

Identifying gaps between policy and practice in malaria control
for South Sudanese refugees and displaced populations

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2. Abbreviations

ACT	artemisinin-based-combination therapy
AIDS	acquired immunodeficiency syndrome
AL	artemether-lumefantrine
AQ	amodiquine
CPA	comprehensive peace agreement
DALYs	Disability Adjusted Life Years
DDT	dichloro-diphenyl-trichloroethen
DHS	demographic and health survey
EPI	Expanded program of immunization
HIV	human immunodeficiency virus
HMIS	health management information system
IM	intramuscular
IMCI	Integrated Management of Childhood Illness
IPT	intermittent preventive treatment
IPTc	intermittent preventive treatment for children
IPTi	intermittent preventive treatment in infants
IPTp	intermittent preventive treatment in pregnancy
IRS	indoor residual spraying
ITN	insecticide-treated mosquito nets
LLIN	long lasting insecticide net
MAP	malaria atlas project
MIS	malaria indicator survey
MSF	Medecine sans frontieres (doctors without borders)
NGO	nongovernmental organizations
NMCP	national malaria control program
P.	plasmodium
RBM	roll back malaria
RDT	rapid diagnostic test
SMC	seasonal malaria chemoprevention
SP	Sulphadoxine-pyrimethamine

UNAIDS	Joint United nations Programs on HIV/AIDS
UNICEF	United Nations Children's Fund
WHO	World health organization

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5. Glossary

Anthropophily: Mosquito prefer to feed on human's blood
Zoophily: Mosquito prefer to feed on animal's blood
Endo/ Exo phagic: the preferred feeding sites either indoor or outdoor.
Endo/ Exo philic: The preferred resting sites, either indoor or outdoor
Entomological Inoculation Rate (EIR): "The intensity of malaria parasite transmission is normally expressed as the entomological inoculation rate (EIR), the product of vector biting rate times the proportion of mosquitoes infected with sporozoite-stage malaria parasites".

6. Abstract

Background: Since 2011, and after the referendum the influx of displaced and refugees to South Sudan increased dramatically to more than 1.6 million. The general health situation deteriorated extensively. The displaced population resettled in regions known to be hyper-endemic with malaria, either internally or across the borders of the neighboring countries.

Objective: To explore the actual malaria control practices among humanitarian health workers supporting refugees and displaced populations from South Sudan in the neighboring countries.

Method: A literature review was conducted, to compare the national malaria guidelines from South Sudan, Ethiopia, and Uganda, in addition to interagency and UNHCR guidelines to the standard WHO guidelines. In addition to the literature review, an online survey was circulated to explore the actual practices and perceived knowledge of the humanitarian health worker about malaria epidemiology, prevention, case managements and the underlining factors for differences between the actual malaria control practices and the guidelines.

Results: The epidemiological profile of malaria affecting the displaced population from South Sudan has similarities in the three countries and slight differences. The range of implemented preventive intervention are limited to ITNs and the low coverage and utilization rate and the obvious gap of other prevention measures. The case management practices are quite different, around 36% of the respondents treat malaria on clinical judgment without requesting the standard investigation tests.

Conclusion: Malaria guidelines in South Sudan, Uganda, Ethiopia, INGOs and WHO are fairly similar. However, the actual malaria preventive interventions implemented are limited, in addition to discrepancies between the case management and standard guidelines. **Key words:** South Sudan, Malaria, Refugee, practices, epidemiology, guidelines.

7. Introduction

I have been working with Medecin Sans Frontiere MSF (doctors without borders) for the last 6 years. I did several missions in different countries in Africa, Asia and the Middle East. During this period I worked as a medical doctor in missions supporting different kind of populations, residents, internally displaced and refugees.

The last mission I did in Ethiopia in 2013, where MSF supported the refugees from Sudan and south Sudan in the southwest regions of the country. During this mission and beside many health problems, the populations resettled in regions endemic with malaria. Those regions have been known to host refugees crossing the borders and escape the internal conflict in Sudan and south Sudan.

I noticed the big burden of malaria on the refugee and host communities. We encountered with many difficulties to control malaria in such hyper-endemic regions for those valuable groups. These are the motivation factors behind the selection for this topic in order to answer questions about the standard and effective guidelines for curative and preventive measures about malaria among displaced populations. In a context where many actors are working and using their own strategic plans, guidelines and policies, with limited level of information sharing within the organization or with other actors.

8. Chapter 1 Background

8.1. Demography and Geopolitical context:

South Sudan is the newest nation that joined Africa in July 2011. The country was founded after independence from Sudan as part of the comprehensive peace agreement CPA, signed in January 2005, to end the longest civil war in Africa. The country occupies an area of 644 thousands sq.km, its landlocked country, bordered by Sudan, Ethiopia, Kenya, Uganda, Democratic Republic of Congo and the Central Africa republic figure (1)(1).

Figure 1 Map of South Sudan



Source: United Nations, department of field support, cartographic section October 2011

The total population is estimated to be around 8.4 million, according to the Sudan house hold survey conducted in 2008, although recent projections estimated the total number of the population to be around 12 million(1). The

percentage of the young population below 30 years is 72%. The population growth rate is estimated to be in the range 3% to 4.2%, and the fertility rate to be around 6.7%. The accuracy of these figures is not confirmed due to the unstable context(1).

The country has diverse ethnic groups, including Dinka, Nuer, Bari, Zande, Shiluk and many other tribes (see *annex1*). The official languages of the country are English and Arabic, including Juba and Sudanese variants, while more than 60 other ethnic, tribal languages and indigenous languages are spoken. About 83% of the population lives in rural areas, and the urbanization rate is estimated to be around 4.2% (annual rate of change), according to the estimation of 2010-2015(2)(3).

The Political instability in the newly founded country, is caused by frequent interethnic conflicts. These conflicts occur usually as intra-tribal and intertribal, and in some occasions the involvement of the security forces occurred. However these conflicts resulted in hundreds to thousands of casualties(4).

As a result of the insecurity, the South Sudanese people migrate to look for secure areas to avoid the security risks and attacks, and get away from the aggression and targeted killings(4)(5).

8.2. Socio-economic status:

Poverty is solidly embedded in the country, where 51% of the population lives below the poverty line. Family members work to generate income sources from cultivation in limited scale, and they depend on animal income to cover the household requirements. Unemployment rates are very high, only 12% of women and 11% of men have formal jobs(6).

8.3. Education:

Only 27% of the adult population over 15 years old have a primary level of education. Despite the fact that primary education is obligatory, in reality

the country has the lowest access rate to school globally. In the year 2010, the rate of enrolment in a primary school was 44%. The percentage of boys enrolled in primary education is relatively higher as compared to girls. The infrastructure for education is largely damaged or absent. The learning space and buildings are reported to be very limited, where only 20% of schools have a proper shelter(7) (8).

8.4. Infrastructure:

The country is rich in natural resources, oil and animal resources, but the war with Sudan, through which exports could take place, and the internal conflicts, slowed down the production of oil, as the main source of income and consequently delayed any development. Not surprisingly, the country has a poor infrastructure, where road density, as an example, is the lowest in Africa. Other important indicators as energy and transportation are extremely poor(2).

8.5. Water and sanitation

Around 33% of South Sudanese rely on surface water. The majority of the population get their water from wells and boreholes. The unsafe sources of water are major health challenges for the country and a main potential risk for waterborne diseases especially among displaced and refugee populations(9).

About 75% of the population does not have any kind of sanitation facility. The majority uses open defecation, indicating poor and high risk sanitation conditions in many parts of South Sudan, including the urban regions(9).

8.6. Health and nutrition

8.6.1. Health services provision

The health services in South Sudan, which are known to be limited due to the long civil war in Sudan, are markedly destroyed or further interrupted as a result of the recent conflict that started in 2013. The problems of health

system, beside the ongoing conflict, range from lack of funding and financial support and deprived infrastructure to poor human resources capacities in setting suffering from an overwhelming burden of tropical infectious diseases and high malnutrition rates. Human resources for health in Sudan is a cross-sectional determinant factor for many poor services. The majority of the population lives in rural areas, with limited number of trained health staff. Rural regions lack access. with only one third of the population having access to health services. The system has evident gaps for a functioning surveillance system, while it is a context with high prevalence and incidence of communicable diseases(10)(11)(12).

8.6.2. Nutrition

South Sudan faced many episodes of food insecurity and risks of famine in the past decades. In recent times, FAO reported a major food insecurity and nutrition crisis to the levels of emergency(13). The conflict aggravated the problem, by forcing the population to leave their homes and causing disruption to the farming cycles (13). The nutritional status of children in the country is alarming. The rate of malnutrition in South Sudan has doubled in the recent conflict, more than 222 thousands children under 5 years old are in need for treatment for severe acute malnutrition(14). The general poor population nutrition status becomes part of a cycle of malnutrition diseases, and plays a major role in the population displacement and movements(13).

8.6.3. Health

The negative impact of the 4 decades of civil war, on population health, is immense. The life expectancy for South Sudanese at birth is 52 years(15). The distribution of years of life lost by causes shows a slope towards the communicable diseases with 63% compared to 22% for non communicable diseases and 14% for injuries(15).

The maternal mortality ratio was 2054 per 100000 births in 2010(10). Although, a different new figure indicates 730 deaths per 100000 births, nevertheless far from the target of the millennium development goal 5 MDG5(16). This high maternal mortality ratio is clearly associated with the lack of emergency obstetrics health services and skilled birth attendants(15)(17).

Child health indicators show a high mortality rate in under 5 years old groups with 75 deaths per 1000 live births. The country has low levels of vaccination coverage, merely 40% of children in the age 6- 59 months received vitamin A. Measles vaccination coverage in the age group 12-23 months is estimated to be 40%, there is no recent accurate data, as a result of the conflict, the WHO considers this low coverage as a potential high risk for disease outbreaks (14). Communicable diseases are the most important causes of illness and deaths in under 5 year olds(17). The high frequency of diarrhea and other waterborne diseases is primarily due to bad hygiene and lack of safe water resources and improved sanitation, associated with low levels of awareness and high levels of illiteracy rate(9).

The number of people living with Human immunodeficiency Virus (HIV) in the country are estimated to be around 150.000, and the deaths due to HIV/AIDS estimated at around 13.000 in 2012. Beside other determinants, HIV is affected greatly by high levels of poverty, low education levels, illiteracy and weak health system services. The access to HIV treatment and other services is inadequate and very limited, mostly only available in the large cities and where international organizations are working(18).

Tuberculosis (TB) is a major health problem in South Sudan. The prevalence of TB is 207 per 100.000 population(19).

South Sudan is a malaria endemic country. The disease is a leading cause of death and is among the top five killing diseases in under 5 children. It has a greater effect among the displaced population(20)(21)(22)(see annex 4).

Optimal malaria treatment and control measures are very limited inside South Sudan. For the last 5 years malaria trends started to peak again in South Sudan, which can indicate challenges facing the disease control(20). However, the situation of population movement in south Sudan, either internally or across the borders to neighboring countries contributes to the spread of the disease, where people move from an area of high transmission with certain species to another area with possible different seasonal or patterns of malaria(23)(23).

8.7. Refugees and displaced population situation

Since 2011, and after the referendum, the influx of the displaced and the refugees to South Sudan increased dramatically. Recently the general health situation deteriorated further more, due to the high numbers of the internally displaced population, and the destruction of the health facilities during the conflicts(16).The situation put the displaced population in challenging circumstances, with great needs for humanitarian support(16). The numbers of internally displaced populations is estimated at around 1.1 million Part of them take shelter around United nations peace keeping bases(16)(24). The UNHCR estimates the number of people that escaped the country as refugees to the neighboring country to be more than five hundred thousand(18)(25). The influx is increasing and frequent movements across the borders are reported with countries like Ethiopia, Uganda, Sudan and Kenya(18). The deteriorating situation effects the refugees from Sudan in South Sudan, where around 240 thousand, escaped the war in Sudan. Large groups of Sudanese refugees returned, as recent UNHCR reports declared, to the area of the blue Nile in Sudan due to food shortages in the refugee camps(19)(26).

9. Chapter 2 Study outline and methodology

9.1. Problem statement

Malaria is one of the biggest health problems in South Sudan, the situation of population movements in the country, either internally or across the borders to neighboring countries, contributed to the spread of this disease(23)(20)(23). Populations move from area of high or low transmission, with certain species, to another area with possible different seasonal patterns of malaria(23). Thousands of displaced populations are in either flood-prone regions or congested areas. They have been relocated to new sites to improve their living conditions, but are still severely exposed to environmental hazards (27)(24).

Due to the deprived capacity of the health system in South Sudan, and failure of the national malaria program to deal with such health problems, the international humanitarian organizations scale up their operations to cover the huge gaps. As a part of the humanitarian health support , the health staff, working in organizations, were challenged with the malaria endemic situation. They have to deal with the burden of malaria and its known previous high mortality rates 12.3% among refugee reported in study done in 2008-2009 in similar displaced populations settings(27). The humanitarian workers control the disease using different guidelines, protocols and policies adopted by their organizations. The staff has their own experience preferences .These differences and perceptions to the guidelines and protocols in such complex emergency can greatly affect the disease control program. With the possibility of weak adherence to the guideline protocols, prevention and monitoring measures can deteriorate rapidly.

9.2. Justification of the study:

There is a need for optimal harmonization between the guidelines and the actual practices as an important element in malaria control for the South

Sudanese population. The fact that this population is dispersed over three countries due to the conflict, with each of the three countries having their own malaria control guidelines, could significantly complicate malaria control for the South Sudanese population. And malaria is an important disease to address, both from a population as well as a health system perspective.

9.2.1. Population perspective:

Malaria is leading cause in morbidities and mortality in South Sudan, and among the displaced population. It has direct impact on other morbidities and health conditions among displaced and refugee populations, e.g. it can contribute to the development of malnutrition and anemia(28).

The disease has major negative impacts on the economy of the community, and can affect the economy of the population and families, which later can contribute as an important factor in their poor health status(29)(30).

Women and children are around 95% of the displaced population, they are one of the most vulnerable groups for the disease. In addition to the harsh living conditions, malaria can add a higher burden on their health, especially pregnant women, by increasing dramatically the chances for anemia, miscarriages and death.

9.2.2. Health system perspective:

To control malaria, the health system and malaria control measures should be implemented in optimal levels and the following areas need to be explored.

To understand the different diagnostic measures and tools used by the health workers and to compare it to the standard guidelines.

To identify possible irrational use of anti malarial treatment, due to weak adherence to the protocols and guidelines in each region, according to its epidemiological characteristics. Exploring the actual practices can identify possible weak points to address in the disease control(31).

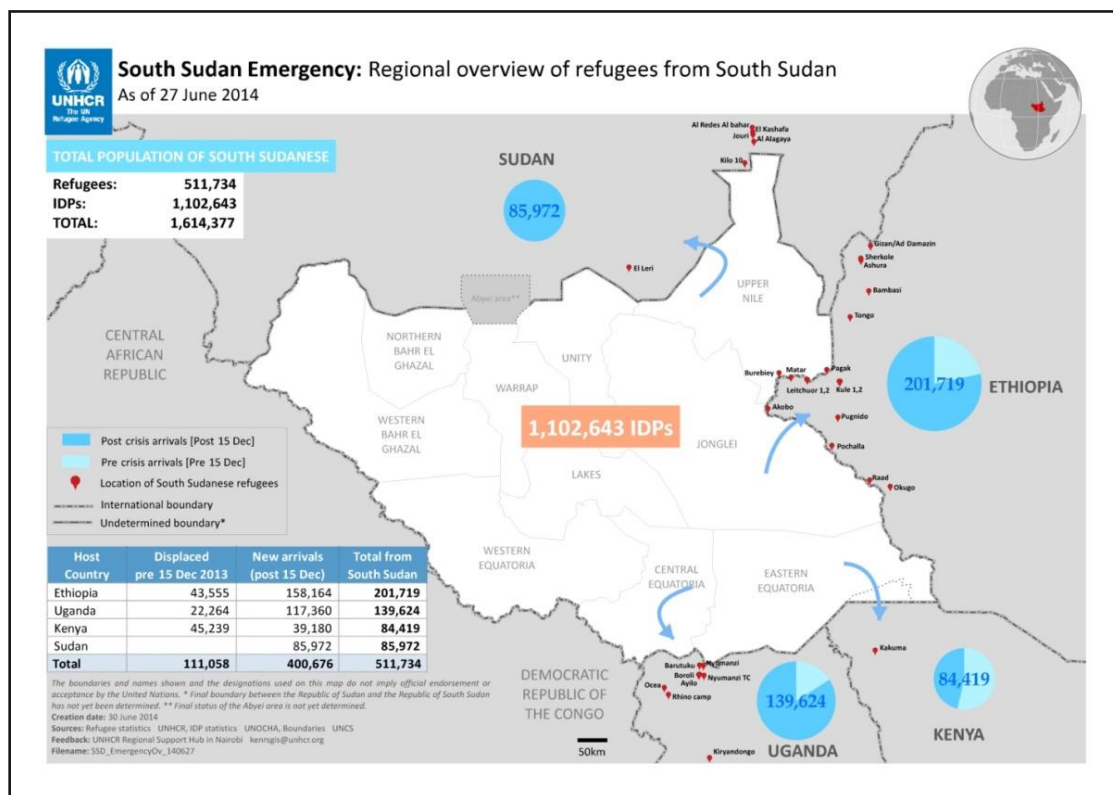
Displaced populations from South Sudan as mobile populations are prone to the above mentioned conditions and can contribute dramatically to the spread of a resistance to the parasite to areas previously free from a resistant strain. They are prone to new strains of the malaria parasite, as in P.v in the Southwest regions in Ethiopia, which can lead to serious morbidities, and can later import the disease back to their home country(27)(32).

Malaria parasites and vectors have different mechanisms to gain resistance to anti malaria drugs. Part of the major causes to develop resistance are poor standard medication practices, which could be the case in a displaced population (Ranson et al. 2009).

Geographically, the regions where refugees resettled are located within endemic malaria regions. It is ecologically favorable for malaria outbreaks and transmission, with similar epidemiological characteristic across different countries (see annex4,5,6)(27).

The influx of refugees to new countries put them under the national malaria policy, guidelines and prevention measures. Other actors in the region have their own guidelines and policies, these together create a need to explore and to compare the available guidelines, policies and control measures among refugees populations within this specific geographical regions which share special similar characteristics(see figure2) (see annex4,5,6).

Figure 2 Regional overview of refugees from South Sudan.



Source: Refugee statistics UNHCR. IDP statistics UNOCHA, Boundaries UNCS. June/2014.

9.3. Objectives

9.3.1. General Objective:

To explore the actual malaria control practices among humanitarian health workers supporting refugees and displaced populations from South Sudan in the neighboring countries, in order to inform key stakeholders about potential intervention gaps in malaria control.

9.3.2. Specific Objectives:

- To identify the epidemiological characteristics of malaria affecting the displaced and refugee populations from South Sudan.
- To identify the range of interventions and compare between the treatment guidelines and control measures used by humanitarian

organizations and the national malaria programs for refugees and local populations.

- To explore the reasons for differences between actual practices and malaria guidelines as relevant to the South Sudanese displaced population.
- To generate recommendations to improve possible gaps in malaria control among displaced populations to be adopted by the relevant health authorities and actors.

9.4. Methods

To achieve the objectives of the study, two main strategies were used. The first strategy was a literature review done to describe malaria epidemiology and to compare malaria guidelines in South Sudan, Ethiopia, and Uganda to WHO and INGOs guidelines used among displaced populations.

The second strategy was a survey, administered to explore the actual malaria control practices among health workers supporting refugees and displaced population, in addition to the host population from south Sudan in the neighboring countries.

9.4.1. Literature review:

Published, peer-reviewed literature:

To serve as evidence, to backup findings and serve as a guidance for recommendations on the way forward, the literature was obtained through a search of Pubmed, Scopus and VU library websites. Google scholar was the search engine used.

The key words used are;

Refugee, Malaria, guideline, South Sudan, Ethiopia, Uganda, Sudan, interventions, prevention, health workers practices, policy and resistance. Moreover, a combinations of the previously mentioned words were used.

Gray literature

The gray literature search have been done specially for malaria guidelines, interventions and policies. The relevant documents describing malaria control and treatment practices and guidelines for both refugees and displaced population, was obtained from the websites of United nations, UN organizations , ministries of health , INGOs and faith based organizations FBOs. Google was used as search engine.

In addition to the above mentioned data a geopolitical contexts and health situation was extracted using the same search engine and similar websites. Unpublished reports were also included from organizations working in the region.

9.4.2. Inclusion criteria:

For the published, peer-reviewed literature, documents published in English within the last 10 years were included.

For the gray literature, the most recent documents, policies and reports, related to public health situation of the population and malaria in the three countries, were included. These documents explained the development of the last guidelines and policies used for refugees and local populations.

9.5. Survey methodology:

The objectives of the survey were to collect information about the actual malaria control practices among health workers supporting the displaced and refugees from South Sudan. It consists of an online questionnaire sent to the participants using Survey Monkey TMas platform.

The questions in the questionnaire reflect the health workers perception and information about malaria epidemiology, case management, prevention measures and the guidelines used. By answering multiple choice questions and open end questions. The perception of the health workers, for possible underlying causes, led to differences between actual practices and standard

guidelines which has been explored by open end questions. see table (1)for variables and annex (2).

9.6. Ethical consideration

A waiver from the Royal Tropical institute ethical committee was given. The completion of the survey was voluntary, and it has been introduced to educated health professionals. The Survey is anonymous , and the participants have the right to withdraw and not to respond at any time. It has been preceded by explanations of the survey objectives. The outcome of the thesis will be shared with the participants .

9.7. Selection criteria:

The participants were either former or current medical staff working with NGOs, UN and MOH at either headquarter, country coordination or field levels for both national and international NGOs staff, in addition to central and service-level positions for the MoH staff. They should be working now or did their missions not before the year 2011.

9.8. Sampling

The sample technique used was Snowball sampling. The first contact was initiated with a current and former NGO staff, working with the refugees and displaced population settings in the region. I contacted key staff in MSF, Medir, UNHCR and WHO. The objectives and the survey were shared with them. I requested to share this information with the relevant contacts fitting the selection criteria asking them (if they agree) to participate on the survey, by sending the link through emails.

Table 1 Survey variables.

Questioner: variables collected	
Back grounds of the staff Variables	Country, region, period and duration of work, type or organization, Position of the staff, type of staff (national international), target population worked for.
variables for epidemiological profile	Prevalence* type of malaria parasites
variables for clinical management	Diagnosis tools used guidelines used Anti-malarial drugs used.
variables for control and Prevention interventions	Vector control measures implemented Parasite control measures
Integrated Management of Child illness(IMCI) program	Implemented / not
The possible causes of differences between the actual practices and the standard malaria guidelines.	Open end question.

9.9. Framework for analysis:

The analytical framework has been developed to compare the last common standard ministries of health and the different organizations guidelines used in the refugees and displaced populations in addition to host community. The frame analyses the relation between the different guidelines used for the

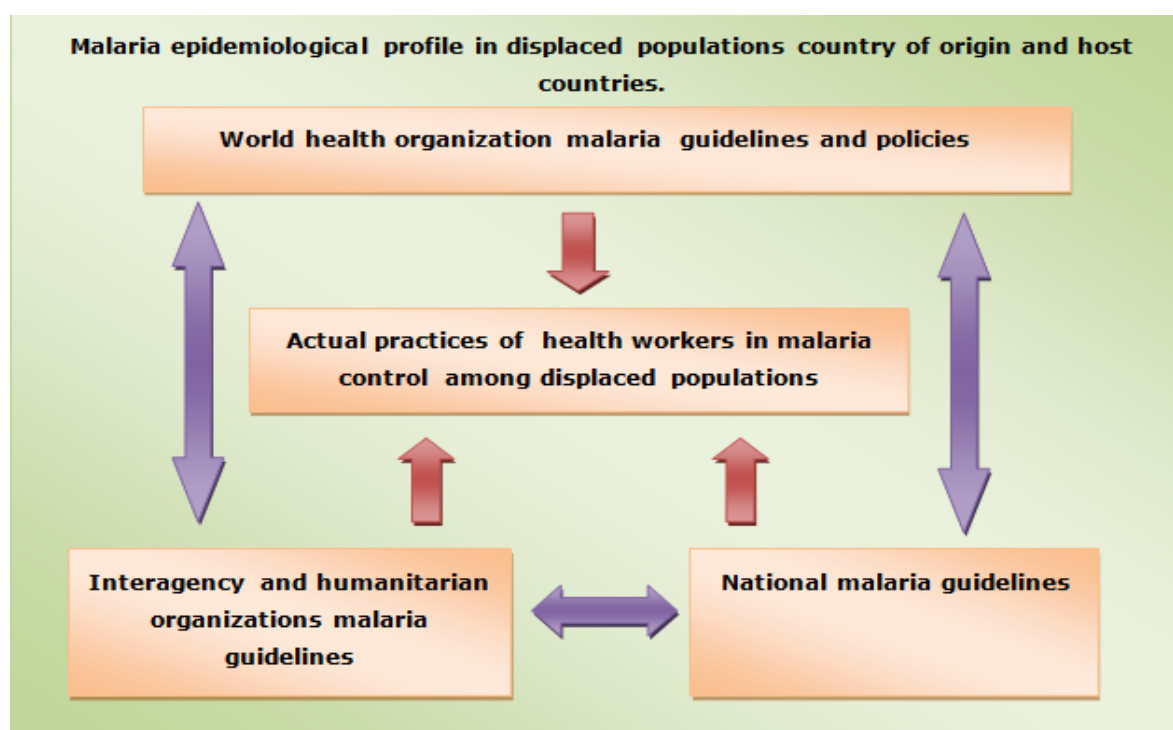
specific malaria epidemiological profile in relation to the actual practices of health workers supporting the refugees and displaced populations.

The elements of the framework

- The framework explore and analyses the relation between the available guidelines, practices and epidemiology.
- The epidemiological malaria profile of the refugees country of origin and host countries, specifically the local and regional epidemiology where they have been located.
- The institutional guidelines for the national malaria program (MOH), WHO, and INGOs.

The actual practices of health workers among displaced, refugees and residents population, using the outcome and results of the survey.

Figure 3: Analytical Frame Work



Analytical frame work; to analyze the relation between malaria guidelines, epidemiology and actual practices.

9.10. Limitations of the study:

The limited number of respondents, it's a convenient participation by snowballing sample for the survey, this could limit the exploration to certain group with their possible similar concepts group.

The analytical frame work developed is limited to the comparison of the guidelines, and the relation between them and the actual practices in certain epidemiological context, without exploring the other determinants of malaria.

10. Chapter 3 Findings

10.1. Malaria Epidemiology profile:

This section will discuss the general epidemiological profile for each of the countries where refugee and displaced populations from S. Sudan have primarily settled.

10.1.1. South Sudan

South Sudan is classified as an area of high transmission (>1 case per 1,000 population) with an estimated total of 10,800,000 cases in 2012. Malaria has an ongoing transmission pattern throughout the year. There is an extensive seasonal peak for six months, within the rainy period which extends from April to December (33).

The burden and epidemiology data of the disease in the country are far from accurate, as a result of the nonfunctioning health management information system HMIS (20). The under reporting, of confirmed cases, is a major obstacle for obtaining reliable data; most cases of malaria are treated in rural areas without proper microscopy or rapid diagnostic tests (RDTs). Even when the tests are done at present the quality seems to be very poor. Malaria accounts for around 20-40% of cases in the outpatients visits and up to 30% of all hospital admissions (consortium, 2010). Additionally the recent conflict limits the chances to have accurate data about the burden of malaria among the displaced population.

The major malaria parasite species in South Sudan is *P. falciparum* causing 95% of the malaria cases, and the *P. vivax* causing around 5% of the cases, (see table 2) and (annex 4,5, 6). The parasite has been reported to be resistant to a number of drugs within the last 10 years, it was mainly towards Chloroquine, Sulphadoxine-pyrimethamine (SP) and Aretmisnin. The development of resistance was the reason behind the shift to aretmisnin-based combination therapy (ACTs) since 2005 (34).

The vectors for transmission are mosquitoes from the species of *Anopheles arabiensis*, *A. gambiae*, and *A. funestus*. Resistance of vectors to insecticides as dichloro-diphenyl-trichloroethane (DDT) was reported in studies conducted in the central parts of Sudan, therefore, potential chances to have similar circumstances in South Sudan can be considered, as a result of the high capability of the vector to develop resistance(35).

10.1.2. Ethiopia:

Malaria is ranked high as number 4 in the burden of diseases affecting the country. It causes 4.9% of total Disability Adjusted Life Years (DALYs) in the country(global disease burden,2010).

Ethiopia is endemic with malaria, around 66% of the land are areas of low transmission, 1% areas of high transmission and it has 33% malaria free regions(33). The major species of the parasite causing the disease are *P.falciparum* 56% and *P. vivax* 44%. Ethiopia, is among the top four countries accounted for *P.vivax*. Globally, its mainly in high land and South regions(see tables2,3) and(annex5,6,7).The main season for malaria follows the June-September rains and occurs between September and December. It occurs approximately all over the country except in the highlands. Short transmission season occurs between April and May, after February-March rains.

In 2006, therapeutic efficacy tests shows resistance amongst malaria parasites in Ethiopia to (10%) and rates ranging from 0-6% for artemether-lumefantrine AL. Resistance to SP is high, and this affects the IPTp interventions negatively. Treatment failure for Chloroquine used for *P.vivax* have been reported in the country.

Anopheles arabiensis, *An.funestus* *A.phronissi* and *A.nilli* are the major mosquito species transmitting the parasite across Ethiopia. Resistance to insecticide has been reported here, mainly to DDT(36).

The Gambella region in Southwest Ethiopia, where the refugees are settled, is located within the area of high transmission. The main parasite species there is *P.falciparum* (World Health Organization 2014)(malaria atlas 2010) table 2 appendix(4,5,6,7). The epidemiology of malaria in this region is quite similar to South Sudan in terms of both the vector and parasites, and quite different from the rest of Ethiopia.

10.1.3. Uganda:

Uganda has the third top malaria burden in Africa and ranked sixth globally. Around 90% of the population are at risk contracting malaria. The disease is the second leading cause of disease burden in Uganda, responsible for 10.7% of total DALYs(37).

The main parasite species which causes malaria is *P.falciparum*. It causes almost 100% of the cases. according to the Uganda malaria indicator survey reports 2010, *P.falciparum* contributes by 90-98% and *P. malariae* by around 1-3% and the other species are rare(38).

The incidence in 2012 in the high transmission zones (>1 per 1000 population) was 327,000, cases and in the low transmission (0-1 per 1000 population) 3,630, . table (2,3) and appendix(7). The high rainfall allow steady and permanent high levels of transmission of the disease in more than 90% of the state. The resistance to the anti-malarial drugs (SP) was reported, and it shows increasing trends nationwide.

Anopheles funestus and *A.gambiae* are the main mosquito species is involved in the disease transmission in Uganda. Resistance of mosquitoes to insecticide has been reported in Uganda since 2005(WHO 2005) table (2,3).

In the Northern part of Uganda, where refugees live, close to the borders with South Sudan, the entomological inoculation rate EIR are among the highest globally appendix(8). Moreover, the Therapeutic efficacy tests(clinical and parasitological treatment failures) are old and new tests have not recently been conducted in the country.

10.1.4. Summary of malaria epidemiology

Table 2 Summary of transmission and common malaria parasites

	S. Sudan	SW region Ethiopia	North Uganda
Parasite species	<i>P.f</i> 95% <i>P.v</i> 5%	<i>P.f</i> <i>P.v</i>	<i>P.f</i>
Transmission intensity	High	High	High
Season length Peak transmission months	6-7 months Sep to Nov	Sep-Dec April May	Throughout the year 2 peaks May and November
Drug resistance	<i>P.f</i> to SP <i>P.v</i> to <i>Chloroquine</i>	<i>P.f</i> SP <i>P.v</i> Chloroquine	SP
Insecticide resistance	DDT	DDT	DDT

Source: Malaria atlas project 2010, Malaria world health report 2013 and Atlas of insecticide resistance in malaria vectors of WHO African region 2005

Table 3 Summary of major malaria vectors in South Sudan, Ethiopia and Uganda

Vectors	An. gambiae Highly important vector	An funestus important vector whenever found	An.arabiensis	An. nili
Distribution	- S. Sudan - North Uganda - S.W Ethiopia	- S. Sudan - North Uganda - S.W Ethiopia	S. Sudan Ethiopia	S.Sudan Ethiopia Uganda
Primary environment	Sunlit Shallow temporary pools.	Swamps, lakes edges, savannah	Dry Savannah, spare woodland	Edges of fast -flowing streams and rivers, in degraded forests savannah
Preferred feeding on Anthrophily Anthro /Zoo- pophilic	Human, Strongly <i>Anthrophilic</i>	Human, Strongly <i>Anthrophilic</i>	Anthrophilic Both	Anthrophilic
Preferred biting locations feeding(endo/exo phagic)	Endo-phagic Both!	Endo-phagic Both!	Exo-phagic	Endo-phagic Exo-phagic
Preferred resting locations Endo /Exo -philic	Endophilic	Enodphilic	Endo-philic Exo-philic	Endo-philic Exo-philic
Preferred feeding time	Evening, night, dawn	Evening, night, dawn	Evening night down	Evening /down
Control	LLINs IRS	LLINs IRS	LLINs IRS	LLINs IRS

Source: Malaria atlas project. Malaria.com, anopheles mosquitoes 2010.

10.2. Malaria guidelines:

10.2.1. World health Organization:

The WHO malaria guidelines and policy papers are intended as a guide for better practices to control malaria worldwide. The target audience is policy makers in ministries of health. Other target groups are the public and policy specialists, health professionals, (doctors, nurses and paramedical staff) WHO malaria guidelines 2010.

For prevention, WHO recommends multiple types of intervention, for both the vector and the parasites. For vector, WHO recommends the use of long-lasting insecticidal nets, indoor residual spraying, and larva control measures, appendix 8(WHO)(WHO 2006).

WHO recommends chemoprevention measures, IPTi, IPT, IPTp, and SMC, using SP and AQ in seasonal malaria areas, in which the efficacy of the drugs are still higher than 90%, table(39) (WHO 2013)

WHO recommends the use of diagnostic tools including microscopy and RDTs before treatment initiation for all suspected cases with fever, and the exemption is for cases located in far remote areas(World Health Organization 2010).

10.2.2. South Sudan; National malaria guidelines:

South Sudan has been exposed to the force of years of chronic war, and has probably one of the highest malaria burdens in Africa(31). However, effective malaria control in a country, in post conflict settings, is disadvantaged by a variety of challenges. Recently, the situations of the displaced and refugees, add an extra obstacle to the common difficulties in front of the national malaria control program (NMCP). However these standard guidelines, policies and interventions are a cornerstone to overcome the obstacles. The government of South Sudan is receiving support from different UN organizations and INGOs, to support the NMCP in a variety of aspects including, developing strategies, interventions and

control measures. As a result, the national strategy is continuously being adapted. The following are the most recent adopted preventions and treatment interventions by NMCP South Sudan(20).

Prevention

For vector control measures, the NMCP recommends and adopts the distribution of Long lasting insecticidal nets (LLINs)., in addition to introduction of indoor residual spraying (IRS) and other intervention for larva source management (LSM). Currently LLINs is what's left as the only key intervention with restricted use of IRS, and larviciding which has been used recently in Malakal town by mentor initiative(40). South Sudan has a history of vector control in the form of larviciding measures, since the 70s and 80s. However, the civil war and the destruction of the infrastructure interrupts many of the prevention measures including larvaciding. It has been implemented by local units to control the vector around the main cities and municipalities.WHO supported South Sudan to adopt integrated vector management (IVM)(41).

The coverage of LLINs was very low, according to the last malaria indicator survey conducted. Only 59.3% of households own at least one mosquito net(21). The proportion of the South Sudanese population, with access to LLINs was 49.7% and with very low utilization rate. The utilization rate of LLINs was 25.3% for children under 5 years and 35.9% for pregnant women. NMCP had planned targeted IRS activities and larviciding interventions. The security context and escalation of the conflicts interrupted these plans. For the displaced population, with history of low utilization rate, the possibility for an extremely low utilization rate is highly expected. According to the observed high malaria prevalence and transmission, access and utilization of LLINs seems to be very limited(42).

For chemoprevention, the NMCP guidelines recommend the use of SP in IPTp for pregnant women. Two doses should be given to the pregnant women

during antenatal care visits. The dose should be given once a month as directly observed treatment for two months and three months for HIV infected women(43).

Case management

For diagnosis the guideline of NMCP recommends the use of microscopy to confirm the malaria parasite as the gold standard test(44). Microscopy needs skilled well trained staff to do the examination(45). However, due to the collapsed health system and lack of human resources, microscopy is limited to major health facilities such as hospitals and limited number of clinics providing primary health care. Only 40% of health facilities offer the diagnostic tests and with poor quality. Malaria diagnoses in South Sudan depends mainly on clinical judgment. Only 27% of the cases had confirmed diagnostic tests(21). Rapid diagnostic tests are introduced in South Sudan by WHO, UNCEF, NGO's, FBO's, and other organizations. They represent the main support with RDT's provision. The use of RDT's at community level is limited. Displaced and refugee population in remote and scattered regions face challenges to have diagnostic services for malaria.

Since 2005, South Sudan as a part of Sudan, shifted treatment to combination therapy. Resistance to Chloroquine CQ and SP was very high(20). The first line treatment for uncomplicated malaria is ACT's. The combination of artesunate AS and amodiaquine AQ(AS+AQ) is used as the first line treatment for uncomplicated malaria.

The second line treatment is artemether and lumefantrine. For severe malaria NMCP recommend the use of parenteral artesunate, Artemether and quinine. After the first doses and stabilization of the patient, third line parenteral treatment is usually shifted to oral ACTs or quinine(45).

The pre-referral severe malaria cases are treated with rectal artesunate. The integrated management of child illness is adopted and syndromic malaria treatment is applied accordingly(44).

10.2.3. Ethiopia national malaria guidelines:

The health system operates under the federal government system. The federal ministry of health is the coordinator for the national programs such as malaria. The national malaria program is guided by the 5 years national strategic health plan 2010/11-2014/15(36). Ethiopia adopted the strategy to increase the human resources in health by training of health extension workers (HEW) since 2003(37). HEW, contributed positively in the delivery of prevention services, including malaria measures(46)(47)

Prevention

For vector control the NMCP has adopted several options. LLINs and IRS are the main vector control measures. IRS coverage was low, slight improvement occurred in the recent years to reach 50% of the target. The IRS program is facing logistic obstacles, human resources obstacles and fund obstacles. Widespread resistance to DDT is reported, and malathion (50%WP) is used as alternative(48). Insecticide resistance studies are carried out, and it is the guide for IRS interventions. The IRS supervision is weak and a lot is needed to meet WHO and Food and Agriculture Organization (FAO) safety requirements. The Target areas are located between 1000 to 2000 above sea level. The IRS interventions are decentralized to HEWs and Kebele levels. The coverage of IRS is still low with only around 15% of the target reached in 2013(33).

LLINs; are distributed and used in Ethiopia. More than 15 million nets were distributed in the period of 2010-2011. The distribution occurs through different channels including Expanded programs of immunization (EPI), and Enhanced outreach strategy EOS(47). Some reports estimate a loss of about 40% of the distributed nets. The social and behavioral aspects contributed negatively to the utilization of the LLINs. It has been reported to be used as fishing nets, curtains or not the proper use of the nets table(4)(49).

Case management:

Microscopy and RDT's are the methods implemented to diagnose malaria. Microscopy is mainly used in Hospitals and health centers with a power supply. FMOH in Ethiopia started using RDT's in 2005, it was for single species. Currently Multi-species RDT's are used. However the diagnosis of malaria in the country moved quickly in the last few years to RDT's. The country has a plan for universal coverage of malaria diagnostic tools. The use of multi species RDT's became the main tool in this area, to reach the community levels through health extension workers. These diagnostic services are widely distributed in health posts, and the treatment of malaria is provided to positive cases(50).

Confirmed *P.falciparum* cases are treated using ACTs. However, positive *P.vivax* only cases are treated with Chloroquine. Severe malaria is caused mainly by *P.f*, but *P.v* is also reported causing severe conditions.

Severe malaria cases are treated with Artesunate. For radical treatment Primaquine is drug of choice, and recommended at the health center levels with close monitoring for side effects.

For pregnant women with positive *P.f* malaria tests, its recommended to use quinine as the first line treatment in the first trimester, and Chloroquine for *P.vivax*(50).

10.2.4. Uganda National malaria guidelines:

Prevention

The national malaria control program adopted multiple strategies for vector control and prevention. The measures are in line with other countries and WHO recommendations. The key interventions are; distribution of long lasting insecticide nets LLINs, Indoor residual spraying IRS, and environmental management , depending in the feasibility and effectiveness.

For treatment and prevention of malaria during pregnancy, the IPTp and intermittent prevention treatment IPT are recommended, table (4) (51)(52)(53)

Case management

For diagnosis, microscopy is the gold standard test to diagnose malaria in all suspected cases. The treatment should be guided by diagnostic confirmatory tests before initiation. The RDT's will be used in lower level health facilities. The plan of the NMCP is to increase the coverage of diagnostic tests to reach 90% of suspected cases. Although this may be a true effort, the reality shows that most malaria diagnosis is still based on clinical judgment of the health workers. Many of the factors affected can be attributed to lack of awareness or unwillingness to adhere to the guidelines so as to request the test by both health worker and patients(54).

The guidelines recommend the use of ACT's to treat malaria confirmed cases. Quinine and Arthemether are also used as second and third lines (*see table 3*).

10.2.5. Interagency malaria guidelines:

This guideline consists of the book "Malaria control in humanitarian emergencies; An inter-agency field handbook", recently updated in 2013(World Health Organization 2013). Its intended to be used by policy makers in humanitarian emergencies, fieldplanners and coordinators designing and implementing malaria control interventions . This is the agreed and used guideline by many health organizations. It's the primary guideline used by agencies such as UNHCR, UNCEF, MSF, CDC, Mentor and other NOG's working in this context in the humanitarian field. Although this guideline contains clear directives for best practices to follow in the field, it clearly states that national guidelines should be followed if they are up to date and the acute emergency phase has ended.

Prevention

The guideline indicates that focus should be the prompt treatment and diagnosis in the acute phase to limit malaria deaths. Mostly the LLINs are the preferred barrier methods. In addition to insecticide, treated plastic sheeting, can be used with caution and to be avoided where the local malaria vector is resistant to pyrethroids

IRS is also recommended in setting where there is a possibility to apply it, which is not the case in the South Sudanese displaced population during the emergency phase. Other measures of chemoprevention like IPT is recommended(51).

Case management

For diagnosis, the RDT's are the recommended tests. The use of RDT's is recommended because it does not need sophisticated infrastructure and highly skilled human resources. These requirements are relatively less when compared to light microscopy where the need for higher level skilled staff and infrastructures are required as preconditions(40). The refugees are located in an area classified, according to WHO, as zone 1 where P.f is dominant and in zone 2 where a mix of P.f and other species is present. For this reason the interagency guidelines prefer the use of RDT's with multispecies detection capability to detect both species (40).

For the treatment the guidelines recommend to follow the national guidelines and policies. With clear preference to treat uncomplicated P.f malaria with ACT's. ACT's are indicated to treat uncomplicated malaria in pregnancy after the first trimester. For severe malaria, Artesunate is the drug of choice. It can be used rectally as a pre-referral step in remote areas, Parenteral artesunate is the treatment of choice, quinine and Artemether are acceptable alternatives in injection form in health centers.

10.2.6. UNHCR Guidelines:

Prevention

The guidelines recommend the use of LLINs. For IRS, special consideration should be kept ahead for the logistic, trained human resources and the suitable housing structure, before applying IRS.

The use of IPTp is advisable, and consideration should be taken for HIV positive pregnant women, they have a higher risk and need more doses. The drug of choice is SP, and the guidelines recommend it, despite the emerging resistance. The IPTp is linked with the presence of ANC services in areas with moderate to high transmission.

Cases management

For the diagnosis, UNHCR recommends RDTs in the acute emergency phase. With the main goal to detect *P.falciparum* in earlier stages to avoid further complications and deaths .

In the treatment phase and medication UNHCR guidelines recommend the use of ACTs, AL is the first line treatment for uncomplicated malaria. However, the guidelines consider the national malaria control program NMCPs documents as gold standard.

For pregnant women, the guidelines recommend the use of AL for uncomplicated cases in the 2nd and 3ed trimester, and the combination of Quinine in the first trimester.

In severe malaria cases, the use of intravenous or intramuscular artesunate and Arthemether are recommended , or other rectal aretmisinin derivatives. quinine is the final alternative and should be shifted as soon as possible to ACTs.

In the emergency phase the guidelines recommend empiric treatment if diagnosis tools are not available. Once the emergency phase is over the guidelines should be harmonized with the host country NMCP guidelines table (4).

According to the UNHCR strategic plan and guidelines, treatment with anti-malarial drugs should be based on drug efficacy data done within the recent two years (55).

10.2.7. Regional level coordination mechanism:

The three countries are part of the east African sub-regional network ERAN for malaria(ERAN 2013). it's a good platform for data and information exchange. They organize meetings at the regional level where national programs, performance and data are shared, the aim to indentify progress in the various intervention strategies(ERAN 2013).

Table 4 Summary table malaria guidelines

	National guidelines			Humanitarian guidelines			
	S Sudan	Ethiopia	Uganda	WHO	Interagency	MSF	UNHCR
Intended audience							
Policy makers and planners	X	X	X	X	X	X	X
National public sector	X	X	X	X			
National private sector	X	X	X	X			
Government agencies	X	X	X	X	X		
Local and international (humanitarian) NGOs	X	X	X	X	X	X	X
UN agencies...	X	X	X	X	X	X	X
Medical and paramedical staff	X	X	X		X	X	X
Recommended prevention measures							
LLIN	X	X	x	X	X	X	X
IRS	X	X	x	X	X	X*	
IPT	X	X	X	X	X	X	X
IPTp	X	X	X	X	X	X	X
Fogging							
IPTi	X	X	X	X	X	X	X

Impregnated plastic sheeting					X	X	X
Recommended diagnostic method							
Microscopy	X	X	X	X	X	x	x
Single-species RDT	X	X	X	X	X	X	X
Multi-species RDT	X	X	X	X	X	X	X
Clinical							
First-line Treatment (Pf)							
ACT	X	X	X	X	X	X	X
AL	X	X	X	X	X	X	X
CQ...							
First-line Treatment (Pv)							
ACT	X	X	X	X			
Choloroquine		X					X

10.3. The actual practices of health workers:

10.3.1. Respondents

The total number of participants were 31. The responses were collected during the period of the 16th June to the 2nd of August 2014. Out of the 31 participants, 30 fully completed the online survey, one was left out of the analysis. All the participants fitted the criteria for participation. They are health workers, providing support for refugees and displaced population through different organizations and institutions, they have been working and worked there within the last 4 years.

The responses came from staff working in missions in three countries. Around 43.33%, of the participants are from South Sudan, Ethiopia 36.67% and Uganda 20% table (4). The positions of the participants varies from staff working at the regional level, coordination and headquarters in different posts as medical coordinators, project coordinators, nurses and midwives .annex . They are a mix of international staff 56.7% and national staff 43.3% and worked for eight different international nongovernmental organizations INGOs, UN organizations and MOH see tables(4),(5),(7)and (8).

The group of participants who worked for more than 1 year represent 50 % of the total respondents, others, 20%, worked for less than 3 months, 26.67% worked for 4-6 months and 3.33% worked for 6-12 months table(6).

Table 5 Distribution of participants according to country

Country	South Sudan	Ethiopia	Uganda	Total
Number	13	11	6	30
Percentage %	43.33 %	36.67 %	20 %	100 %

Table 6 Type of staff and duration of mission /Organization

Staff	National	International	Total	0-3 months	4-6 months	6-12 months	> 1 year
UN organizations	4	3	7	0	0	1	6
INGO	7	14	21	6	8	1	6
MOH	2	0	2	0	0	0	2
Total	13	17	30	6	8	2	14
%	43.33	56.67	100	20	26.67	6.67	46.67

Table 7 Type of population supported

Type of population served	Responses	Percentage
Residents	13	43.33%
Displaced	14	46.67
Refugees	19	63.33

10.3.2. Understanding of local malaria epidemiology

Around 80% of the participants reported they worked in a hyper endemic regions, whereas 13% mentioned they worked in low endemic regions and 6% worked in meso-endemic regions.

For the parasites species, 80% of the responses indicate malaria is caused by *P.falciparum* and 40% of them mentioned *P.vivax*. For the other species *P.ovale* was 0% and *P.malariae* is 3.33% of respondents answers, see table table(9)and(8).

Table 8 Prevalence of malaria in participant's country.

Malaria prevalence	Hyper-endemic	Low endemic	Meso-endemic	Total

Responses	24	4	2	30
Percentage %	80 %	13.33 %	6.67 %	100

Table 9 Parasite species

Parasite species	P.f	P.v	P.O	P.m	Unknown
South Sudan	11	3	0	0	0
Ethiopia	10	9	0	1	1
Uganda	6	0	0	0	0
Total	27	12	0	1	1
Percentage	90%	40%	0%	3.33%	3.33%

Table 10 Prevention measures used

Methods	IPTp	IRS	SMC	Fog	LLIN	IPT	Imp/plastic*
S. Sudan	4	5	2	3	13	5	2
Ethiopia	3	6	1	0	11	0	0
Uganda	1	1	0	0	5	1	0
Total	8	12	3	3	29	6	2
Percentage	26.67%	40%	10%	10%	96.67%	20%	6.67%

10.3.3. Prevention measures used:

For prevention, around 96% of the respondents used LLIN as a measure for vector control, while IRS is used by 40% of them. Other measures as IPTp, IPT, SMC, fogging and impregnated plastic sheeting are used with lower percentages, in the ranges between 26% to 6% see table(14).

10.3.4. The integrated management of child illness(IMCI):

Around 83% of the respondent mentioned that IMCI is implemented in their settings and 13.33% mentioned it is not used table11.

Table 11 IMCI

The use of integrated management of child illness(IMCI)	Yes	No	No response
South Sudan	9	2	1
Ethiopia	10	2	0
Uganda	6	0	0
Total	25	4	1
Percentage	83.33%	13.33%	3.33%

10.3.5. Guidelines used:

The main guidelines used are the national guidelines where 63.33% used them, WHO guidelines used by 46.67% of the participants, and organization guidelines were used by 40% of the participants table (12). In South Sudan WHO guidelines, national guidelines and original guidelines are used by 53.85% of the participants .

In Ethiopia the national guidelines are used by 81.82% of the participants, and WHO guidelines are used by 54% of the participants.

In Uganda, national guidelines are used by 50% of the participants, WHO guidelines are used by 16.7%, however 50% of the participants used a mix of guidelines.

In some responses the total adds exceeds more than 100% because some respondents indicated more than one guideline in their response to the question.

Table 12 Guidelines used

Country	Total of Participants	WHO	WHO%	National	National%	Organizations/No	Organizations%
S. Sudan	13	7	53.85	7	53.85	7	53.85
Ethiopia	11	6	54.55	9	81.82	4	36.36
Uganda	6	1	16.67	3	50	2	33.33
Total	30	14	46.67	19	63.33	13	43.33

10.3.6. Case management:

Diagnosis:

Around 92% of the participants from South Sudan used RDT's to diagnose malaria, 45% used microscopy and 38% depend on a clinical judgement to diagnose malaria. In Ethiopia and Uganda 100% of the participants indicated their use of RDT's to diagnose the disease. However, around 81% of the participants from Ethiopia indicated the use of microscopy to diagnose the disease compared to 33% in Uganda and 46% in South Sudan. The overall responses showed RDT's are used by 96% of the participants, microscopy by 56% of the participants and clinical judgment by 36% of the participants. The total amount of this is more than 100% because there are respondents who choose to indicate more than one diagnostic method.

Table 13 Diagnostic methods used

Diagnostic tools	No of participants	RDTs	%	Microscopy	%	Clinical	%
S. Sudan	13	12	92.31	6	46.15	5	38.46
Ethiopia	11	11	100	9	81.82	5	45.45
Uganda	6	6	100	2	33.33	1	16.67
Total	30	29		17		11	
Over all percentage		96.67%		56.67%		36.67%	

Treatment:

Around 88% of the participants used ACT's as first line treatment, 20% of them mentioned AL as the drug type used. Chloroquine was used by staff from Ethiopia to treat P.V cases . For the second line 43.3% of participants used AL , 26.67 used Arthemether , 23.33% used quinine and 10% used ACT. One staff used a combination of Artesunate and tetracycline or doxycycline as a second line treatment. The treatment used for the third line are mainly quinine 53.33% and Arthemether 26.67% see table (11). Chloroquine is used by 2 of the participants from Ethiopia to treat P.v.

Table 14 Medications used for malaria treatment

Drugs used	1st line	Percentage %	2nd line	Percentage %	3ed line	Percentage %
ACTs	20	66.67 %	3	10 %	0	0
Chloroquine*	2	6.67 %	0	0	0	0
Artemether	0	0	8	26.67 %	8	26.67 %
AL (Coartem)	6	20 %	13	43.33 %	0	0
Quinine	0	0	7	23.33 %	16	53.33 %
Artesunate +Tetracycline or clindamycin	0	0	1	3.33 %	0	0
SP	1	3.33 %	0	0	0	0
Artesunate	0	0	3	10 %	0	0
Quinine+ Tetracycline or doxycycline	0	0	0	0	1	3.33 %

10.3.7. Participant's perceived reasons for differences between the actual practices and the guidelines:

Table 15 Differences between actual practices and guidelines

	Responses	No	%	Yes	%
S. Sudan	13	3	23.08%	10	76.92
Ethiopia	11	6	54.55%	5	45.45
Uganda	6	2	33.33%	4	66.67
Total	30	11	36.67%	19	63.33
%		36.67%		63.33%	

The responses for the possible causes underlining the differences between the actual practices and the guidelines varies from country to country.

In South Sudan 76% of the participants mentioned there are differences. Where in Ethiopia 45% of the respondents reported there are differences between actual practices and guidelines. Around 66% of the respondents from Uganda mentioned there are differences. see table 15.

10.3.8. Some of the main reasons for the differences mentioned by the respondents are:

Out of the 19 respondents 6 mentioned diagnosing malaria on clinical judgments, particularly in outpatient departments (OPD) as the reason. According to their justification, because its remote areas, where the clinical officer has less supervision, they respond to the demands of the patients, one of the responded mentioned "*Sometimes due to certain conditions, like cultural believes, we face difficulties in applying the correct management*". Three of the respondents mentioned weak supervision and the lack of guidelines are underlining causes for the differences, although one of them mentioned "*S/he treat according to the gained experience and the available guidelines*".

Another reason mentioned was that the staff did not feel satisfied with the result of the investigations from the laboratory, a respondent mentioned

"clinical treatment was a must sometimes due to lab expected errors, the second was a lack of minimum knowledge among locals".

The poor information available to the population was mentioned as a possible reason from four participants working for the displaced population in South Sudan, linked with the poor follow-up from NMCP.

One respondent mentioned the *"National staff finds the guidelines not consistent with their clinical experiences and the case management"*.

One respondents mentioned the weak coordination between the organizations and the national program could be the reason behind the differences between guidelines and actual practices.

11. Chapter (4) Discussion:

11.1. Epidemiology

The displaced population from South Sudan is located in regions of high transmission within the three countries. The regions share features of the epidemiological profile, where *P. falciparum* is the main parasite species causing malaria. Some of the vectors responsible for the disease transmission, such as *An.funestus*, *An. Gambiae* and *An.nili* are present in the three countries. However, there are some slight differences in the intensity and the prevalence and the transmission seasons. In South Sudan the season is continuous compared to two seasons in Ethiopia.

The health workers, interviewed about malaria epidemiology affecting the displaced population in the three countries, gave an indication of relative correct understanding of the local malaria epidemiology, where 80% of them mentioned its hyper-endemic regions, in line with the data available from the literature review.

However, the epidemiological data was not up to date, mainly in South Sudan, where the health system is collapsed and massive gaps in technical and human resources exist. Drug efficacy studies, especially in areas of the displaced populations were not conducted within the last 2 to 3 years. That it is possible to implement such studies in these contexts was demonstrated by the lessons learned from Burma/Myanmar resistance studies(56). No recent resistance studies for insecticidal chemicals were done or shared. Those are vital measures because the parasites and mosquitoes have the ability to develop resistance within a short period of time, which can lead to failure of certain interventions such as IPTp using SP or IRS(. At present the displacement of the population extends for more than 3 years, and the need for this information is vital.

The understanding of population movements is a key step for malaria control, not only for the displaced population, but also for the host countries.

Research has shown that understanding population movements is an important step for strategic planning for disease control in east African countries. In the case of the civil conflict in South Sudan, this data needs further exploration.

table(6)(58).

11.2. Malaria guidelines and interventions:

The three national malaria guidelines, the humanitarian interagency guidelines and WHO guidelines are quite similar. The differences observed are due to implementation and the operational capacity of the NMCPs and the different organizations (20)(59). The epidemiological context variations at the national level, which has been seen in the case of Ethiopia where Pv is more prevalent, is the reason behind the differences in drug policy between national guidelines. As updated information on drug resistance patterns in the region is not available, it is unclear if this difference in treatment guidelines affecting the mobile South Sudanese population has had any impact on case management.

11.2.1. Prevention:

For prevention measures, all the guidelines agree upon the need to adopt a combination of different strategies for vector control. From the participants responses and the performance reports of the national malaria control programs for the residents, LLINs are the key intervention implemented LLIN in the region(60). Around 96% of the participants indicate the use of LLINs as their vector control measure. IRS implementation is indicated by 40% of the participants, while other prevention measures are far less implemented, for displaced nor for resident populations. The combined implementation of multiple vector control interventions would improve malaria control as multiple interventions are complementary for each other and an enhanced effect is usually observed(61).

It is proven that there are difficulties in the provision of LLINs to reach reasonable coverage, in addition to other low utilization rates reported in South Sudan, Uganda, and Ethiopia and other countries in the region(60). The utilization rate observed in resident population is low and is likely to be at even lower levels in the context of a population movement. This issue to the poor conditions of the camps, and the frequent movements, where the maintenance of the LLIN will be challenged. Understanding the behavior of the population in this specific context, especially in regard to LLIN utilization barriers among displaced populations specifically, will be helpful for identifying future solutions (49)(24)(62). Other types of vector control measures like IRS are unlikely to be feasible for application with the type of shelter available for the South Sudanese displaced population.

For parasites chemoprevention from the survey, it seems that the use of SMC, IPT, IPTp, IPTi were not implemented in wide scale by the organizations and the health workers. This could be due to the lack of knowledge or operational obstacles. However, the perception of such interventions need to be well understood as to have maximum benefits, where the standard implementation, compliance and adherences to protocol are key elements in the effectiveness. IRS and IPTp for pregnant women are a good example(63). Where IRS is not possible, it would be possible to distribute insecticide treated plastic sheeting as an alternative intervention.

For malaria chemoprophylaxis, it seems that SMC, IPT, IPTp, and IPTi were not implemented on a wide scale by the organizations and the health workers. This could be due to the lack of knowledge or due to operational obstacles. However, the perceptions related to such interventions need to be well understood if implementation is to have maximum benefits. The standard implementation, compliance and adherences to protocol are key

elements in the effectiveness. IRS and IPTp for pregnant women are a good example(63)

11.2.2. Case management:

For the diagnostic tools, WHO, National guidelines and the inter-agency guidelines recommend the use of RDTs and microscopy. Microscopy is kept as the gold standard test for all guidelines. In reality the 3 countries are faced with challenges in the provision of the diagnostic tools such as microscopy and RDTs as they depend on external funds for the provision of these diagnostic tools. The range of the difficulties facing the countries in RDTs provision, starts from non-qualified human resources to supply and quality difficulties (20)(Organization 2014). However, INGOs have better access to RDTs in the displaced population settings, and they are preferable as they have lower technical requirements, which is important especially in the emergency phases(55). From the survey 96% indicate the use of RDTs, 56% microscopy and 36% clinical diagnosis. The possible explanations for the relatively high use of RDTs compared to microscopy could be that the majority of respondents were humanitarian workers. Besides that they are recommended in the humanitarian guidelines, INGOs have greater access and availability to RDTs. Despite the guideline restrictions which require malaria treatment to be based on confirmation with diagnostic tests, the initiation of treatment on clinical judgments is common. Around 36% of the respondents indicate they diagnose malaria on clinical judgments. These differences between the practices and the standard guidelines are common and on wider scale in the region and African(64). According to the respondents it is due to lack of supervision, and pressures from the cultural beliefs of both health workers and the community. Those findings are in line with other studies, conducted in similar contexts, where the clinical practices are affected by different factors as the poor settings, limited resources, patients behavior and health worker training level(65). Another study

conducted in Tanzania by Chandler et al(66)(64), looking at reasons behind over diagnosis of malaria, resulted in four groups of explanations:

The effects of training within a context where malaria is promoted as an important disease.

The effects of peers in compliance to the perceived expectations from colleagues.

The pressure from patients preferences.

Groups questioning the quality of the diagnostic tests.

Weak coordination and lack of supervision are part of the underlying causes reported. Furthermore, although there is a regional coordination mechanism for east African countries, the level of information sharing is limited at the service provider level between the different actors. This could be due to poor orientation middle and low level staff working in different organizations. The other possible reasons for poor coordination and information sharing amongst implementing organizations is a high turnover of human resources, which will also affect their supervision capacity(60).

11.2.3. Treatment:

The treatment guidelines are fairly similar in the adoption of ACTs as first line drugs for malaria treatment. The overall practices are in line with the treatments prescribed in the guidelines that were reported to have been used. Chloroquine was indicated to be in use by 2 of the respondents to treat P.v malaria cases as the first line in Ethiopia. However, recent studies show growing resistance to the drug to treat P.v in the country, and this may need further research to ensure guidelines are in line with the local epidemiological profile (Kebede et al. 2014).

Furthermore, responses from participants indicate that their main concerns about differences between the guidelines and practices are related to the gaps in clinical management. Curiously, differences between prescribed and practiced vector control strategies were not highlighted, suggesting that

there is a strong focus on clinical response to malaria in the humanitarian community.

11.2.4. Study limitation

The sample technique is snowballing, which could not be used statistically for inference, nevertheless it can give an estimation for the overall health worker understanding, because the participants are from quite different organizations and institutions worked in different countries and hold variety of positions.

12. Chapter 5

12.1. Conclusion:

The size of the displaced population from South Sudan is around 1.7 million, equal to 15-20% of the country total population. They have resettled in malaria endemic regions across five different countries. Three of these countries, including South Sudan itself, Uganda and Ethiopia, where the majority of displaced South Sudanese are present, experience fairly uniform epidemiological profiles for malaria transmission in the border regions, characterized by high transmission and *Plasmodium falciparum* as the main species that causes malaria. The key epidemiological difference is relative high *P.v* prevalence is in Ethiopia compared to South Sudan.

Resistance studies for vector and parasites among displaced population settings were not conducted in recent times, with possible gaps related to the information sharing mechanisms between the different actors.

The prevention measures used, are mainly LLINs, with low utilization rate in South Sudan, Ethiopia and Uganda. Other methods for prevention are trailing behind as in the case of IRS, SMC, IPT and larva source control measures or not widely implemented. The majority of projects seem to focus on a single measure (LLINs) for vector control.

The national malaria control programs and the common humanitarian organizations guidelines used are in line with WHO standard guidelines as well as with each other. The actual malaria case management and control practices in the three countries, however, are not always in line with the recommended standard guidelines. Case management practices are frequently not in line with the recommended standard diagnostic methods and treatment practices of health workers. Participants treat malaria based on clinical judgment without using diagnostic tests. Additionally, there is a suggestion that, amongst humanitarian workers, there is a focus on clinical response to malaria and that vector control activities are not a clear priority.

Successful malaria control interventions among displaced and residents populations requires a combination of improved collaboration and coordination between the different actors and the national malaria programs and further research.

12.2. Recommendations

To address the identified gaps for malaria control as major public health problem for the South Sudanese displaced populations, both long-term and short-term approaches are needed.

Short term interventions

As the type of shelter available is not in favor of IRS application, a research project, to be implemented by one or more actors, needs to be conducted to identify which alternative vector control measures such as impregnated plastic sheeting, can be used to serve as an alternative to IRS.

Conduct malaria parasite resistant studies among the displaced population, which can be done by one or two actors in relatively secure context in Ethiopia..

Conduct insecticidal resistance studies, which will help to monitor the efficacy of different vector control interventions implemented.

Conduct studies to explore the behavioral attitude and barriers among the displaced population to the curative and preventive measures of malaria

Long term interventions:

Mapping the population movements and malaria epidemiology in the regions, and sharing results regularly and widely with relevant actors in order to inform effective strategic malaria control interventions. This could be started in short term but needs to be maintained for the future.

Harmonization of interventions across the displaced populations in South Sudan and the border areas.

Organizing regular training to improve supervisors skills for health workers to monitor actual practices.

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14. Annexes

14.1. Annex(1) South Sudan Ethnic groups map.

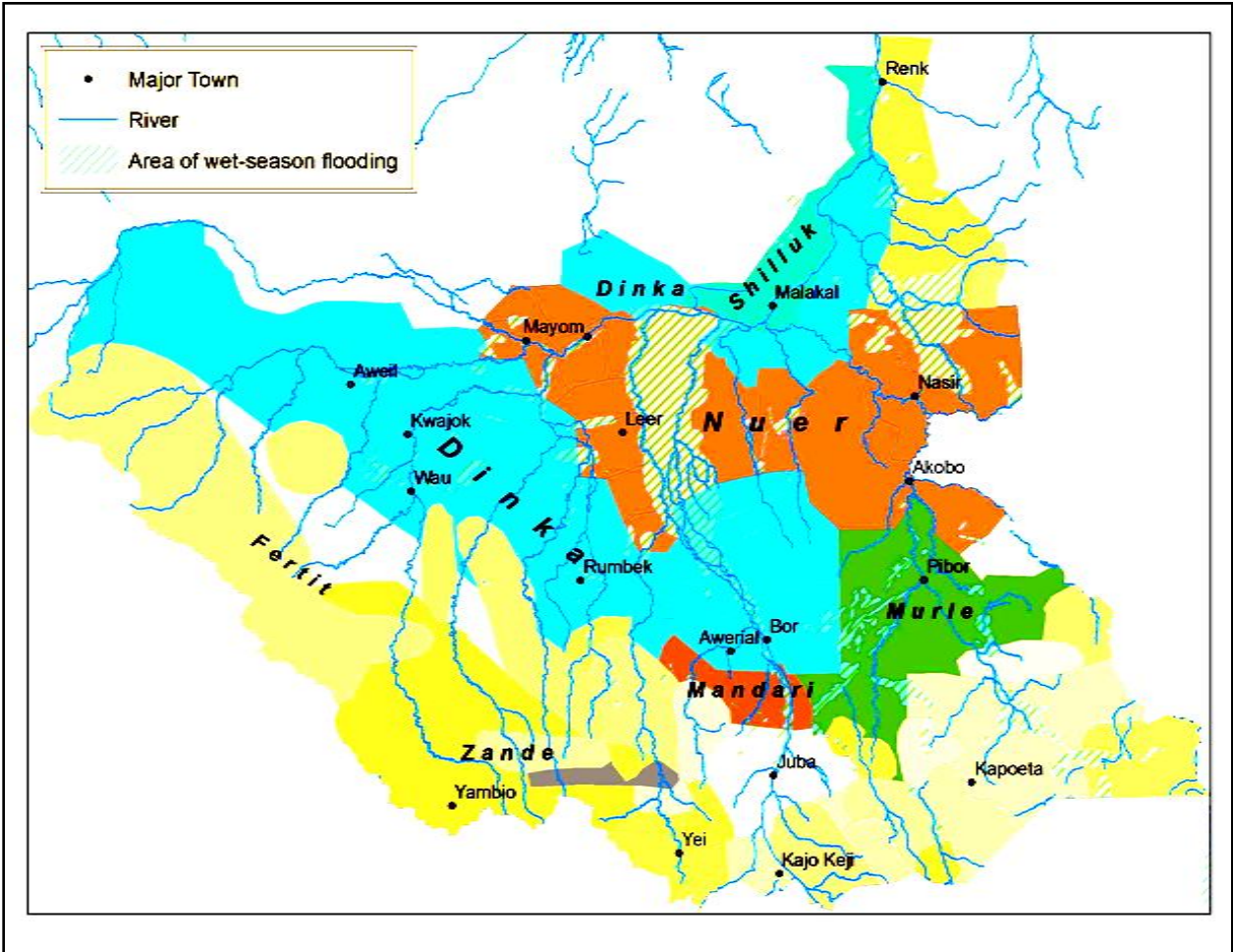


Figure 6 Map of main ethnic groups in South Sudan. Source Maps of east Africa 2014

14.2. Annex 2 Survey questionnaire

The actual malaria control practices of humanitarian health workers among displaced population from south Sudan and the epidemiology, guidelines and control measures implemented.

1- At Which country did/do you work?

a) South Sudan b)Ethiopia c) Uganda d) Sudan e) others(please specify).....

2- Which region did/do you work?

3- Period worked? ..MM/DD/YYYY. for how long.

a) less than 3 months b) 4-6months c) 7-12 months d) more than 1 year

4- What is the organization you worked for?.....

5- What is your position?.....

6- Type of the staff

a) International b)National

7- What is the target population you worked for?

A) Residents B)Displaced IDPs C) displaced refugees.

8- What is the malaria prevalence in the region you worked for?

a) Low endemic. b) Meso-endemic. d)hyper-endemic. d)No malaria
e) unknown.

9- What is the type of malaria parasite in the region?

a) P.vivax b) P.malariae d) P.ovale c) P.falciparum d) Unknown

10- How do you diagnose malaria in your settings?

a)Microscopy. b)Rapid diagnostic tests (RDTs). c)clinical d) other
(please specify).....

11-Which guidelines are/were most used?

a) WHO guidelines b)National guidelines c)organization guidelines
d)depends on academic knowledge and experience. e)other (please specify).

12- what are the drugs used to treat malaria?

First line.....

Second line.....

Third line

13- What are the control measures (vector, and parasite) implemented by your program?

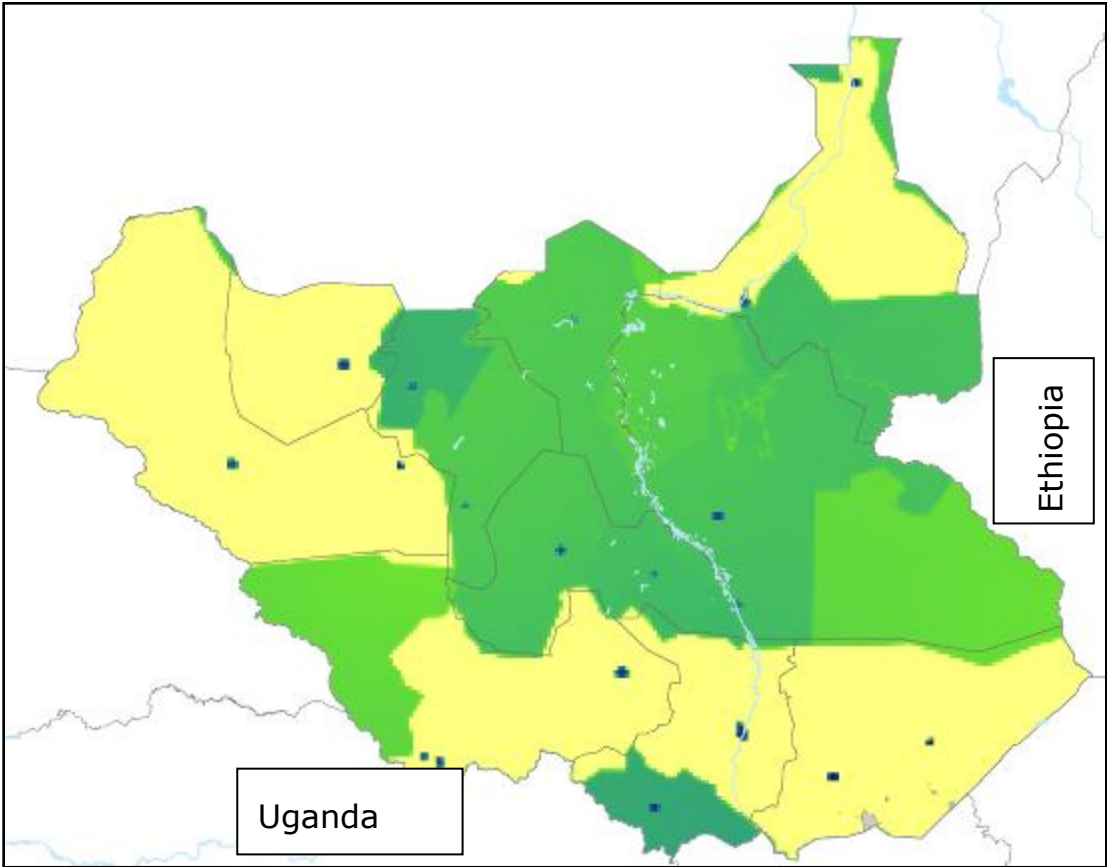
a)IPT b)IRS d)Impregnated plastic sheeting c)Fogging d) ITN c)IPT e) SMC f) others (please specify).....

14- Is the integrated management of childhood illness (IMCI) used?

a) Yes b) No

15- If you believe there are differences between the guidelines and the actual practices please explain the reasons why?.....

14.3. Appendix 3 Malaria clinical burden in South Sudan-map



Source: Malaria atlas project

The map show the clinical burden of malaria in south Sudan 2010.

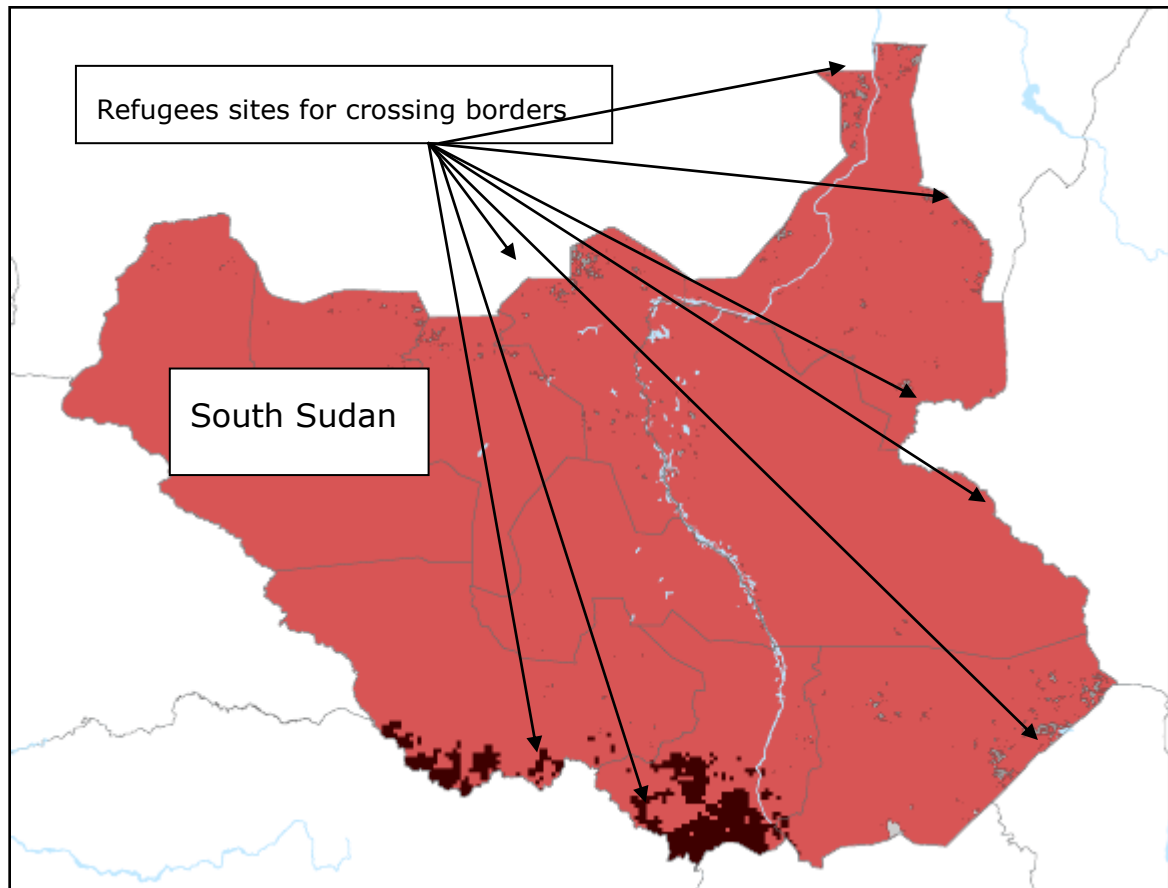
Water

Plasmodium falciparum free
PI < 0.1%

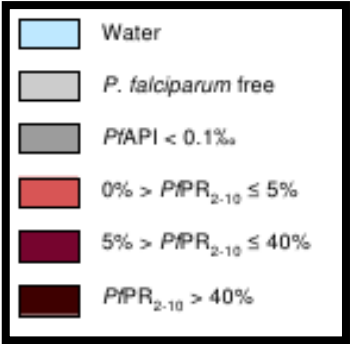
Clinical burden

- > 10,000
- 1,000
- 100
- 10
- 0

14.4. Annex 4 Map of South Sudan: classifies endemicity of *P.falciparum* 2010

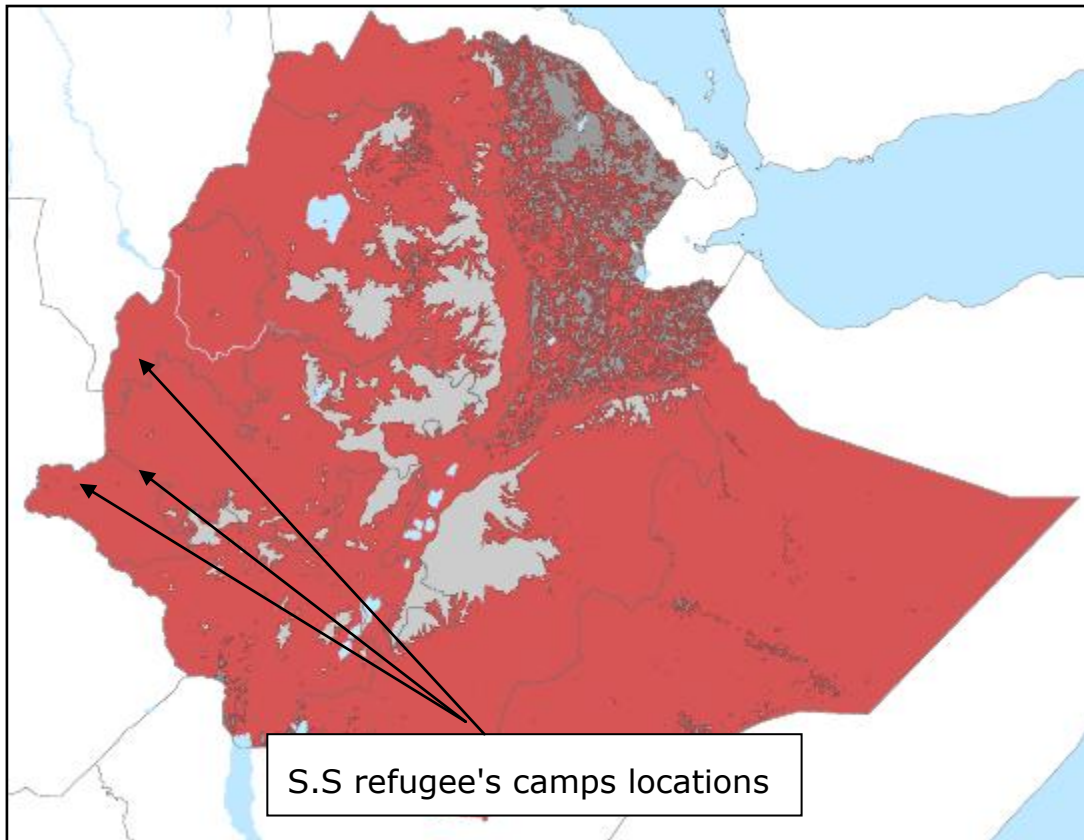


- Areas in light pink has lowest levels of risk, where average prevalence in the age 2-10 years(P.f PR) is less than 5%. areas in dark pink has more than 40% P.f PR.
- This arrows are the possible roads and crossing sites in the borders.

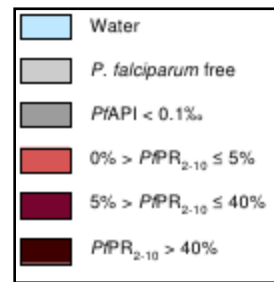


Source: malaria Atlas project 2013.

14.5. annex 5 Map of Ethiopia. P.f endemicity 2010

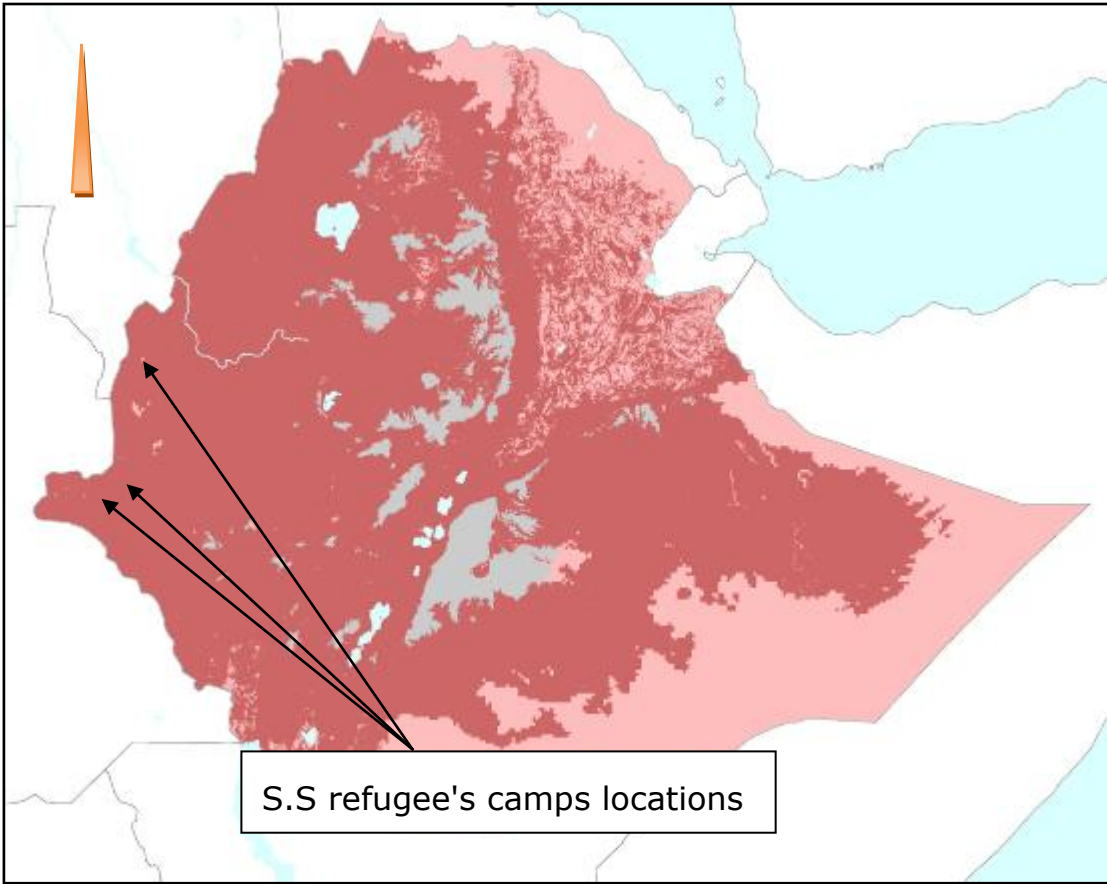


The map classifies *P.f* endemicity in Ethiopia. The annual average infection prevalence (*P.f* PR) in 2-10 years old children is used. Light pink areas has low prevalence <5%. Dark red has the highest prevalence >40%.

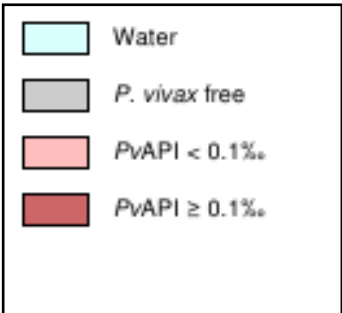


Source: Atlas project 2012. modified to show the refugee locations in south west part of the Ethiopia.

14.6. Annex 6 Map of Ethiopia shows *P.vivax* endemicity distribution

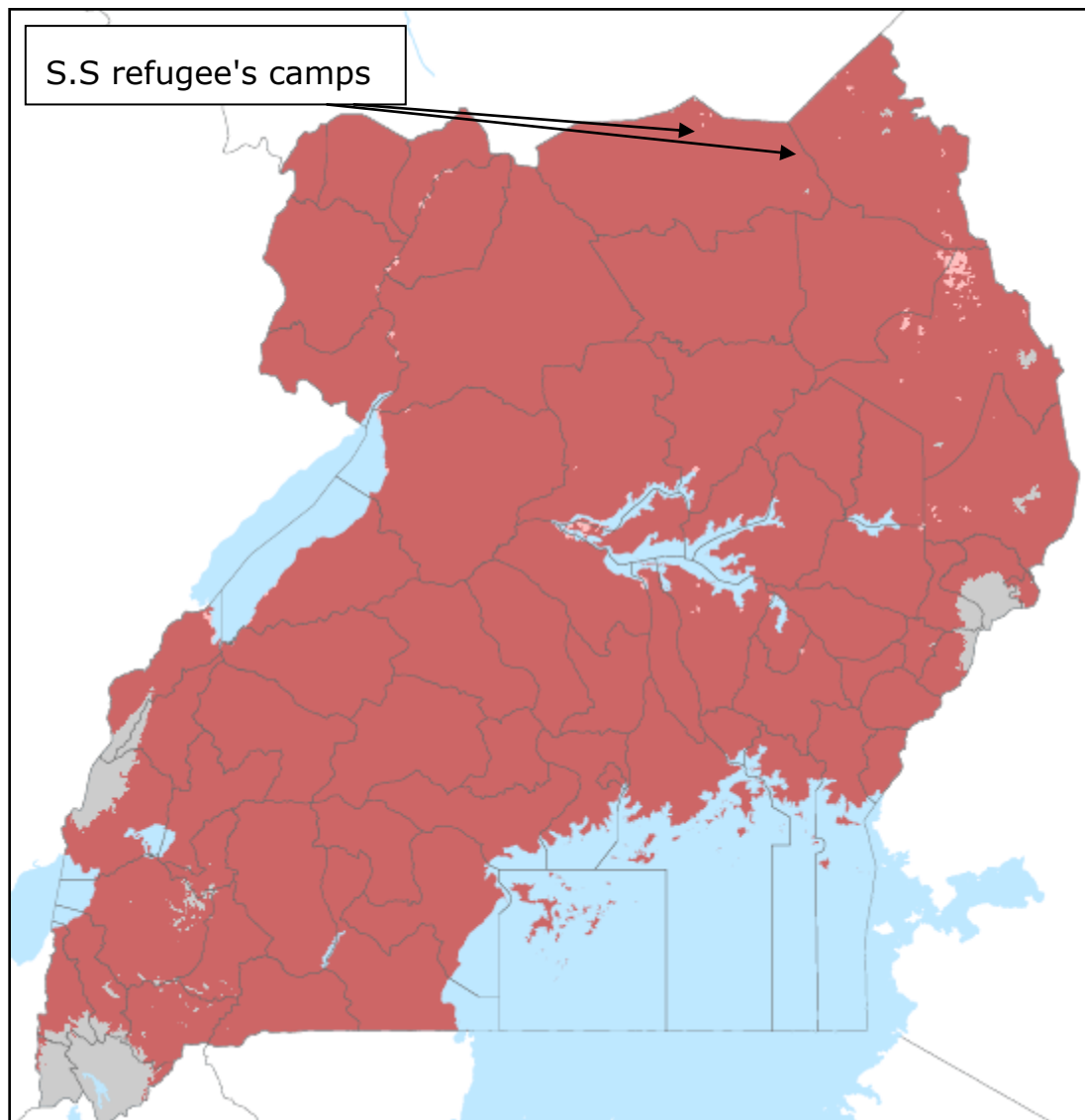


Areas shown in grey have low risk. areas shown in light pink unstable malaria transmission. Areas in red have stable transmission.

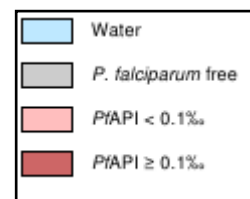


Source: malaria atlas project 2012. modified to show the refugee locations

14.7. Annex 7 Map of Uganda shows the estimation of *P.falciparum* transmission



Areas in light grey are likely to be risk free. Areas on light pink unstable transmission. Areas in red are at stable risk transmission.



Source: Malaria atlas project 2012, modified to add the S. Sudanese refugee camps locations.

14.8. Annex 8 WHO recommended vector control measures

Action	For individual and family protection	For community protection
Reduction of human-mosquito contact	insecticide-treated nets, repellents, protective clothing, screening of houses	Insecticide-treated nets zooprophylaxis
Destruction of adult mosquitoes		insecticide-treated nets, indoor residual spraying, space spraying, ultra low-volume sprays
Destruction of mosquito larvae	Peri-domestic sanitation	Larviciding of water surfaces, intermittent irrigation, sluicing, biological control
Source reduction	Small-scale drainage	Environmental sanitation, water management, drainage
Social participation	Motivation for personal and family protection	Health Education, community participation

Source: World health organization,(70)

