test and treat policy even among adequately trained health workers in RDT and ACT use, is the fear of false negative test results, especially in the case of children with no or little malaria immunity, and their being all too aware that delays in providing effective malaria treatment can be fatal. Because of this fear, trained health workers in RDT and ACT tend to skip the RDT test and mostly use clinical judgment to make the diagnosis of malaria. Unfortunately what mitigates against the test and treat policy is that it is indeed true that the RDT can miss true malaria positive patients, depending on RDT sensitivity which is generally 90%, and a recent study undertaken in Tanzania by d'Acremont et al. (2010) and the previous findings from Zanzibar by Msellen et al. (2009) showed that RDTs would miss some cases. However in both these

studies all missed by RDT were clinically uncomplicated malaria infections which are probably mainly low-density infections and hence most of these non–malaria-treated infections would be self limiting. Although this suggests that the adverse consequences of false negative RDTs are likely to be minimal, one should not rule out the possibility for serious malaria infections testing negative on RDT and hence clinical judgment remains paramount, however it should be used in conjunction with and not in opposition to RDTs.

In this study, 98% of children in 2008 and 54% in 2011, were managed for fever at home by caretakers, however only 4% in 2008 and 12% in 2011 received anti-malaria drugs at home respectively. The results show an eight percent increase of presumptive treatment of malaria by caretakers at home, which might imply that caretakers do not have confidence in the RDT test. The lack of confidence may arise from the substantial knowledge they have about the signs and symptoms of malaria, which they acquired from personal experience of the disease, as it has been an age-long health problem with information relating to it having been passed on from one generation to another, and/or which they acquired through informal sources that might include relations, friends and neighbours; and indeed some of them may have previously received formal training on the home management of malaria. Hence based on their perceptions that they are able to diagnose and correctly treat malaria, caretakers probably proceeded along these lines when faced with an ill child with symptoms suggestive of malaria. Also the disconnect between a RDT negative result and their own presumed diagnosis of malaria might lead caretakers to distrust the RDT test and they therefore might prefer to treat their febrile children at home with antimalarial drugs rather than taking their children to a health care facility, where malaria may or may not be diagnosed, even though they are certain the child has malaria. The implication of misconceptions about the signs and symptoms of malaria is that such people will be taking inappropriate management steps in the treatment of malaria, due partially to incorrect advice from health professionals previously, due partially to locally acquired knowledge and due partially to their own experiences (WHO, 2004).

3. **Treated for malaria with ACT after testing positive for malaria**

It is axiomatic that if a patient tests positive for malaria then one would treat them with ACT, as besides being prescribed in the malaria guidelines, it is the first-line drug to which the malaria parasite is currently susceptible. However, the results in this study revealed that only 85 % in 2008 and 72% in 2011 of those who tested positive for malaria were given ACT, with the rest receiving either less effective antimalarials (9% in 2008; 2% in 2011) or some other medication which is not effective against malaria (6% in 2008; 26% in 2011). Therefore a large minority of children with

malaria did not receive the best antimalarials medication, ACT, and an even larger minority of them did not receive any antimalarials, thereby placing young vulnerable children in danger of developing complications of malaria, while an excellent efficacy and side effect profile drug exists. Of more concern is that the proportion not treated with ACT rose between 2008 and 2011, and even worse the proportion not treated with any antimalarial increased dramatically between 2008 and 2011. The reason for withholding ACT from patients who tested positive for malaria is unclear, considering that no ACT stock outs were reported. Although drug stocks assessment were not part of the study objectives, a quick excursion through the drug records showed that stock-outs were rare, as health centre records indicated that 92% of prescribed antimalarials were dispensed by the health care facility in 2008 and 99% were dispensed in 2011. The rise in the proportion of antimalarials dispensed from 2008 to 2011 is likely in large part due to changes in how medications were delivered to the health centres. Beginning in mid-2008 the national Zambia Medical Stores began delivering medications directly to health centres (bypassing the District Health Offices) as part of a comprehensive effort to streamline the supply chain. This system has reduced the frequency of stock-outs (MOH, 2010). The most likely explanation for this incorrect treatment of malaria enigma, in the absence of a logistical problem, could be difficulties in the translation of ACT policy to ACT prescribing practices. However only a minority of those treated with medication other than ACT actually received antimalarials, so this does call into question the ability of all types of health staff to properly treat malaria. Staff composition of different cadres at health facilities possessing varying qualifications, experience and expertise in treating patients could contribute to hesitation to prescribe ACT to deserving patients. These findings are consistent with other studies conducted elsewhere in Africa where it was found that different staff possessed unique ways of acting on knowledge acquired in training, which was reflected by different abilities in prescribing practices between nurses and clinical officers or physicians (Ucakacon et al., 2011). Our results revealed that 22% of the nurses and 78% of the clinical offices in 2008 and 40% of the nurses and 60% of the clinical officers in 2011 were able to conform to the new malaria test and treat policy respectively. This is probably because in Zambia, clinical officers` (a category of health staff with 3 years of medical training) are formally trained to prescribe certain category of drugs just as doctors do. . They perform 50-80% of what is traditionally considered to be doctors' work. Which includes prescription of medication, whereas the nurses only prescribe medication due to a shortage of clinicians, and this is not primarily their role. Our findings however contrast with findings from the study by Zurovac et al. (2004) in Kenya, in which the authors found that nursing aides who are considered less trained, adhered much more closely to treatment guidelines than nurses and clinical officers. Given the prevailing health worker

shortages as compared to the Ministry of Health staff establishment at different health facilities, it would therefore be critical to ensure that all cadres of staff are trained on such new treatment policies to ensure that these skills are provided to all members of the team who may take on key prescribing responsibilities. Furthermore, a similar study in Uganda revealed, that the composition of staff at different clinics, who also possessed different qualifications and skills, was a barrier to prescribing ACT to deserving candidates and a study in Kenya showed that ACT was prescribed to 90% of patients with uncomplicated laboratory-confirmed malaria in health facilities with both ACT and diagnostic testing in stock (Yandigisi et al., 2011). Other studies conducted across Africa had revealed that there had been difficulties in appropriate ACT use rates. The rates ranged from 22% to 76% (Zurovac et al., 2005; Abdelgader et al., 2012).

In addition, local antimalarials prescribing culture at each clinic could have also played a role. Certain clinics for example, had higher rates of failure to appropriately prescribe ACT, but the reason for this discrepancy is uncertain. This study therefore, similar to other studies in Africa, has shown that despite having had recorded a high rate of appropriate ACT use, a minority of children with malaria did not receive the best antimalarials medication, ACT, and an even larger minority of them did not receive any antimalarials, thereby placing young vulnerable children in danger of developing complications of malaria, while an excellent efficacy and side effect profile drug exists. Correcting this practice will be of great importance in the fight against malaria.

In the analysis of whether those tested positive for malaria and given ACT compared to those tested positive for malaria and were not given ACT, it was found that patients who lived in formal housing and those who lived within the radius of less than 1km from the health center in 2011 were significantly more likely not to be given ACT despite having tested positive for malaria (PR=0.57) (PR=0.70) respectively The significance of these results are not clear because this study did not measure this, but on speculation it could be that perhaps the health workers thought that those who live in formal housing would be less likely to have malaria because the houses they live in are typically built according to a design that allows less entry points for mosquitoes. Moreover, health workers would have known those people living close by would probably have been beneficiaries of 'Long Lasting Insecticide Treated Nets' though its correct and consistent use is not guaranteed.

Accessing correct, prompt and effective malaria treatment must not be dependent on the patients` type of residence, formal, informal or traditional, nor on the distance the patient covers to reach the health facility, but it must rather be based on malaria test results according to the test and treat policy. The barriers to prompt and effective malaria treatment among the population perceived to be poor in Zambia highlighted in this study, are consistent with other studies conducted by Chuma et al (2010)

in Kenya and by Silweya & Baboo, (2013) in Zambia. These studies found a wide range of interconnected factors at both household and at health system levels. At household level the studies found that poverty forces people to live in informal houses which predispose them to mosquito bites and hence a high likelihood of getting infected with malaria parasites and their lack of means of transportation to cover long distances to reach the health facilities is a barrier to accessing health care services. Similarly at health system level drug stock outs, low staffing levels and lack of appropriately trained staff to treat patients were noted to influence access to early and efficacious malaria treatment in children under five years of age (Chuma et al, 2010); Silweya & Baboo, 2013)

Further analysis of the risk factors that influenced ACT prescription to patients who tested positive for malaria were found to be whether the child was treated at home or not and if treated at home whether the child received malaria drugs or all treatments. It was found that children who were treated at home were significantly less likely to receive ACT despite having tested positive for malaria in 2008. Although the reason to withhold ACT treatment to patients who tested positive for malaria regardless of having had received malaria drugs at home was not explored in this study, other studies conducted in Sub Saharan Africa suggested that some health workers reported that they were told to rule out other causes of fever before prescribing ACT even if the RDT was positive. Given this background, perhaps the reason why these children still tested positive for malaria regardless of having received antimalarials at home is that children could either have been given the wrong medication or else leftover (and likely date expired) antimalarials drugs in sub-curative doses. This assertion is affirmed by studies conducted by Wijesinghe et al, (2011) in the Solomon Islands. The authors found that the potential public health benefits of the introduction of free, efficacious ACT in the Solomon Islands would not be realized if patients did not adhere to treatment regimes or self-medicate with sub-curative doses.

When health workers focus on the results of malaria testing and forget about other causes of fever, there is a possibility of missing and not treating potentially serious infections with dire consequences to the health of the patient. The World Health Organization has noted that malaria symptoms resemble those of other diseases with fever as the cardinal symptom WHO, (2013). It is therefore important for supervisors and mentors to emphasize to health workers the need for thorough assessment of the patient to identify other possible causes of fever, or even the presence of co-morbidities. Besides malaria case-management training of health workers in Kenya, trainers also included a portion of training on assessing and treating children with fever. The aim of this training was to prepare health workers to deal with other causes of fever than malaria Njogu et al, (2009). A recent qualitative study in Ghana by Ansal et al., (2013) showed that patients expected RDTs to

diagnose not only malaria, but any cause of their illness and were disappointed when told they were negative for malaria without an alternative diagnosis.

The second set of reasons for non-adherence to ACT prescription after a positive RDT related to more general health system factors, particularly the workload of health care staff. Although respondents from all the studied health facilities claimed low staffing levels compared to the Ministry of Health staff establishment, the workload as measured by this study did not reveal critical staff shortages. Elsewhere in Zambia however, according to the Ministry of Health, the issue of staff shortages especially nurses and doctors has been documented (MOH, 2004). This has resulted in unskilled staff such as clerks, nursing aides, community health workers, environmental health officers and laboratory technicians working beyond their normal level of competency. The probable explanation for non adherence to the test and treat policy in the wake of acceptable workloads could be attributed to a low level of preparedness to implement the new policy.

Although the reasons for ignoring malaria positive results were quite extensively explored above, a number of other factors that could potentially be involved include home management of malaria, type of treatment given at home, severity of illness, type of health worker cadre and prescribing culture. For those febrile children who were given antimalarial drugs at home, before being brought to the health care facility health workers could have withheld ACT treatment, despite a positive malaria test, in order to avert drug overdosage if it were ACT that was administered at home, and/or adverse drug interactions if other antimalarial drugs were given. The other plausible explanation could be that children who presented with severe illness might not have been given ACT because the child would either not retain or fail to swallow the drug and/or were rushed to a second level health facility care for full parenteral treatment and supportive care.

Concerning health worker cadres, the study revealed that 22% of the nurses and 78% of the clinical officers in 2008 and 40% of the nurses and 60% of the clinical officers in 2011 were able to conform to the new malaria test and treat policy. The health care facilities are composed of different cadres who possess varying qualifications, experience and expertise in treating patients. These attributes may influence prescription practices regarding administering ACT to deserving patients because of the limited sphere of practice of each cadre type. Besides the doctor, other health worker cadres, in line with treatment guidelines, may not give certain drugs to severely ill patients as they require second level care, due to their illness severity. Given the prevailing low staffing levels at health facilities as provided for by the Ministry of Health staff establishment, it would therefore be prudent to train all health cadres in emergency care provided at second level health facilities and develop flexible treatment guidelines. These findings, contrast with those from the study by Zurovac et al.

(2004) in Kenya, in which the authors found that nursing aides who are considered less trained, adhered much more closely to treatment guidelines than nurses and clinical officers. These findings are consistent with other studies conducted elsewhere in Africa by Ucakacon et al., (2011), where it was found that different staff possessed unique ways of acting on knowledge acquired in training, which was reflected by different abilities in prescribing practices between nurses and clinical officers or physicians.

In addition, local antimalarials prescribing culture at each clinic could have also played a role. Certain clinics for example had higher rates of failure to appropriately prescribe ACT, but the reason for this discrepancy is uncertain. The other likely explanation for this incorrect treatment of malaria enigma in the absence of a logistical problem could be difficulties in the translation of ACT policy to ACT prescribing practices. Other reasons to withhold ACT to patients who tested positive for malaria remain unresolved considering that no report on ACT stock outs was reported. Although drug stocks were not part of the study objectives, a quick excursion through the drug records showed that stock-outs were rare, as health centre records indicated that 92% of prescribed antimalarials were dispensed by the health care facility in 2008 and 99% were dispensed in 2011. The rise in the proportion of antimalarials dispensed from 2008 to 2011 is likely in large part due to changes in how medications were delivered to the health centers. Beginning in mid-2008 the national Zambian Medical Stores began delivering medications directly to health centers (bypassing the District Health Offices) as part of a comprehensive effort to streamline the supply chain. This system has reduced the frequency of stock-outs (MOH, 2010). However, as noted above, only a minority of those treated with medication other than ACT actually received antimalarials, so this does call into question the ability of all types of health staff to properly treat malaria.

4. Treated for malaria with ACT after testing negative for malaria

Adherence to results of diagnostic tests means that health workers should treat with antimalarial drugs those patients whose results are RDT positive and not treat with antimalarial drugs the patients whose RDT results are negative. While adherence to the test and treat policy directive to withhold malaria treatment from patients with a negative RDT/blood slide result, could prevent a significant amount of overtreatment without significantly increasing the risk of missing true malaria cases, it is a common phenomenon to encounter health workers who are not keen to desist from treating malaria even after a negative test (Njama-Meya et al., 2008). Furthermore, it was envisaged that compliance with test results would be outstanding, because not only have studies shown that RDT is almost as good as blood slide tests in detecting malaria infection, but also that RDT can be performed by the

health workers themselves, and hence the results are rapidly available. Non-adherence to test results could either be due to uncoordinated formal and informal RDT and ACT use training and experience and/or erratic supervision, or prior training which led to an overemphasis on malaria, and limited capabilities to make alternative diagnoses. While the above are plausible, the uncomfortable truth is that given that false negatives occur both in RDT and blood slide tests, clinicians would always be concerned that their patients have malaria even though the tests state otherwise and hence they would feel compelled to treat them for malaria.

Similar findings have been reported in Tanzania by Chandler *et al.* (2008). In the study justifications given for treating patients with negative results were based on inadequate training in RDT and experience of following the previous guidelines on the use of antimalarial drugs. Other studies conducted in Nigeria by Uzochukwu (2011) and Derua et al. (2011), found that while health workers reported that RDT results were reliable, very few used them in case management, leading to over-prescription among RDT-negative patients. These findings demonstrate that achieving compliance with this policy is obviously challenging. Similar findings were reported by Msellem et al., (2009) in Zanzibar in which the authors noted that one of the reasons why health workers prescribed antimalarial drugs despite a negative RDT result, especially in the case of subjects without or with little malaria immunity, was fear of a fatal outcome in a case of missed diagnosis of malaria arising from a false RDT negative result. Noting the above the WHO issued new guidelines in 2010 which acknowledged false negatives when testing for malaria and hence the guidelines (as noted previously), now advises clinicians to use clinical judgement as to whether antimalarial drugs should be prescribed after a negative test, provided the patient is a resident in a malaria endemic region and presents with fever or a history of fever in the last 24 hours (WHO, 2010). Another reason for prescribing antimalarials even though patients test negative for malaria, is possibly because caregivers, who might have convinced themselves that their child has malaria, demand that the clinician prescribe anti malarials. Occurrences of this have been found by Hopkins et al. (2007) in a case study conducted in Kenya, where caregivers' demand from the health care provider to prescribe antimalarial drugs for their children, influenced the better judgement of health care providers despite a negative malaria test.

5. Correctly managed after testing negative for malaria

Other results worth noting in our study were the lack of enthusiasm on the part of the health workers to further investigate the cause of fever for those children who tested negative for malaria, in the midst of the robust IMCI strategy which could have been used to conduct a thorough health

assessment. Only a small proportion of patients who tested negative for malaria were further investigated to establish the cause of the fever and disappointingly this proportion decreased over time by an absolute amount of 25% within 3 years (36% in 2008 and 11% in 2011). The reasons for the inertia and reluctance to institute further investigations of the cause of the fever in those who tested negative for malaria, could be attributed to various factors. One of the likely factors is that prior training and experience might have laid an overemphasis on malaria and limited the staff's capabilities to make alternative diagnoses. Similar findings have been reported in Tanzania and in Cameroon by Chandler et al., (2008) where justifications given for prescribing antimalarials to patients with negative test results, were based on the belief of health staff that clinical acumen should over-ride test results.

Generally stocking health facilities with the necessary equipment enables health workers to undertake complex medical tests and provide appropriate treatment. Only 2 out of 10 health facilities sampled in this study had a mini-laboratory with trained laboratory technicians. This means that only 2 health facilities could perform other laboratory test for infection such as urinary tract infection investigations. Besides the lack of appropriate equipment in health facilities, proper management of non-malarial febrile illness is also dependent on the capacity of the staff to perform accurate diagnosis and treatment of other febrile illnesses. In the absence of laboratory equipment and varied clinical diagnostic ability, health workers have limited capacity to deal with further investigations after negative RDT results in patients. Staff shortages would impact on the ability to perform detailed clinical assessments fater negative tests for malaria and this was the case in a study in Eastern Tanzania by Chipwaza et al., (2014), however in our study the measured clinical workload was within manageable ranges.

6. Correctly treated for Malaria despite not receiving ACT

As indicated above, during the time of study, the ministry of health had put in place a robust mechanism to avert ACT, RDTS and other drug stock outs. Conversely, in spite of the availability of ACT drugs in all the health facilities which were selected for the study, some patients who tested positive for malaria were either given quinine or fansidar. Although the reasons for failure to prescribe ACT to deserving patients were not explored in this study, this might be because staff prefers other drugs, or some patients had contraindications to ACT, or some had severe malaria. If staff preferred other drugs other than ACT, then it was a misplaced preference because in 2008 and 2011 when this study was undertaken, fansidar was no longer a drug of choice for treatment of malaria, due to widespread resistance to it. Although the study revealed that only two patients out of

190 (1%) were given fansidar in 2011, there is no justification to put patients in a precarious situation by denying them appropriate treatment. Giving patients drugs which are not effective while the effective one exists and is available, creates doubt as to the abilities of the practitioners, taking into consideration that malaria disease can easily progresses to fatality in children under five years, when effective treatment is delayed. Plausibly, the reason to give fansidar was due to a contraindication to ACT, though this concern was not noted in the patients` folders. It is worthwhile for practitioners to document such occurrences to support their decisions. Similarly, there was no clear documentation to show that the patients had any contraindication to ACT in the folders of the seven patients (3.7%) who were given quinine (a second line drug) in 2011, though deciphering from the brief patient notes in the folders there were suggestive signs of severe illness and possibly this is why quinine was given. However the guidelines for severe malaria (WHO, 2008) states that; "patients suffering from severe malaria presenting at the peripheral level of the health system should be provided pre-referral treatment with quinine and transferred to a health facility where full parenteral treatment and supportive care can be given" and since there were no documented referral notes to a second level facility in any of the reviewed medical records of patients who received quinine at the health center, this casts doubt on the appropriateness of the prescription of quinine. Health staff are also (or should be) aware that severe malaria, due to its poor prognosis, should be treated parenterally with either an Artemisinin derivative or quinine at the second level facility. Lack of evidence that the patients who received quinine were referred to a second level health care facility would on balance, imply that probably the staff had their own preference for treating with quinine, presumably based on clinical judgment, rather than treating with it based on the severity of the malaria.

7. Correct Management of patients presenting with Fever in a Malaria Endemic Area

The univariate analysis result of proportion correctly managed presented in table 5 revealed that 38% of all patients presenting with fever in a malaria endemic area in 2008 were correctly managed compared to 33% in 2011, representing a 5% decrease in patients correctly managed over a period of 3 years. This is not due to health workers resisting relinquishing presumptive treatment as presumptive treatment actually dropped from 24% in 2008 to 11% in 2011. Hence this finding cannot be explained by ongoing attachment of staff to the policy of presumptive treatment which they have practiced for decades and is contrary to the finding by several other studies, which found that health workers continued to resist relinquishing presumptive treatment long after the new test and treat policy was introduced (Bisoffi et al., 2009; Msellen et al., 2009; Sayang et al., 2009). Bivariate analysis (Table 8) of whether patients presenting with fever were correctly managed or not shows that

although there were some tentative statistically significant predictors of correct management of patients with fever, namely: type of staff (nurses performed better than other staff with PR 1.9); gender (males were more often treated correctly PR 1.3);   preparedness of facility to implement test and treat (strangely those attending facilities which were more prepared to implement test and treat were less likely to be correctly managed PR 0.6); type of residence (strangely those living in formal housing were less likely to be correctly managed PR 0.64); distance patient lived from facility (those living closer were more likely to be correctly managed PR 1.4) and treatment at home (those who had prior presumptive treatment at home were more likely to be correctly managed PR 1.5), none of them had high strength of association and none of the associations were consistently present in both 2008 and 2011. Hence it is unlikely that any of them were causal associations. The main reasons for not correctly managing patients with fever were that a large proportion of patients were not tested for malaria (however this decreased from 2008 to 2011) and that patients who tested negative were thereafter not properly managed, with this group increasing between 2008 and 2011. This suggests that the focus on the test and treat policy is yielding a positive result, in that a greater proportion are being tested for malaria, however staff are less certain how to manage those children who test negative, highlighting the lack of emphasis in the guidelines on how management should proceed if a patient tests negative. Steinhardt et al. (2014) in a study in Malawi found that lower-level cadres of health workers are more likely to adhere to guidelines but were uncertain how to proceed in instances not covered in the guidelines. This finding has important implications for training/refresher training, enhanced supportive supervision and feedback sessions to improve health workers performance and increase health workers confidence in febrile assessment and case management.

8. Malaria treatment at home.

The results of the study on whether the child was treated at home or not revealed that in 2008 almost all febrile children (98%) were treated at home, but by 2011 this had dropped to 54%. This suggests that the need to test for malaria before treating for it has filtered through to the general public. However while the proportion of febrile children treated at home has decreased the proportion treated with antimalarials has increased from 4% in 2008 to 12% in 2011, suggesting that despite the test and treat policy being in place and hence the presumption that antimalarials would over time become less easily available, antimalarials have over time probably become more easily available. The persisting high percentage of children treated at home for fever suggests that the 2011 WHO policy brief on malaria which advocates that community case management of malaria be maintained but that

community members should be trained in the use of RDTs and ACT, should be easy to implement (WHO, 2011).

Besides most of the caregivers in high malaria transmission regions being trained on signs and symptoms of malaria and having been previously permitted to presumptively treat febrile children with chloroquine, these people have had personal experience of the disease in their lifetimes. Over the years they have learnt the signs and symptoms of malaria through personal experience, from friends and relatives and have nursed febrile children before. In addition, they are also traditionally inclined to treat febrile children at home using a tepid sponging method and or giving available medication including orthodox and herbal preparations and therefore it is not surprising that most caregivers opted to treat their febrile children at home. Also the Ministry of Health in line with the WHO global malaria programme recommendations to make available ACT at community level, could have worked in collaboration with other cooperating partners to train some caregivers in the communities in RDT and ACT use. In addition, the WHO recognises Community Case Management of malaria as the service delivery point, which implies that, caregivers who are able to somehow purchase ACT would administer it to febrile children. This could explain the paradigm of rising antimalarial drug use when it should not be available. These findings are consistent with the study conducted by Akweongo et al. (2011) on community case management of malaria in five African sites. The authors found that most respondents followed a sequence of health seeking behaviour which ranged from seeking the opinion of spouses and elderly relatives to treating febrile children using the tepid sponging method and administration of available herbs and drugs, before finally taking the child to a health facility if these measures did not yield the desired results (Akweongo et al., 2011).

9. Preparedness of Facilities for test and treat management of malaria

A number of components are required to be put place before a facility can be declared to be properly and fully prepared to implement the test and treat management of malaria. These components include availability of ACT and RDT wall charts in consultation rooms, availability of treatment guidelines, trained and adequate staffing levels, manageable workloads and regular supportive supervisory visits by District Health Management staff to health facilities. Our study revealed very low preparedness of facilities for implementing the test and treat management of malaria, with only 4 out of 10 health facilities being adequately prepared. Adequate contact time with patients is essential for improved health care delivery. Children present with a myriad of often overlapping sign and symptoms for which it is difficult to clinically come up with a definitive diagnosis. Because of this challenge,

clinicians should spend adequate time with their patients to enable them to carry out a systematic and careful examination. Corresponding to the reported staff shortages, all health facilities indicated that they had decreased contact time with patients'; however the workload for all categories of staff, as measured by patients seen per staff member per day, was not excessive, calling into doubt the claim of a lack of time to attend to patients. Decreased contact time between clinician and patients, if it is truly present as claimed by the facilities, could lead to omission of critical clinical procedures such as testing febrile children for malaria. It also implies a higher likelihood of provision of mediocre health care, which may lead to adverse consequences for the patients. In addition to inadequate contact time with patients, all facilities reported that they turn some patients away without attending to them. It means that these patients did not even have an opportunity to have the little contact time with health care providers that their counterparts had. These findings are consistent with a study done by Rowe et al. (2005) who found that poor health workers practices, defined as adherence to an accepted standard or guidelines, contributed to low use of health facilities by vulnerable populations and ultimately to premature death of patients, even though health interventions existed which could have saved them.

In addition to decreased contact time between clinicians and patients, the study revealed that only 3 out of 10 and 2 out 10 health facilities had at least one nurse and one clinical officer trained on test and treat procedures, respectively. Although health workers were qualified in their respective medical and health related courses, it is a good practice for the health authorities to formally provide update training of health staff through seminars and workshops, or whichever method of training they may find befitting. It could have been assumed that with the passage of time and with repeated practice, staff would informally acquaint themselves with the new drugs and the new procedures, but Rowe et al. (2005) argued that, correct knowledge without training does not always predict correct performance. The authors explained that, the practices of health workers are influenced by many dynamic factors such as knowledge, skills, remuneration, experience, fear of a bad outcome, health workers` confidence, severity of illness, patients` demand, attitudes of co-workers, personal values, patient caseloads, societal values, supervision provision and the prevailing health system. As health workers are faced with these situations, they constantly try to adopt their practices to satisfy professional values and personal goals. Therefore, even if health workers are taught new guidelines and comprehension is perfect, they probably do not simply replace their pre-existing individual policies with new guidelines, but rather modify their practices to incorporate either none, some, or all of the new guidelines. As a consequence, the authors concluded that "correct knowledge may not predict correct performance" (Rowe et al., 2005). The implication is that, if health managers want to promote certain practices, such as those in the new guidelines, they need to understand the existing

and often evolving influences and be adept at using their resources to alter environments to promote the desired practices.

Other studies have revealed that good performance in any setting is dependent upon training, supervision and feedback. A systematic review study conducted by Ruizendaal et al. (2014) on success or failure of critical steps in community case management of malaria with RDT tests, revealed that community health workers with varied training periods which ranged from 6 hours to one month in different settings, performed differently, according to the period of training and intensity of supervision. Those with one month of training and with regular supervision and feedback performed far much better than those with a shorter training period and with irregular supervision on RDT and ACT use (Ruizendaal at al., 2014). These findings underscore the importance of training and regular supervision. According to Rowe et al. (2005), supportive supervision improves health workers` knowledge and skills, motivates them through praise and models correct practices which heath workers are then likely to emulate. Furthermore, supportive supervision provides professional development and improves health workers` satisfaction (Rowe et al., 2005). Our study revealed that 8 out 10 health facilities were supervised on a quarterly basis. Though supervision may seem adequate based on its frequency, it is worth noting that most of the health workers who were supervised did not get formal training on RDT and ACT use. This study did not however measure the package of supervision that was supposed to be provided and in particular whether it involved on the job training on test and treat, or not. Indeed, supervision, depending on its form, may elicit hostility from subordinates since they might view supervisors as critics or even 'examiners'. This assertion is consistent with a study conducted by Rowe et al. (2005), who found that one of the reasons supervisors faced hostilities from their juniors was because supervisors criticized their work even though they had no prior demonstration by their superiors on how to correctly perform it. The authors further advised that supervisors should create and maintain good interpersonal relationships if they are to earn respect from their subordinates.

10. Symptoms that patients with suspected malaria presented with

All children suspected of having malaria who were included in the study had fever as the common denominator. Other associated signs and symptoms included diarrheoa, vomiting, anorexia, weakness, pallor and lethargy. However, the results showed that these signs and symptoms were an unreliable indicator of children having had malaria, because despite having presented with the symptoms above, it did not necessarily mean the presence of malaria parasitaemia, as most children (62%) tested for malaria, in fact tested negative.

These results reaffirms that malaria has indistinguishable clinical presentations from other infections, making it difficult to clinically differentiate it from conditions such as pneumonia and other bacteraemias. These findings are consistent with a study conducted by Hogh et al. (1995) in which they found that clinical diagnosis of malaria, especially in children aged less than five years old, had a poor diagnostic accuracy and a low positive predictive value, because symptoms and signs are variable and can easily be imitated by other infectious and non-infectious diseases. Therefore, reliance on signs and symptoms for diagnosis of malaria can greatly mislead clinicians into treating for malaria, when in reality the child has another infection. This is of importance as these signs and symptoms are often used to diagnose malaria, as noted in a study in The Gambia, where fever or history of fever presenting with either diarrhoea, anorexia, pallor, lethargy, vomiting, and inability to feed, were often used by health workers as a basis for treating malaria (Olaleye et al., 1998). In recent years, based on common and divergent findings, the WHO informal consultation on fever management, global review of evidence and practice, has published emerging evidence on aetiologies of fevers in children aged less than five years. The report stated that between 47% to 84% of fever is due to malaria, 9%-23% of fevers is due to acute respiratory infections, 9%-23% is due to gastroenteritis, 1% is due skin infections and less than 1% is due to meningitis (WHO, 2013).

11. Overall implementation of the Test and Treat policy

Five years after the introduction of the test and treat policy, despite the lack of the universal displaying of wall charts in consultation rooms, less than optimal coverage with in-service training of health workers in RDT and ACT use, irregular supervision from the District Health Office, inadequate staffing levels as per the Ministry of Health staff establishment and the low level of preparedness of health facilities to implement the test and treat policy, the overall use of RDT and ACT has mostly prevailed in the health facilities. Although RDT and ACT use prevailed, the overall outcome has not been impressive. The existence of these gaps means that the mechanism to effectively implement the test and treat policy was incomplete. This could explain the reason why malaria testing rates were low and presumptive treatment still existed. This argument is supported by the national-wide research on health workers` adherence to RDT test results in children aged five years or less, conducted by Manyando et al. (2014). The authors found that four years after the Ministry of Health revised the national guidelines to mandate parasitological and/or RDT results before treating for malaria (MOH, (2010), and nine years after the introduction of the new test and treat policy, only 84% were tested and 69% of RDT negative children received antimalarials drugs. The non-compliance to RDT results was attributed to mistrust of RDT results, ill preparedness for

implementation of the test and treat policy and the influence of the IMCI guidelines. The authors noted that the high levels of non-compliance with RDT results and the persistence of malaria clinical diagnoses with antimalarials prescription were observed in all districts in Zambia despite varying malaria prevalence. They concluded that in areas of high prevalence, where clinical diagnosis may be a marginally more effective predictor of malaria infection, this practice would hardly raise concern, however, in areas of low prevalence concerns arise, because the probability of fever being due to malaria infection is low and the probability of the fever reflecting other childhood illnesses such as pneumonia, ear, nose throat and gastro intestinal infections is correspondingly higher. Therefore clinically attributing the cause of fever as malaria not only leads clinicians to misdiagnosis, but also to missed opportunities to investigate and treat children for other childhood illnesses (Manyando et al., 2014).

The impact of the effective provision of test and treat training cannot be predicted in this study, since details of the type of training delivered to health workers and the quality of supervision was not measured. However, Hill et al. (2014) asserted that improving supervision quality has a greater impact than increasing the frequency of supervision alone. The authors further observed that supportive supervision, community monitoring, quality improvement and promoting problem solving approaches, show the most promise. Hill et al, (2014). It is from the affirmation by Hill et al. (2014) that we assume that perhaps if the quality of supervision, though irregular, was combined with a problem–solving approach, health workers might have undertaken complex procedures in the absence of formal training.

Limitations

The study sample did not include those medical records of children of five years and younger who received their treatment entirely in the private sector and hence the results are only applicable to public health facilities. Private clinics are autonomous (although also subject to governmental guidelines) and hence their adherence to the 'test and treat' policy may be lower than in the public sector.

The selection criterion of including only those with a temperature of 37.5 degrees Celsius and above, could have excluded some cases eligible as "suspected malaria", as malaria infection can present with normal body temperature and non-specific signs and symptoms, such as poor appetite, restlessness, cough, diarrhoea, malaise and apathy, Ministry of Health (2010a). However including these cases would have made the inclusion criteria too broad and risked including many cases that were not true "suspected malaria" cases. In several of the medical records there was scanty information on the

medical history of patients and the physical examinations conducted on the patients to rule out other ailments. Additionally in many records, results of investigations and tests conducted were either missing or not documented. This missing information made it difficult to assess how children with suspected malaria were treated. Another limitation worth noting was that the data extraction form did not have a provision for recording the usage of other antimalarial drugs such as quinine (a second line drug) and/or fansidar (an outdated medication). However during data collection we noted that some health workers prescribed quinine, while others still prescribed fansidar and therefore we added this variable to the data extraction form soon after data collection began and then back checked the records we had already extracted data form. Furthermore, we noted in passing that many records that we reviewed revealed that the 'Integrated Management of Childhood Illness' (IMCI) approach (which is an approach intermediate between "presumptive treatment" and 'test and treat' in that it limits presumptive treatment to those who by clinical criteria are at higher risk, rather than treating all cases with fever as malaria [see appendix 8]) to treatment of febrile children, was widely practised, but we unfortunately did not formally collect this data. Therefore, although we were able to document what proportion of children were handled with the 'test and treat' approach, it is incorrect to assume that the rest all received "presumptive treatment", as they may have been assessed via IMCI (although the extent of this IMCI management was not measured), or they may not have been managed as a suspected case of malaria. This limitation is minor though, as the 'test and treat' approach is much more advantageous than IMCI, although IMCI is better than "presumptive treatment", WHO/IMCI, Adaptation Guide (1992) Adaptation Guide.

While it might appear that a serious limitation regarding IMCI is that we did not assess the patients' records to determine whether IMCI guidelines were used in their management or not, this is not the case. It is not an omission as the IMCI guidelines require that the management of febrile cases be done in virtually the same way as the 'test and treat' policy (IMCI guidelines require febrile children to be tested for malaria and for those that test positive for malaria to be given given ACT) except that it allows treatment for malaria even if the test for malaria is negative. However in this study treating for malaria even if the test for malaria is negative was accepted as 'correct management' hence all of the study outcomes were congruent whether patients were treated via 'test and treat' policy or via IMCI guidelines. That said it would however have been useful to determine what proportion of the patients that were correctly managed were treated via IMICI versus 'test and treat' even though it was not an objective of the study (as IMCI guidelines were supplanted by the revised 'test and treat' policy in 2010), since the literature shows that it is the misinterpretation of IMCI guidelines which pushes clinicians to continue presumptive treatment (Ministry of Health(2015)Guidelines for

diagnosis and treatment of malaria in Zambia, Fibir et al (2015. Hence those who manage children via IMCI might be more likely to end up providing presumptive treatment (if a large proportion of them misinterpret the IMCI guidelines) than those who manage children via the 'test and treat' policy.

Another limitation was that the staff and facilities were assessed currently (2013) and yet the outcome data (percentage correctly using 'test and treat') is for 2008 and 2011. Therefore, the current staff and facility data might not be directly linked to the previous outcomes, however they would be, if patterns of staffing and facility management practices have not changed in that time period. From personal experience of working within the public health department I can confirm that it is implausible (but not impossible as I do not have the data available to back-up this assertion) that staffing patterns and facility management practices changed within this time period. We had intended to compare adequately prepared facilities to those inadequately prepared to implement the test and treat guidelines in the bivariate analysis, however none of the facilities were adequately prepared and therefore we had to instead rely on the weaker comparison of 'minimally prepared' facilities against unprepared facilities.
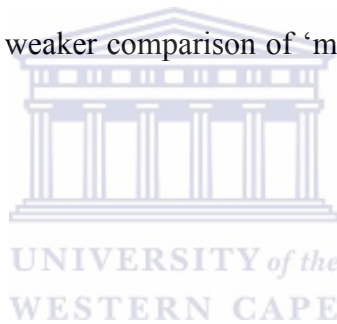
Conclusions

Although testing for malaria was quite low the prevalence increased by 19% between 2008 and 2011, rising from a malaria testing prevalence of 55% in 2008 to 75% in 2011. Presumptive treatment of malaria still existed 5 years after the introduction of the 'test and treat' policy, though a gradual decrease was noted with the percentage changing from 24% in 2008 to 11% in 2011. However sub-optimal treatment with ACT of those who tested positive for malaria was noted and this percentage had decreased between 2008 (85%) and 2011 (72%). Very few patients who presented with fever were correctly managed and this percentage had also decreased between 2008 (38%) and 2011 (33%). No factors assessed in this study were found to be consistently associated in both 2008 and 2011 with either testing for malaria, or treating confirmed malaria cases with ACT, or managing patients with fever correctly. Home management of fever was still being practiced on a large scale. The majority of the selected health facilities were ill-prepared for implementation of the test and treat policy.

Recommendations

- In order for health workers to correctly perform the RDT test (or microscopy) and to appropriately act on its results (whether positive or negative), which involves a series of complex steps, they ought to be formally trained, mentored and constructively supervised.

- Health facilities should be adequately equipped to enable health workers to implement the 'test and treat' policy and to investigate other causes of fevers in RDT negative patients. Things that are required for a health facility to be "adequately equipped" include all those shown in table 4.

- The factors associated with whether clinical staff properly implement the test and treat policy should be further investigated and since we have shown that they are likely to be a complex mix of interacting factors (such as whether the use of IMCI guidelines promotes presumptive treatment of malaria due to potential misinterpretation of the IMCI guidelines), they are more likely to be unraveled by a study using a qualitative methodology.

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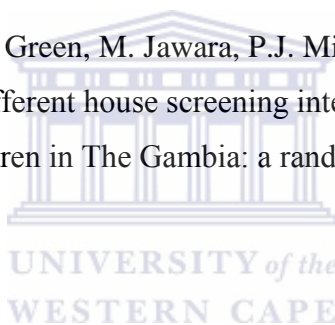
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Appendix 1

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INFORMATION SHEET

Project Title: Assessment of the clinical management of children suspected of having malaria in Lusaka District, Zambia.

What is this study about?

This is a research project being conducted by **Evans L. Mwale** at the University of the Western Cape. We are inviting you to participate in this research project because your health facility has been randomly selected to be part of a study sample and we need to interview you as the health facility manager and or health facility worker. The purpose of this research project is to **improve quality of malaria diagnosis and treatment and strengthening the health care system. I**nformation will be shared with medical practitioners in the quest to achieve high quality level of management of children suspected of having malaria.

What will I be asked to do if I agree to participate?

Two different questionnaires seeking to collect different information will be administered to health facility managers and health workers of the selected health facilities. Health facility mangers will be asked to provide information on staffing levels, frequency of district health official supervision and the quality of medical management provided to children suspected of having malaria. Health workers will be asked to provide information on their period in months or years they have worked at the health facility and information pertaining to training received in rapid diagnostic tests and or microscopy test and ACT treatment, and the need if any, for further training or refresher courses on rapid diagnostic test and ACT prescription and administration to children suspected of having malaria.

Health staff will provide responses to questionnaires at the health facility premises during working hours. Filling out questionnaires is expected to last up to 30 minutes or less as there are only 5 questions for health facility managers and 7 questions for health workers respectively.

Following health managers` and workers` interviews, research assistants will seek permission from the health managers to review medical records which will be selected according to the approved sampling procedure.

A summary of the questions that will be asked is provided below:

Questions for health facility managers

1. How often is your facility visited by DHMT or NMCC officials to discuss successes and challenges of using RDT and prescribing ACT to children of under five years?
2. Are all positions at this facility filled according to Ministry of Health staff establishment?
3. If there are staff shortages, which category of staff are they?
4. If staff shortage then, how does this staff shortage situation impact on the way services are provided?
5. On average how many patients are seen by each category of health worker per day

Questions for health workers
1. What is your current designation
2. In what year did you begin working in this health facility?
3. Have you been trained in malaria treatment using rapid diagnostic test and administration of ACT?
4. If your answer is yes, in which year were you trained?
5. Do you think you need a refresher course in this malaria treatment protocol using RDT and ACT?
6. If, your answer is yes, briefly indicate which area you need to enhance your knowledge in using RDT and prescribing ACT for children under five years.
7. Indicate by ticking and or crossing in the spaces provided if you have or you do not have in your consultation room the listed item.

Would my participation in this study be kept confidential?

We will do our best to keep your personal information confidential. To help protect your confidentiality, (1) your name will not be included on the questionnaire which will also bear your responses and other collected data; (2) a code will be placed on the questionnaire and other collected data; (3) through the use of an identification key, the researcher will be able to link the questionnaire you answered to your identity; and (4) only the researcher will have access to the identification key. If we write a report or article about this research project, your identity will be protected to the maximum extent possible.

What are the risks of this research?

There are no known risks associated with participating in this research project.

What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about the extent to which health workers adhere to the new malaria 'test and treat' policy. We hope that, in the future, other people might benefit from this study through improved understanding of malaria treatment.
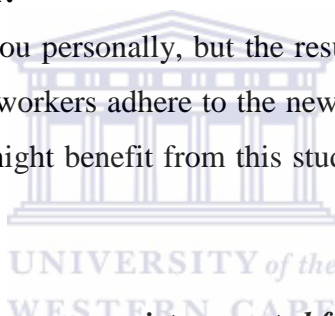
Describe the anticipated benefits to science or society expected from the research, if any.

Adherence to the new malaria 'test and treat' policy will treat true malaria cases, reduce over diagnosis and inappropriate treatment of malaria with ACT. This will contribute to prolongation of ACT use in malaria treatment and reduce development of resistance strains.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized. For example, if an emergency situation occurs during your participation in the research, where a patient suddenly falls seriously ill or a seriously ill patient is brought to the health facility for your attention, the investigator will terminate your participation without regard to your consent to let you to provide treatment to the patient(s)

What if I have questions?

This research is being conducted by Dr. G. Reagon, School of Public Health at the University of the Western Cape. If you have any questions about the research study itself, please contact Dr. G. Reagon at: the University of the Western Cape, Private Bag X17, Belville 7535, Telephone: + 27 21 959-2809, Fax: + 2721 959-2872, Email: greagon@uwc.ac.za

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Head of Department: Prof U. Lehmann

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This research has been approved by the University of the Western Cape's Senate Research Committee and Ethics Committee.

Appendix 2

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CONSENT FORM

(Health Facility Managers)

Title of Research Project: Assessment of the clinical management of children suspected of having malaria in Lusaka District, Zambia.

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

Participant's name………………………………………………………………………………

Participant's signature………………………………………………………………………………

Witness………………………………………………………………………………………………..

Date…………………………………………………………………………………………………..

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact the study coordinator:

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CONSENT FORM

(Health Facility workers)

Title of Research Project: Assessment of the clinical management of children suspected of having malaria in Lusaka District, Zambia.

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

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Page | 125

APPENDIX 4

Data Extraction Tool for Patient Folders

S/N	Question	Responses	
	Demographic Data		
1	What was the sex of the child?	Male	Female
2	What was the age of the child in months?	................months	
3	Where did the child live?	....Formal housing ... Informal Housing ....Traditional Housing	
4	What was the distance in kilometres between residential area and health care facility	...less than 1 Km ...1 – 2 Kms ...3- 4 Kms ...More than 5kms	
	Clinical Information		
5	What was the weight of the child in kilograms	.....Kilograms	
6	What was the temperature?	....°Celsius	
7	What were the main complaint(s) of the child as described by the care taker?	...Diarrhoea and vomiting ...Loss of appetite ...body hotness ...Child is weak ... Others (Specify)...................	
8	Was the child given any form of treatment at home?	...Yes ...No	
9	If yes, which treatment?	... Malarial drugs ...Analgesics ...Antibiotics ...Herbs ...Steam inhalation	
10	What was (were) the main finding (s) on physical examination of the child by the health worker?	... Child had fever ...Signs of dehydration ...Palm Pallor ...severe wasting ...lethargic ......Others (Specify)..............................	
11	What was the health worker`s provisional diagnosis of the Child?	...Suspected malaria ...Upper Respiratory infection ...Gastro-entritis ...Ear infection ...Others (Specify).................	
12	Did the health worker perform a malaria test?	...yes ..No	
13	If yes, which test/s	... RDT ...microscopy ...both	
14	What was the result of the test	...Negative ...Positive	
15	Was the patient prescribed any medication?	...Yes ...No	
16	Which medication was prescribed?	...ACT ...Quinine ...Antibiotic ...Analgesic ...Others (Specify)...............	
17	Which category of health worker examined this child	...Medical Doctor ...Medical Licentiate ...Registered Nurse ...Enrolled Nurse ...Environmental Health Technician ...Clinical Officer ...Community Health Worker ...Others (Specify)................	
18	If the child tested negative for malaria, did the health worker carry out any further assessment (e.g. other tests done or alternative diagnosis listed in the folder)?	....yes ...No	

Appendix 5

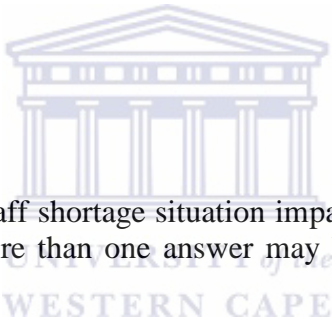## Questionnaire that was administered to health workers at the facility

<table>
<tr><td colspan="2">Training in RDT/ACT</td><td></td></tr>
<tr><td></td><td>Question</td><td>Responses</td></tr>
<tr><td>1</td><td>What is your current designation</td><td>...Medical Doctor
...Medical Licentiate
...Registered Nurse
...Enrolled Nurse
...Enrolled Midwife
...Registered Midwife
...Public Health Nurse
...Family Health Nurse
... Clinical Officer
...Environmental Health Technician
..Others (Specify).............</td></tr>
<tr><td>2</td><td>In what year did you begin working in this health facility?</td><td>....year</td></tr>
<tr><td>3</td><td>Have you been trained in malaria treatment using rapid diagnostic test and administration of ACT?</td><td>...Yes
...No</td></tr>
<tr><td>4</td><td>If your answer is yes, in which year were you trained?</td><td>...Year.........</td></tr>
<tr><td>5</td><td>Do you think you need a refresher course in this malaria treatment protocol using RDT and ACT?</td><td>...Yes
...No</td></tr>
<tr><td>6</td><td>If, your answer is yes, briefly indicate which area you need to enhance your knowledge in using RDT and prescribing ACT for children under five years.
(If you need more writing space, use space provided at end of questionnaire).</td><td>...to gain competence in testing
...doubts results when compared to clinical presentation
...others (Specify) a.......................
....</td></tr>
<tr><td>7</td><td>Indicate by ticking and or crossing in the spaces provided if you have or you do not have in your consultation room the listed item.</td><td>ACT Job aid...............................
...ACT policy document.................
...Clinical Algorithm......................
...Malaria RDTs Job Aid................
...Dosage Guide............................</td></tr>
</table>

Appendix 6

Facility manager questionnaire (Staffing levels, Workloads, Supervision)

1	How often is your facility visited by DHMT or NMCC officials to discuss successes and challenges of using RDT and prescribing ACT to children of under five years	...Quarterly ...Every six months ...Annually ...Bi-annually ...None
2	Are all positions at this facility filled according to Ministry of Health staff establishment?	...Yes ...No
3	If there are staff shortages, which category of staff are they?	...Doctors ...Nurses ...clinical Officers ...EHTs ...CHWs ...Others (Specify).........
4	If staff shortage then, how does this staff shortage situation impact on the way services are provided (more than one answer may be chosen)	...Less contact time with patients ...Delegate most clinical work ...Handover of patients to incoming shift ...Undertake vital procedures only …Patients get turned away …Minimise procedures and investigations ...Others (specify)........................... ....
5	On average how many patients are seen by each category of health worker per day	..............Doctors ....Nurses ....clinical Officers ……………….EHTs ……………....CHWs

Table: 12 Results of health care questionnaire on RDT Training undertaken and further training needs

Clinic	Dr	RNs	ENS	CO	EHT	Ave. Years	Staff Trained in RDT	year Trained	refresher course No	refresher course Yes	Area of course Testing	Area of course Results	ACT Job Aid	ACT Policy	Algorithm	RDT Job Aid	ACT Dosages
1	0	8	10	1	0	13	0	0	0	0	0	0	0	0	0	0	yes
2	0	7	7	1	0	9	0	0	0	0	0	0	0	0	0	0	yes
3	0	5	7	2	0	8	0	0	0	0	0	0	0	0	0	0	yes
4	0	0	2	1	1	7	0	0	0	0	0	0	0	0	0	0	yes
5	0	0	2	1	1	8	0	0	0	0	0	0	0	0	0	0	yes
6	2	4	6	5	2	10	2	2012		YES	yes	yes	0	0	0	0	yes
7	2	3	9	5	0	10	6	2012		YES	yes	yes	0	0	0	0	no
8	0	2	8	0	0	11	3	2011		YES	yes	yes	0	yes	0	0	yes
9	0	0	1	0	0	11	0	0	0	0	0	0	yes	yes	0	0	yes
10	0	0	3	0	0	8	0	0	0	0	0	0	0	yes	0	0	yes
Totals	4	29	55	16	4		11										

Table 12 shows that only 11 out of 108 (10.1%) in 10 health centers were trained in RDT testing. Three staff were trained in 2011 and 8 were trained in 2012. Though all their consultation rooms have ACT dosages, only 9 rooms have ACT job Aid, 7 have ACT policy none has Algorithm or RDT job aid.

Appendix 8

Table: 13, Table showing Doctor/ patient; nurse/patient ratio and contact time.

clinic	Dr	RNs	ENS	CO	EHT	Not filled	Dr shortage	Nurse shortage	CO	EHT	CHW	Less contact	delegate	Handover	shortcuts	Number patients seen by each staff per day per each clinic			
																Dr	Nurses	co	CHW
1	0	8	10	1	0	Not filled	Dr shortage	Nurse shortage				Less contact		Handover	shortcuts	70	45	160	
2	0	7	7	1	0	Not filled	Dr shortage	Nurse shortage				Less contact		Handover	shortcuts	70	67	210	
3	0	5	7	2	0	Not filled	Dr shortage	Nurse shortage	CO			Less contact		Handover	shortcuts		150	250	
4	0	0	2	1	1	Not filled	Dr shortage	Nurse shortage				Less contact		Handover	shortcuts		40	40	30
5	0	0	2	1	1	Not filled	Dr shortage	Nurse shortage			CHW	Less contact		Handover	shortcuts		80	170	50
6	2	4	6	5	2	Not filled	2 Visting Drs	Nurse shortage	CO			Less contact		Handover	shortcuts	25	25	30	
7	2	3	9	5	0	Not filled	2 Visting Drs	Nurse shortage		EHT		Less contact		Handover	shortcuts	200	500	200	
8	0	2	8	0	0	Not filled	Dr shortage	Nurse shortage				Less contact	delegate	Handover	shortcuts	60	60	60	
9	0	0	1	0	0	Not filled	Dr shortage	Nurse shortage	CO	EHT	CHW	Less contact			shortcuts	120	120		
10	0	0	3	0	0	Not filled	Dr shortage	nurse shortage	CO	eHT	CHW	Less contact	delegate	Handover	shortcuts	115	115	100	
Totals	4	29	55	16	4														

Table 13 shows that Doctors, nurses and clinical Officers, understaffed all the 10 health centres. This results in less contact time with patients in order to treat as patients as possible. Even so, they do not complete their work in a shift and tend to handover to the incoming shift who also do not treat all patients resulting in some patients being turned away
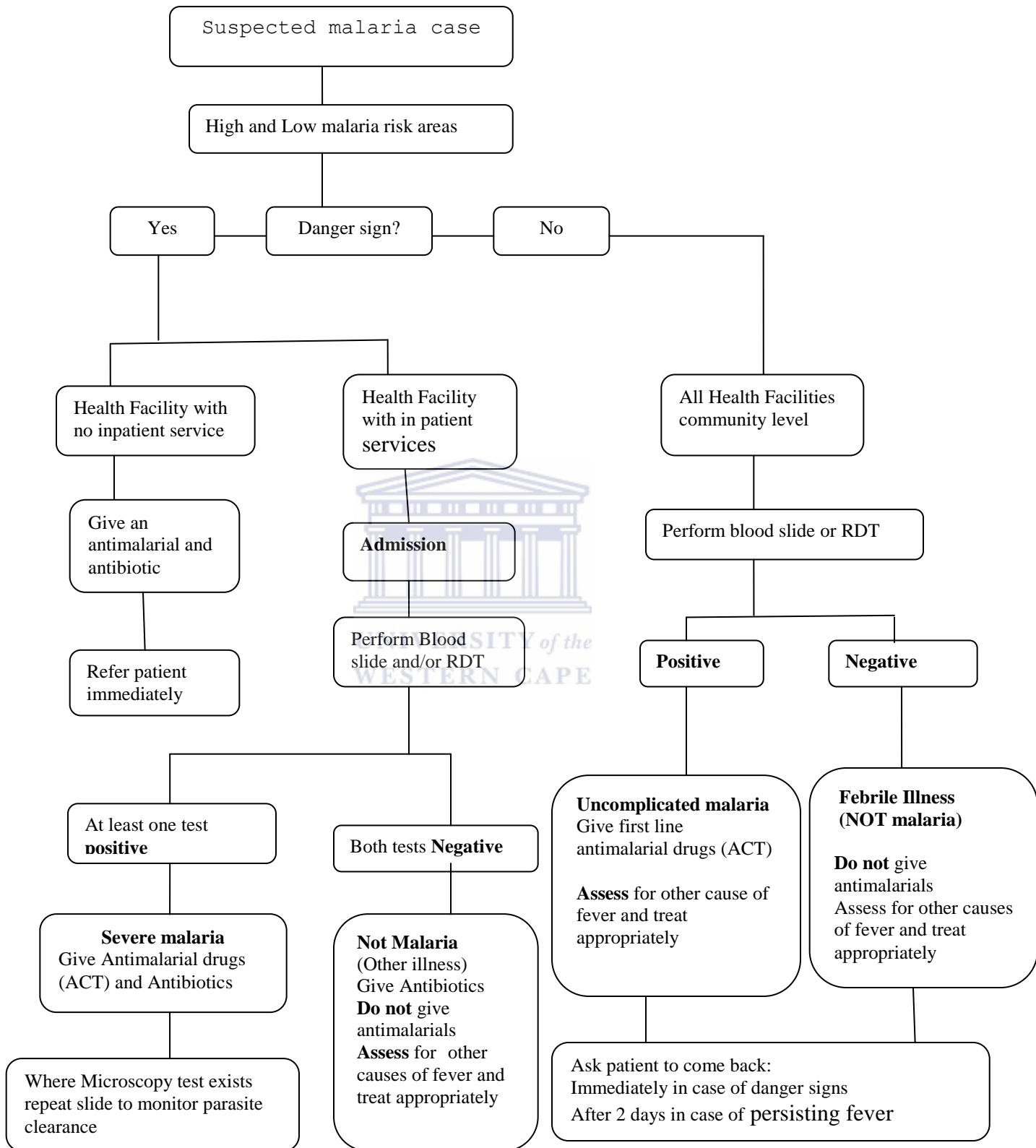
Appendix 9

Extract of treatment guideline of children with fever from Integrated Management of Childhood Illness manual dated 2008.

WHO/UNICEF(2008) Integrated Management of Childhood Illness (IMCI); Assess and classify the sick child Age 2 months up to 5 years, abridged course, Zambia

SIGN	CLASSIFY	TREATMENT: URGENT PRE-REFERRAL TREATMENT ARE IN BOLD
1. Any general danger 2. Chest in drawing 3. Stridor	Severe pneumonia or very severe disease	• Give first does of an appropriate antibiotic • If wheezing give a rapid acting bronchodilator or subcutaneous epinephrine • Refer to UGENTLY to hospital
1.Fast breathing	Pneumonia	❑ Give an appropriate antibiotic for 5 days ❑ If wheezing give inhaler or oral sulbutalmol for 5 days. ❑ If recurrent wheezing, refer for assessment ❑ Soothe the throat and relieve the cough with a safe remedy ❑ Check for HIV infection ❑ If coughing for more than 21 days, refer for possible TB. ❑ Advise care taker when to return immediately ❑ Follow-up in 2 days
No signs of pneumonia or very severe disease	Cough or cold	❑ If wheezing give inhaled or oral sulbutalmol for 5 days ❑ If recurrent wheezing refer for assessment. ❑ Soothe the throat and relieve the cough with a safe remedy. ❑ If coughing more than 21 days refer for TB ❑ Advise caretaker when to return immediately ❑ Follow-up in 5 days if not improving
Any general danger sign or Stiff neck	**VERY SEVERE FEBRILE DISEASE**	❑ **Give quinine for febrile illness(first dose)** ❑ Give first dose of an appropriate antibiotic ❑ Give one dose of paracetamol in clinic for high fever (38.5 Degrees or above. ❑ Refer UGENTLY to hospital
SIGN	CLASSIFY	TREATMENT: URGENT PRE-REFERRAL TREATMENT ARE IN BOLD
Fever: by history or feels hot or temperature 37.5 degrees Celsius	**Malaria**	❑ Do RDT or Microscopy for malaria ❑ If malaria test positive **or unable to do test, treat with oral malaria** ❑ If malaria test is negative, look for other causes of fever ❑ **If malaria test is negative and no other cause of fever is found treat with oral antimalarial** ❑ Give one dose of paracetamol in clinic for high fever(38.5 degrees or above) ❑ Advise care taker when to return immediately ❑ Follow up in 2 days, if fever persists ❑ If fever is prevent everyday for more than 7 days refer for assessment

Appendix 10
Excerpt of the Guidelines for the Diagnosis and Treatment of Malaria in Zambia

Suspected malaria case

High and Low malaria risk areas

Yes — Danger sign? — No

Health Facility with no inpatient service

Give an antimalarial and antibiotic

Refer patient immediately

Health Facility with in patient services

Admission

Perform Blood slide and/or RDT

At least one test **positive**

Both tests **Negative**

Severe malaria
Give Antimalarial drugs (ACT) and Antibiotics

Where Microscopy test exists repeat slide to monitor parasite clearance

Not Malaria
(Other illness)
Give Antibiotics
Do not give antimalarials
Assess for other causes of fever and treat appropriately

All Health Facilities community level

Perform blood slide or RDT

Positive

Negative

Uncomplicated malaria
Give first line antimalarial drugs (ACT)

Assess for other cause of fever and treat appropriately

Febrile Illness (NOT malaria)

Do not give antimalarials
Assess for other causes of fever and treat appropriately

Ask patient to come back:
Immediately in case of danger signs
After 2 days in case of persisting fever

Note

The following danger signs are considered critical for referral at peripheral level:
In children:

- Unable to drink or breast feed

- Vomit everything

- Convulsions

- Lethargic or unconscious and present with neck stiffness

- Chest in drawing or stridor

- Rectal artesunate is recommended as pre-referral treatment

- Rapid diagnostic (RDT) is performed while waiting for the results of blood slide to decide on earlier treatment and to document malaria in the patient who have received pre-referral antimalarial treatment (and thus may have already cleared their parasites)

- Because of the concomitant bacterial infection in severe malaria patients, especially children, antibiotics should be given along with antimalarials and antibacterial infection should be ruled out (by bacteraemia by blood culture if available)

Ministry of Health (2014) Guidelines for the Diagnosis and Treatment of Malaria in Zambia: 104
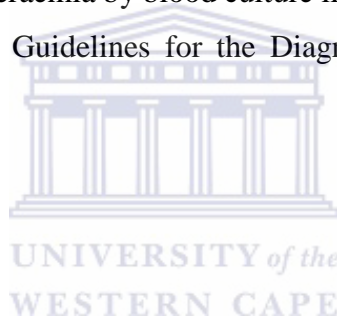
REPUBLIC OF ZAMBIA

MINISTRY OF COMMUNITY DEVELOPMENT, MOTHER AND CHILD HEALTH

22nd January, 2013

OFFICE OF THE PERMANENT SECRETARY
COMMUNITY HOUSE
SADZU ROAD
PRIVATE BAG W 252
LUSAKA

The Lusaka Provincial Medical Officer
Lusaka Provincial Medical Office
LUSAKA

Dear Dr. Lambart

Re: Approval to conduct research in Lusaka District – Mr. Evans Mwale

Kindly refer to above subject matter.

The Ministry of Community Development Mother and Child Health is in receipt of a request to conduct research in Lusaka districts on **Assessment of the clinical management of children of under five years suspected of having malaria in Lusaka health centres, in Lusaka districts, Zambia.**

The researcher, Mr. Evans Mwale has obtained ethics approval from the ERES Converge IRB, Zambia to conduct the research in selected Lusaka health centres in Lusaka districts

We wish to inform you that the MCDMCH grants Mr. Mwale authority to conduct research in Lusaka District. Any materials or specimen collected should be kept within Zambia and will not be permitted to transported out of the country. Any findings should be approved by the Ministry before publication.

Kindly accord Mr. Evans Mwale the necessary support to conduct this research.

Professor Elwyn Chomba
Permanent Secretary
MINISTRY OF COMMUNITY DEVELOPMENT, MOTHER AND CHILD HEALTH

CC: Lusaka District Medical Officer – Dr. Masaninga

OFFICE OF THE DEAN
DEPARTMENT OF RESEARCH DEVELOPMENT

UNIVERSITY *of the*
WESTERN CAPE

05 December 2012

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape has approved the methodology and ethics of the following research project by:
Mr E Mwale (School of Public Health)

Research Project: Assessment of the clinical management of children suspected of having malaria in Lusaka district, Zambia.

Registration no: 12/10/29

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape