HEALTH WORKERS KNOWLEDGE OF THE UNCOMPLICATED MALARIA TREATMENT POLICY IN PUBLIC HEALTH FACILITIES IN KENYA: A CROSS-SECTIONAL STUDY

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DECLARATION

In submitting this thesis, I certify that this is my original work and that it has not been submitted elsewhere for a degree. I understand the rules of plagiarism and that any work done by others should be properly cited. I declare that I am the sole author of this work and other people's work has been properly acknowledged in the text.

Signature: **Date:** 23/11/2016.

CERTIFICATE OF APPROVAL

This thesis is approved for submission in partial fulfilment for the award of the degree in Masters of Science in Medical Statistics at the University of Nairobi.

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DEDICATION

I dedicate this thesis to my beloved parents who against all odds have supported me to this far and my friends especially Boniface Oyugi for his support and encouragement.

LIST OF ABBREVIATIONS

Abbreviations

ACT	Artemisinin based Combination Therapy
AL	Artemether-lumefantrine
SSA	sub-Saharan Africa
WHO	World Health Organization
NMCP	National Malaria Control Programme
RDT	Rapid diagnostic test
KEMRI	Kenya Medical Research Institute
KWTRP	KEMRI Wellcome Trust Research Programme
HWs	Health Workers
DHA-PPQ	Dihydroartemisinin-piperaquine
SP	Sulfadoxine-pyrimethamine
NTGs	National Treatment guidelines

GLOSSARY OF TERMS

Uncomplicated malaria: Symptomatic infection with malaria parasitaemia without danger signs of severity and/or evidence of vital organ dysfunction.

Artemisinin-based combination therapy (ACT): A combination of artemisinin or one of its derivatives with an antimalarial(s) of a different class

Drug resistance: According to WHO, it is the ability of a parasite strain to survive and/or reproduce despite the administration and absorption of a medicine given in doses equal to or higher than those usually recommended, but within the tolerance of the subject, provided drug exposure at the site of action is adequate. Resistance to antimalarial arises because of the selection of parasites with genetic mutations or gene amplifications that confer reduced susceptibility.

Endemic: Occurring frequently in a particular region or population.

Fever: An increase in body temperature above the normal temperature, above 37.5°C.

Monotherapy: Antimalarial treatment with a single medicine.

Parenteral: The provision of medication into the body by any means other than through the alimentary canal (oral route or rectal), such as by subcutaneous, intramuscular or intravenous injection.

Rapid diagnostic test (RDT): An antigen-based stick, cassette or card test for malaria in which a coloured line indicates that plasmodial antigens have been detected.

ABSTRACT

Background: Following the paradigm change of the malaria treatment policy from treating all fevers as malaria to parasitological testing of all suspected cases before treating only positives cases, several countries have done in-service trainings, supervision and support of health workers to improve their performance. Despite the trainings and distribution of guidelines and jobs aids, there are still cases of presumptive treatment and low testing rates of suspected malaria cases.

Objectives: The study assessed health workers knowledge of the uncomplicated malaria treatment policy in Kenyan public health facilities.

Methods: The primary study outcome was the proportion of health workers who were knowledgeable about the malaria treatment policy and predictors of their knowledge. Descriptive statistics including frequencies and tabulations were used to describe the trend and level of health workers' knowledge. Bivariate and multiple multi-level logistic regression models were used to determine the factors affecting the level of health worker knowledge.

Results: A total of 2,206 health workers were included in the analysis (range across surveys 203-237). Majority were female 1,189/2,206 (53.9%) with a mean age of 35.3 years (SD 9.54). The knowledge about universal testing of all suspected malaria cases and the first line treatment drug AL was high across all surveys (range across all surveys74.3-100%). The knowledge of test and treat only positive cases with ACT was sub-optimal with a range of 7.2-43.8% across the surveys. From the multiple logistic regression the following factors were independently associated with health worker knowledge: malaria

risk (OR; 2.87 95% Confidence Interval CI; 1.42-6.20) and age of health workers (OR; 2.21, 95% CI; 1.14-4.37). No hospital-level factors were significantly related to correct malaria treatment policy knowledge among the health workers

Conclusion: Following changes in malaria treatment policy, there has been improvements in the level of health workers' knowledge of the current Kenyan malaria treatment policy. The knowledge of the second-line drug for treating malaria is still sub-optimal. The younger health workers and those from high malaria risk areas were more knowledgeable. Investment in focused training and regular supervision may be needed, particularly for first-level health workers working in public health facilities who care for the greatest proportion of malaria patients.

CHAPTER ONE:

1.0 BACKGROUND INFORMATION

Effective diagnosis and treatment of uncomplicated malaria is vital as severe form of the disease is associated with high fatality rate [1]. *Plasmodium falciparum* is the predominant species causing malaria in Kenya, at 98.5% [2]. Even though malaria is highly preventable, treatable and curable, it is still a key public health concern globally. In the year 2015, the World Health Organization (WHO) estimated close to 214 million malaria cases and 438 000 malaria deaths occurred. Most cases and deaths at 88% and 90%, respectively, occurred in Africa. Three quarters of the deaths occurred in under-fives [3]. In Africa malaria is estimated to cause approximately twenty percent of all child deaths. In Sub-Saharan Africa (SSA), the disease accounts for about 30-50% outpatient and half of inpatient visits to hospitals [4]. In Kenya, malaria is among the major causes of mortality and morbidity because it causes 19 percent of admissions to health facilities and thirty percent of visits to the outpatient departments. In addition, it is among the leading causes of death in children under the age of five years [5, 6].

Kenya adopted the use of artemisinin-combination therapy (ACT) since 2004 and universal testing of malaria in all age groups regardless of epidemiological settings in 2010 which is the current treatment policy of “test and treat” [2]. Following malaria treatment policy change in Kenya, annual training of health workers and distribution of job aids has been

conducted by the Ministry of Health to improve health worker knowledge and practice of malaria case-management.

Effective implementation of the new malaria treatment policy rely on health workers' knowledge and translating it by correctly diagnosing and treating malaria cases. In addition, patients rely on health workers to select their treatment. Therefore understanding their knowledge will guide interventions needed to improve their knowledge and practices to adhere to the recommended malaria treatment guidelines leading to improved quality of malaria case-management.

1.1 Problem statement

In 2015, only about 13% African children with malaria received effective treatment for the disease. Health workers have the responsibility of making the correct diagnosis and appropriately treating suspected malaria cases. Despite the introduction of the test and treat malaria policy six years ago, there have been cases of over-diagnosis and overtreatment of malaria, resulting in high mortality due to failure to treat other causes of febrile illness like bacterial infections [7, 8]. In addition, various studies have reported cases where health care workers presumptively treat patients as having malaria without a diagnostic test, or with negative test results with anti-malarials [7, 9-13].

Presumptive malaria treatment causes irrational use of ACTs that are costly. Furthermore, in-service training is one of the strategic interventions delivered by the Kenya National Malaria Control Programme annually, though adequate information about the impact the trainings has on the knowledge of health workers is lacking. Lastly, information on health worker knowledge of uncomplicated malaria case-management policy is scanty.

1.2 Justification

Majority of patients with malaria in Kenya seek treatment in publically funded health facilities (both government and faith-based facilities). Understanding health workers' knowledge of uncomplicated malaria case-management and the factors associated with the knowledge and implementation of the current malaria policy is vital in evaluating the impact of set up interventions to aid implementation of the policy like training, and direct setting up strategies to ensure full implementation and effective malaria case-management.

Kenya, being among the WHO Africa malaria-endemic countries, is tasked with the responsibility of ensuring the implementation of the recommended malaria guidelines in efforts to control malaria and health workers are key players in achieving this. The recommended anti-malarials, ACTs, are more expensive than older malaria therapies as a result they should be used rationally. Effective malaria case-management is imperative in moving towards eliminating the disease [14]. In addition, health worker's adherence to guidelines is critical for the successful implementation of any new case-management policy and prevention of drug resistance.

Understanding the knowledge and determinants of health worker knowledge of malaria treatment policy in these hospitals will guide the implementation of malaria treatment guidelines being used in Kenya and globally. The findings from this study will inform malaria case-management and may improve understanding of adherence to treatment guidelines in low-resource settings. Lastly, the knowledge might lead to improvement of the quality of care through further research, investment in focused training, regular supervision and development of informed policies. This thesis will explore health workers' knowledge and the determinants in public health facilities in Kenya.

1.3 Overall objective

To determine the health workers' knowledge of malaria case-management policy and factors influencing the level of knowledge in the outpatient settings in Kenya.

1.31 Specific objectives

1. To determine the linear trend of health workers' knowledge of malaria case-management policy in Kenya.
2. To determine the facility and health worker characteristics associated with health workers' knowledge of uncomplicated malaria case-management policy in Kenya.
3. To examine whether there is an improvement in health workers knowledge of malaria case-management policy in Kenya.
4. To determine whether there is variability between counties, hospitals and health workers.

1.4 Research questions

1. Is there an improvement in the health workers' knowledge of malaria case-management policy over the years?
2. What factors are associated with the health workers' knowledge of malaria case-management policy?

1.5 Hypothesis

1.51 Null hypotheses

1. There is no improvement in the health workers' knowledge of malaria case management policy
2. Malaria case management knowledge is affected by health worker characteristics

1.52 Alternative hypotheses

1. There is improvement in the health workers' knowledge of malaria case management policy over time
2. Malaria case management knowledge is affected by health facility and region factors

CHAPTER TWO:

2.0 LITERATURE REVIEW

2.1 Malaria case management

Globally, malaria is still a public health problem, with about 3.3 billion people at risk of malaria [3]. In the year 2015, the WHO estimated that close to 214 million malaria cases occurred, with the majority of the cases occurring in Africa and three quarters of them occurring in children under-five years of age [3]. In Kenya, malaria is a major cause of mortality and morbidity especially in children aged five years and below. The disease accounts for a third of outpatient attendance and about 19 percent of hospital admissions in Kenya, and it is among the leading causes of death in under-five children [5, 6].

Before the universal testing policy, diagnosis of malaria was mainly based on clinically suspecting malaria and detecting parasites in the blood, either parasitological or confirmatory diagnosis. For children under the age of 5 years, all fevers were presumptively treated as malaria with ACT, while over five year olds were to be tested first before commencing anti-malarials. Following a decline in the transmission of malaria in various parts of Africa and the burden of the disease globally [15-17], and the availability of cheaper rapid diagnostic tests (RDTs), the WHO recommended in 2010, that all suspected cases of malaria in all age groups be laboratory confirmed by microscopy or RDT before initiating anti-malarial therapy [18, 19]. This is geared towards reducing the occurrence of drug resistance, prevent excessive use of anti-malarial drugs and encourage

identification of other non-malaria febrile illnesses in the context of declining change of malaria epidemiology. Consequently, the recommended anti-malarial drugs should only be directed to patients who certainly have malaria [1]. In 2012, there was an extension of the treatment policy to include a track component. This component entails routine capturing and reporting of commodity stocks, malaria testing rates of all suspected cases and subsequent appropriate treatment of the cases through health information systems [20].

In Kenya, it is currently recommended to limit treatment to only laboratory-confirmed malaria cases. The major aim of ensuring adequate use of parasitological diagnosis with either microscopy or RDTs is to reduce malaria overtreatment by guaranteeing that treatment is targeted at only patients with true malaria infection. For uncomplicated malaria, all patients suspected to have malaria without signs of severe disease or danger signs should be tested for malaria and only those whose test results are positive be treated with the recommended ACT (Artemether-lumefantrine). Microscopy is the standard test for malaria in public health facilities across Kenya [21].

Following the introduction of new malaria treatment guidelines by WHO that recommend universal laboratory testing of all suspected malaria cases before treatment in 2010 [19], many countries, including Kenya have adopted them. Despite improvements in malaria case-management being reported by a study done in Kenya [22] and the testing rates being

high, a number of patients are still being treated presumptively, i.e. being treated without a malaria test [9, 13, 23].

Most health workers rely on clinical symptoms when making a diagnosis even though they are poor predictors for the disease. This practice results in malaria disease over-diagnosis hence excessive reporting of malaria cases [24], over-use of anti-malarial drugs , under-treatment, under-reporting and incorrect treatment of non-malarial febrile illnesses [25, 26]. Moreover, it leads to increased real or apparent anti-malarial drug resistance, treatment of negative test cases as malaria [27], and inappropriate allocation of resources, including over-treatment with expensive ACTs. Malaria over-diagnosis and over-treatment can result in failing to treat other blood stream causes of fever [8]. Clinical diagnosis of malaria without laboratory confirmation is also linked to increased mortality and hospitalisation [28].

The standard for diagnosing and treating malaria is a positive blood smear test using microscopy or RDT in a patient with history of fever or suspected to have malaria, but in practice this is not frequently adhered to. There have been cases that show poor adherence to malaria management guidelines in many settings even though clinical guidelines are standards to be followed by health workers. For instance, not strictly following malaria slide results in treating suspected malaria cases, whereby some malaria slide positive patients are not prescribed anti-malarials (under-treatment). Malaria slide negative patients

and those not tested being prescribed anti-malarials, this has led to inappropriate use of malaria drugs [7, 9-13, 27].

2.2 Malaria treatment policy in Kenya

Effective treatment of malaria in accordance to recommended treatment guidelines is a fundamental pillar of the malaria control strategy. Treatment of malaria in Kenya was first changed from using chloroquine to sulfadoxine-pyrimethamine(SP) in 1998 [5]. Kenya adopted the use of a specific ACT, artemether-lumefantrine (AL) for treatment of uncomplicated malaria in the year 2004 [29].

In 2010, AL was recommended for use in the second and third trimester of pregnancy, and in everyone regardless of their weight while, dihydroartemisinin-piperaquine (DHA-PPQ) was recommended as the second-line malaria treatment drug. In addition, parasitological testing of all patients with suspected malaria regardless of epidemiological setting was implemented. The treatment policy was further reviewed to recommend injectable artesunate for severe malaria and pre-referral treatment in the year 2012, and in the first trimester of pregnancy quinine was the recommended treatment [2, 20].

2.3 Training of health workers

Following the implementation of the new malaria treatment guidelines in Kenya, annual rounds of nationwide health worker in-service trainings on malaria case-management in public facilities have been undertaken between 2010 and 2016 using a standardized

curriculum.The trainings were supported by all-age outpatient algorithms wall charts as seen in Figure 1. Subsequently, distribution of job-aids to health workers through routine commodity supply channels and during the trainings was done. In addition, the Kenya Malaria Strategy (KMS) 2014 – 2018 aims to have all suspected malaria cases presenting to a health worker managed according to the national malaria treatment guidelines by 2018. [30]. This is to be achieved through training of health workers, support and supervision.

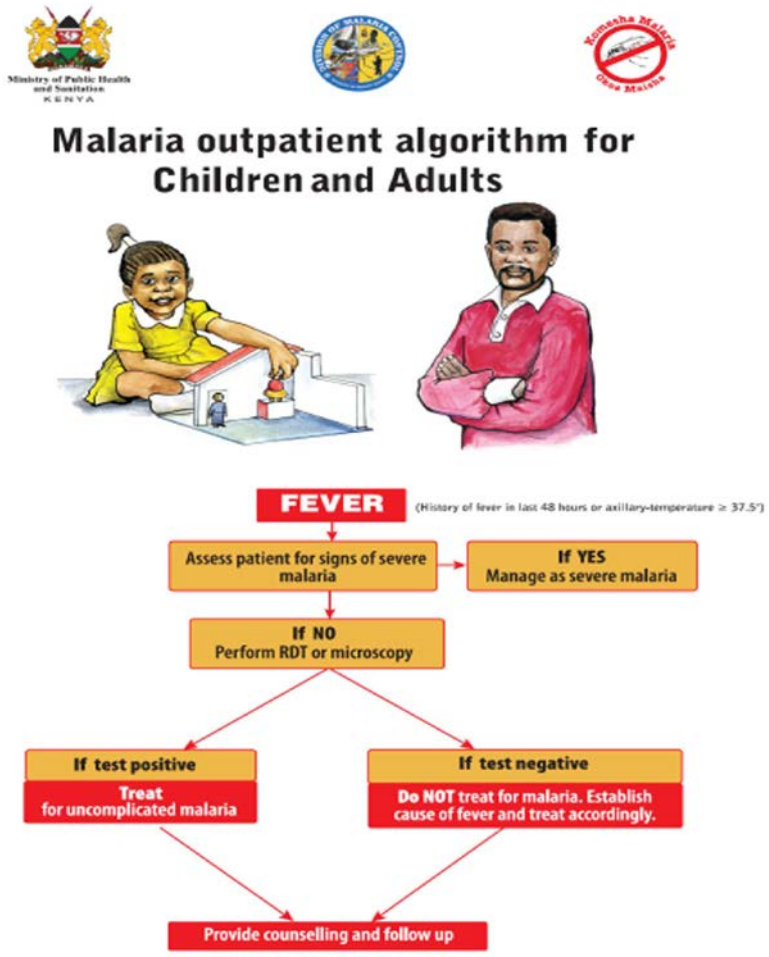

Figure 1: Kenyan ‘‘test and treat’’ policy translated into malaria outpatient algorithm [22].

CHAPTER THREE:

3.0 MATERIALS AND METHODS

3.1 Study design and setting

This was a repeated cross-sectional study design including ten health facility surveys done between 2010 and 2016. The surveys were done in public health facilities determining levels and trends in national malaria indicators and the quality of outpatient malaria case-management in accordance to national malaria guidelines. All surveys applied the same study design and settings from 2010 to 2016.

3.1 Study population

Health workers seeing patients in the outpatient departments of survey health facilities on the day of the survey were interviewed about their demographics, in-service training, access to national malaria treatment guidelines, supervision in the preceding three months, and knowledge about malaria case management policies.

Subsequently, a health facility structural assessment at each sampled facility was conducted by interviewing the facility in-charge and direct observation. Data were collected on availability of AL and other antimalarial medicines, availability of diagnostic services, supervisory visit in the preceding three months, and outpatient clinical staffing and training.

3.11 Inclusion criteria

- Public health facilities from level 2 to level 4.
- Health workers performing outpatient consultations in the selected health facilities.

3.12 Exclusion criteria

- Private health facilities.
- Tertiary hospitals because they serve mainly as referral facilities.
- Government facilities providing services to special patient groups such as military or prisoners.
- Health workers working in the inpatient department and specialized clinics in the selected facilities.

3.2 Sample size and sampling

Proportionate stratified random sample was drawn from all public health facilities considering administrative boundaries, type and level of facilities and their ownership to ensure national representativeness for each survey. The sample size of health facilities in each survey was calculated to detect a 15% change in performance of the case-management indicator (patient appropriately managed for malaria that is tested and only positive treated with an ACT). The sample was adjusted in order to take into consideration clustering effect at the health facility level and the likelihood of practices at facilities with unavailable case-management commodities. Therefore, in order to detect 15% difference between each survey with the level of confidence of 5%, power of 80%, design effect of 2, and

assumption that 50% of facilities will not have either AL or malaria diagnostic services, the estimated sample size was 680 patients below and above 5 years of age during the each survey. In order to get at least two under-fives and two over five year olds per facility, a minimum of 170 health facilities per survey was required (680/4).

No formal sample size for health care providers was calculated, but the inclusion of all health care workers working in the outpatient departments in the sampled facilities was deemed sufficient to assess knowledge level of uncomplicated malaria. A minimum of one health care worker per facility per survey was deemed enough to assess knowledge of outpatient malaria case management policy at 5% confidence interval, 80% power. All health care providers providing outpatient consultations in the sampled health facilities who were interviewed in each survey.

3.3 Data collection and management

Data collection was done using standardized questionnaires by trained field workers. The training was done for five days before each survey. Data collection was done over 4 weeks by ten teams each composed of three data officers with one surveyor being a team leader who performed facility assessment and interviewed health workers. Data collection at each facility was done over one day per survey. The same data collection methodology was applied across all surveys. Data were double-entered and verified using Microsoft Access database 2007 (Microsoft Inc., Redmond Washington) and data entry errors were corrected,

and data validated against the paper questionnaires to check for consistency and completeness.

3.4 Definitions

The primary study outcome was a composite measured at the health worker level: correct knowledge on case management performance defined as: 1) all patients with fever or history of fever should be tested for malaria; 2) only patients who test positive should be treated for malaria; 3) the first-line drug recommended for treatment of uncomplicated malaria is AL in all age-groups and oral quinine in the first trimester of pregnancy. The secondary indicator was the proportion that knows the second-line drug recommended for treatment of uncomplicated malaria; dihydroartemisinin-piperaquine (DHA-PPQ). These definitions are based on the 2010 Kenya National malaria treatment guidelines [2] and the 2010 WHO malaria treatment guideline [1].

3.5 Statistical Analysis

Frequency distribution of responses by categories of each variable were calculated and presented. There results were not adjusted for clustering at the facility level because in most facilities there was only one respondent hence no clustering at the facility level. To identify factors associated with correct health worker knowledge we used multivariable logistic model using the last survey done in 2016. The following health facility factors; availability of malaria diagnostics (microscopy and/or RDTs), antimalarial medicines (ACT), facility type and level, availability of national malaria treatment guidelines and wall charts. Health

worker level variables; age, gender, cadre, trained on malaria case-management policy, supervised on malaria case-management three month before the surveys was assessed on their influence on health workers knowledge. Health worker data was linked to health facility data.

The linked health worker-facility data had a hierarchical structure, as health workers are clustered by county, coming up with a two-level model with health worker and health facility characteristics at level 1 and county at level 2. County was defined as the level 2 identifier to reflect the sampling strategy, the amount of clustering expected at this level, and because it was known for every observation. To check whether adding county as a random effects improved the model I fitted several models and selected the best fitting model using Akaike Information Criterion (AIC).

Multivariable logistic regression at the individual health worker level was used to adjust for multiple variables affecting case-management knowledge and multi-level modelling with random-intercepts to adjust for clustering at county level. Variables significant in bivariate analysis (p-value < 0.1) were added into a multivariable model using stepwise forward selection of variables, and eliminating those no longer significant at p-value< 0.05. Evidence of effect modifications between variables was determined by including interaction terms between the variables and each other significant variable in the final

model, for instance whether malaria endemicity. The Intra-cluster correlation Coefficient (ICC) at the county level was accounted for in all analysis.

For a two-level logistic regression, the dependent variable μij is defined as the probability that the health worker i has the correct knowledge of the uncomplicated malaria treatment policy from health facility in county j, and {μij/ (1- μij)} is the log odds that a health worker is knowledgeable.

The model for the health workers' knowledge was specified as:

$$Logit\ (\mu ij) = \alpha + \beta Xij + \theta Sj + \varepsilon ij + \partial j$$

where α is the intercept; Xij are attributes of the health worker at a health facility in county j; Sj are attributes of health facility in county j; β and θ are the parameters associated with the explanatory variables; εij and ∂j the residuals at levels 1 and 2, respectively, and capture unobserved variation, measurement and specification errors. The statistical significance was measured using the 95% confidence intervals and P values.

To examine whether there is a significant improvement in health workers' knowledge of malaria treatment policy in Kenya over time, I used graphs to plot the change. All analysis were done using R statistical software [31]

3.6 Study limitations

The study only captures data from a few health workers who were working in outpatient departments in the sampled public hospitals, hence generalizing results to other departments and facilities in Kenya an d globally should be done with caution. Despite this, the findings gives us insight into health worker knowledge and impact of interventions focused on improving health worker performance.

3.7 Ethical consideration

The study was approved by the Kenyatta National Hospital/University of Nairobi-Ethics and Research Committee (KNH-ERC/A/383). Informed written consent was obtained from all participating health workers.

CHAPTER FOUR:

4.0 RESULTS

Study sample

A total of 2,206 heath workers providing outpatient consultations were interviewed across the surveys from 2010 to 2016, (range across surveys 203-237). Majority were female 1,189/2,206 (53.9%) with a mean age of 35.3 years (SD 9.54). Most of the health workers were from government-owned health facilities and dispensaries (Table 1).

Trends in knowledge level across the surveys

Knowledge on universal testing and the recommended first-line drug AL in patients with weight above five kilograms and second and third trimester was consistently high across all the surveys (range across surveys 74.3-100%). There was an increase in overall knowledge of the recommended ACT-AL as the first-line malaria drug in all age groups from the baseline level of 13.9% to 53.1% in the last survey. The proportion of health workers who had the correct knowledge about the composite indicator that is; all suspected malaria patients be tested and only those with positive test be treated with the recommended ACT-AL increased from 7.2% at baseline to 43.8% in the last survey ($p<0.001$). A total of 64.0% were aware of the recommended drug for treating malaria in first trimester of pregnancy range across survey (57.8- 69.9%) (Table 2).

Table 1: Demographic characteristics of health workers across the surveys

	Survey round	1 N=237	2 N=233	3 N=216	4 N=216	5 N=227	6 N=211	7 N=212	8 N=203	9 N=227	10 N=224
Health facility	**Facility level**										
	Dispensary	135 (57.0)	129 (55.4)	135 (62.5)	115 (66.9)	134 (59.0)	128 (60.7)	118 (55.7)	102 (51.3)	128 (56.4)	128 (57.1)
	Health Centre	62 (26.2)	60 (25.6)	42 (19.4)	39 (22.7)	58 (25.6)	49 (23.2)	55 (25.9)	62 (31.2)	65 (28.6)	62 (27.7)
	Hospital	40 (16.4)	44 (18.9)	39 (18.1)	18 (10.5)	35 (15.4)	34 (16.1)	39 (18.4)	35 (17.6)	34 (15.0)	34 (15.2)
	Ownership										
	Faith-based	38 (16.0)	51 (21.9)	21 (9.7)	25 (14.5)	37 (16.3)	18 (8.5)	42 (19.8)	15 (7.5)	10 (4.4)	37 (16.5)
	Government	195 (82.3)	179 (76.8)	192 (88.9)	146 (84.9)	188 (82.8)	187 (88.6)	164 (77.4)	182 (91.5)	211 (93.0)	185 (82.6)
	Private clinics/ NGO	4 (1.7)	3 (1.3)	3 (1.4)	1 (0.6)	2 (0.9)	6 (2.8)	6 (2.8)	2 (1.0)	6 (2.6)	2 (0.9)
Health Worker	**Age**										
	≤ 35 years	143 (60.3)	137 (58.8)	113 [a](53.3)	143 (66.2)	127 (56.0)	137 (64.9)	128 [b](60.7)	128 [c](64.0)	137 [d](60.9)	155 (69.2)
	> 35 years	94 (39.7)	96 (41.2)	99 (46.7)	73 (33.8)	100 (44.1)	74 (35.1)	83 (39.3)	72 (36.0)	88 (39.1)	69 (30.8)
	Gender										
	Female	126 (53.2)	124 (53.2)	117 (54.2)	122 (56.5)	136 (59.9)	103 (48.8)	115 (54.3)	111 (54.7)	113 (46.8)	122 (54.5)
	Cadre										
	Others	14 (5.9)	9 (3.9)	14 (6.5)	20 (9.3)	10 (4.4)	16 (7.6)	11 (5.2)	11 (5.4)	17 (7.5)	15 (6.7)
	Nurse	152 (64.4)	153 (65.7)	132 (61.1)	127 (58.8)	149 (65.6)	124 (58.8)	129 (60.9)	108 (53.2)	129 (56.8)	109 (48.7)
	Medical/Clinical officer	71 (30.0)	71 (30.5)	70 (32.4)	69 (31.9)	68 (30.0)	71 (33.7)	72 (34.0)	84 (41.4)	81 (35.7)	100 (44.6)

[a] 4 missing values; [b] 1 missing value; [c]3 missing values; [d]2 missing values

Table 2: Health workers knowledge of malaria policy from 2010 to 2016 in Kenyan public health facilities

			Knowledge of treatment policy					
Survey round	**Year**	**N**	**Universal testing n (%)**	**Only test positives be treated with ACT n (%)**	**Recommended first-line drug for all (artemether-lumefantrine) n (%)**	**Recommended drug in first trimester of pregnancy (oral quinine) n (%)**	**Correct knowledge of treatment policy n (%)**	**Second-line drug (DHA-PPQ) n (%)**
1	2010	237	195 (82.3)	124 (52.3)	33 (13.9)	137 (57.8)	17 (7.2)	61 (25.7)
2	2011	233	191 (82.3)	126 (54.1)	56 (24.0)	140 (60.3)	29 (12.5)	76 (32.9)
3	2012	216	183 (85.9)	120 (56.1)	74 (34.6)	151 (70.6)	45 (21.0)	84 (40.0)
4	2012	216	183 (84.7)	147 (68.1)	65 (30.1)	148 (68.5)	40 (18.5)	85 (39.4)
5	2013	227	190 (84.1)	181 (80.1)	83 (36.7)	158 (69.9)	64 (28.3)	91 (40.3)
6	2014	211	178 (84.4)	164 (77.7)	63 (29.9)	123 (58.3)	42 (19.9)	65 (31.1)
7	2014	212	184 (86.8)	182 (86.3)	80 (37.7)	137 (64.9)	64 (30.2)	95 (45.7)
8	2015	203	167 (82.3)	177 (87.2)	80 (39.4)	125 (61.6)	65 (32.0)	86 (42.8)
9	2015	227	197 (86.8)	199 (87.7)	101 (44.5)	138 (61.1)	82 (36.1)	84 (37.2)
10	2016	224	194 (87.0)	202 (90.6)	119 (53.1)	151 (67.4)	98 (43.8)	119 (53.1)
Total	2010-2016	2206	1862 (84.6)	1622 (73.7)	754 (34.2)	1408 (64.0)	546 (24.8)	846 (38.7)

Overall, knowledge about the treatment policy increased from the first round in 2010 to the last round done in 2016, specifically the second-line ACT for uncomplicated malaria, treating only test positives, and the first-line drug in children below 5 kilograms of weight (Figure 2).

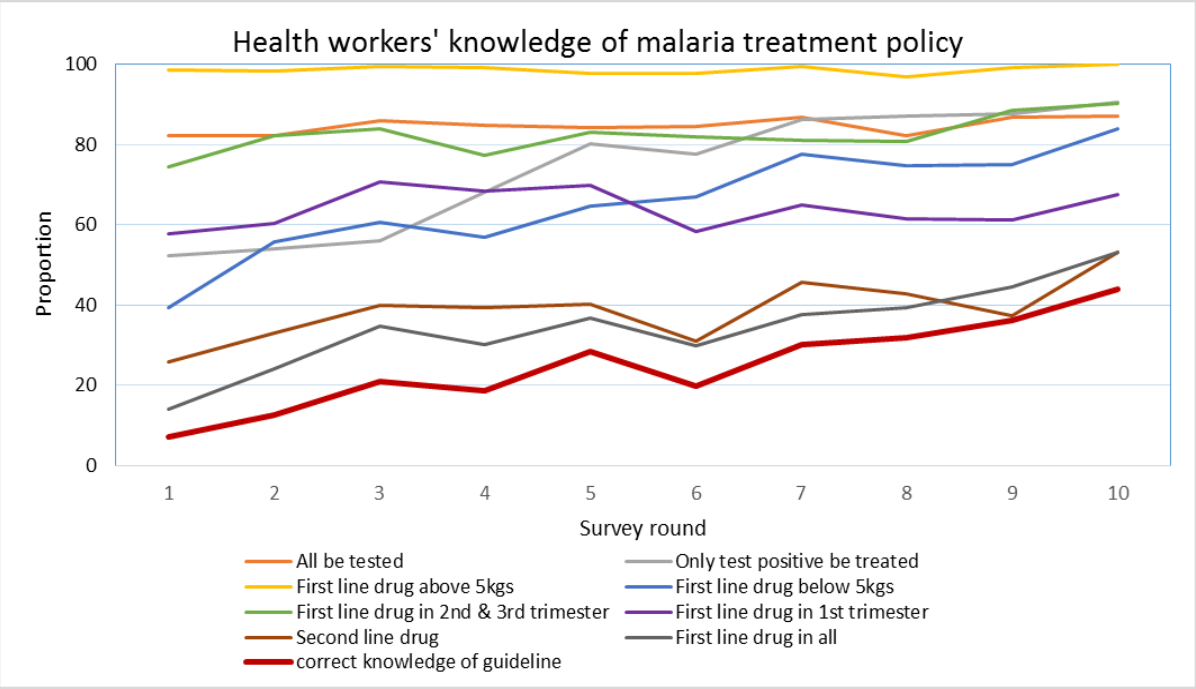

Figure 2: Trend of health worker knowledge across the surveys

Factors associated with health worker knowledge of uncomplicated malaria treatment policy

During the last survey undertaken between 13th June and 8th July, 2016, a total of 172 health facilities were surveyed, the majority of assessed facilities were dispensaries 110/172 (64.0%) followed by health centres 45 (26.2%) and hospitals 17 (9.9%). Similarly, the majority of the facilities were government owned (82.6%) and (17.4%) were faith-based. Most of the health facilities had functional diagnostics (93.0%) and ACT in stock (86.6%) (Table 3).

Table 3: Health facility characteristics

	N=172 n (%)	95% CI
Facility level		
Dispensary	110 (64.0)	56.7-71.2
Health Centre	45 (26.2)	19.5-32.8
Hospital	17 (9.9)	5.4-14.4
Ownership		
Faith based	30 (17.4)	11.7-23.2
Government	142 (82.6)	76.8-88.3
Availability of malaria diagnostic		
Functional microscopy	78 (45.4)	37.8-52.9
Functional RDT	123 (71.5)	64.7-78.3
Any functional diagnostic	160 (93.0)	89.2-96.9
Availability of malaria drugs		
Any AL pack in stock	149 (86.6)	81.5-91.8
Quinine tablets in stock	19 (11.1)	6.3-15.8
Availability of guidelines		
Copy of current malaria treatment guideline	129 (75.9)	69.4-82.4

A total of 224 health workers were interviewed in the last survey out of which 122/ 224 (54.5%) were female and nurses by cadre (48.7%). The mean age was 33.9 years (SD =9.0). The proportion knowledgeable about the composite indicator were 98/224 (43.8%) with a range of 53.6-100% across the specific sections of the treatment policy (Table 4).

Table 4: Health worker characteristics

	N=224 n (%)	95% CI
Age		
Mean age (SD)	33.9 (9.0)	
≤ 35 years	155 (69.2)	63.1-75.3
> 35 years	69 (30.8)	24.7-36.9
Gender		
Female	122 (54.5)	47.9-61.0
Cadre		
Nurse	109 (48.7)	42.1-55.3
Medical /Clinical officer	100 (44.6)	38.1-51.2
Others	15 (6.7)	3.4-10.0
Trained on new malaria case management		
	151 (67.4)	61.2-73.6
Supervised in the last 3 months preceding the survey	161 (72.5)	66.6-78.4
Supervision related to malaria case management		
	124 (55.9)	49.3-62.4
Malaria risk		
Low risk	163 (72.8)	66.9-78.6
High risk	61 (27.2)	21.4-33.1
Knowledge of uncomplicated malaria case management policy		
All suspected malaria patients be tested		
	194 (87.0)	82.5-91.4
Only test positive be treated for malaria		
	202 (90.6)	86.7-94.4
First line drug for all (AL)[a]	153 (68.3)	
		62.2-74.4
First-line drug in first-trimester of pregnancy (Quinine)	151 (67.4)	61.0-73.3
Second line drug (DHA-PPQ)		
	120 (53.6)	47.0-60.1

[a] The first line drug in all groups and second and third trimesters of pregnancy,

SD-standard deviation; DHA-PPQ - dihydroartemisinin-piperaquine

In bivariate analysis, the following health worker factors were had a positive effect on knowledge level of health workers; malaria risk (OR; 3.36, 95% CI; 1.66-2.73), age ≤ 35 years (OR; 2.30, 95% CI 1.24-4.37), in-service training (OR; 2.55, 95% CI; 1.38-4.80), and cadre nurse (OR; 4.80, 95% CI; 1.31-23.21) and medical or clinical officer (OR; 7.35, 95%

CI; 2.00-36.18). Only one facility factor was significant in univariate analysis, the availability of the current malaria treatment guidelines (OR; 2.07, 95% CI; 1.04-4.16).

However, from the multiple logistic regression only the following factors were independently associated with health worker knowledge: malaria risk (OR; 2.87 95% Confidence Interval CI; 1.42-6.20) and age of health workers (OR; 2.21, 95% CI; 1.14-4.37). No health facility-level factors were significantly related to correct malaria treatment policy knowledge among the health workers (). After testing for interaction effects in the final model there was a significant interaction between malaria endemicity and new case-management training (OR; 8.68, 95% CI; 1.72-49.47). The degree of variation of health workers knowledge at the county level was 4% (ICC=0.04).

Table 5: Predictors of correct health worker knowledge of uncomplicated malaria treatment policy

		Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Health facility	**Facility level**				
	Dispensary	Ref			
	Health Centre	0.73 (0.37-1.45)	0.360		
	Hospital	0.71 (0.30-1.66)	0.427		
	Ownership				
	Faith-based	Ref			
	Government	1.74 (0.80-3.89)	0.168		
	Availability of functional malaria diagnostic				
		0.32 (0.07-1.16)	0.108		
	Availability of recommended malaria drugs				
		1.12 (0.46-2.64)	0.803		
	Availability of the current malaria treatment guideline				
		2.07 (1.04-4.16)			
			0.038	1.43 (0.66-3.00)	0.352
Health Worker	**Age**				
	≤ 35 years	2.30 (1.24-4.37)	0.009	2.21 (1.14-4.37)	0.020*
	> 35 years	Ref			
	Gender				
	Male	Ref			
	Female	0.95 (0.53-1.71)	0.869		
	Cadre				
	Others	Ref			
	Nurse	4.80 (1.31-23.21)	0.027	3.36 (0.87-7.03)	0.100
	Medical/Clinical officer				
		7.35 (2.00-36.18)	0.006	3.73 (0.94-9.32)	0.078
	In-service training				
	Not trained on new malaria case-management	Ref			
	Trained on new malaria case-management				
		2.55 (1.38-4.8)	0.003	1.85 (0.96-3.64)	0.069
	Supervision visits				
	No Supervision visits in the previous 3 months	Ref			
	Supervision visits in the previous 3 months				
		1.15 (0.61-2.09)	0.652		
	Access to new malaria treatment guidelines				
	No access to new guidelines	Ref			
	Access to new guidelines				
		1.43 (0.74-2.73)	0.277		
Malaria risk	Low risk	Ref			
	High risk	3.36 (1.66-7.41)	0.001	2.87 (1.42-6.20)	0.004*

* Significant at level <0.05

4.1 DISCUSSION

Following the change from presumptively treating all fevers as malaria to parasitological confirmation of malaria before treatment, several countries in the African malaria endemic regions adopted the new recommendations. In Kenya the policy was changed to use of ACT (AL) for treatment of uncomplicated malaria in 2004 and to universal testing in 2010 [21, 32]. After which various interventions have been implemented to build the capacity of health workers in managing patients in accordance to national treatment guidelines (NTGs) in the recent years. These interventions include annual in-service training of health care workers to increase their knowledge of the current treatment guidelines and focused supervision. This study determined the health workers (HWs) knowledge and factors influencing their knowledge of the malaria treatment policy.

The results show that knowledge on universal testing and the recommended ACT in the above 5 kilograms weight band was high throughout the surveys. The study findings also indicate an increase in health worker level of knowledge on the first-line ACT-AL for treating uncomplicated malaria and treating only test positives. The level of the malaria policy was low at baseline and increased to 43.8% in the last round. In addition, health workers from high malaria risk areas were twice more likely to have the correct knowledge of malaria policy. This might be attributed to the focus of the National Malaria Control Programme (NMCP) on high malaria risks areas with interventions including malaria case-management trainings as evidenced by the significant interaction between high malaria

endemicity and in-service training. Younger HWs were more knowledgeable about the current policy compared to older HWs.

The results also showed that having been trained on malaria case management and having access to current guidelines had no significant association with level of knowledge, this might be because HWs mostly refer to guidelines when prescribing drugs or making a diagnosis. The findings from this study showed high levels of knowledge on universal testing and recommended ACT which is similar to reports in a study done in Kenya where all providers correctly stated the first-line drug as AL [33] and in Cameroon which reported 89.6% of providers from public health facilities knew the first-line drug [34]. The results are in contrary to a study done in Sudan where only 22% of HWs were knowledgeable about the recommended ACT [35].

Knowledge about the second-line drug DHA-PPQ was sub-optimal at baseline and about a half of HWs were able to correctly state the recommended drug in the last survey. Similar reports of only a few HWs knowing the second-line treatment for malaria was reported in Sudan [35], although an earlier report from Kenya had shown that 96% of providers knew the then second-line drug (quinine) [33].

Even though knowledge of malaria policy have been reported to not directly influence practice [34] some studies have shown that it has some impact on advising patients, making

the correct diagnosis and choosing the correct treatment. It might have also contributed to the major improvements noted in malaria case-management observed recently in outpatient departments in Kenya [36]. There was no variability of knowledge levels between counties.

4.2 CONCLUSION

There have been improvements in the knowledge about the current malaria treatment policy in Kenya. Health workers who are younger or aged 35 years and those from high malaria risk areas were more knowledgeable. The results from the study provides insight into what sections of the treatment policy the NMCP and different government agencies needs to focus on when conducting training and supervision. There is need of more studies to look into what other factors that influence HWs practices in providing outpatient malaria case management despite having the correct knowledge of the treatment policy. Investing into focused in-service training and regular supervision may be needed, particularly for front-line health workers working in public health facilities who care for the greatest proportion of malaria patients.

4.3 RECOMMENDATIONS

We recommend further research into what factors influence the implementation of the current malaria treatment policy despite health workers having the correct knowledge about the policy. Secondly, the NMCP needs to focus the training of the treatment policy as a whole including the second-line treatment drug. The older health workers (more than 35 years old) need to be trained more as they were less knowledgeable.

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