



5th Ethiopian Malaria Research Network Symposium Report

JUNE 1, 2015

Acknowledgment

A number of organizations and individuals exerted their unreserved efforts for the realization of this symposium. The Ethiopian Malaria Research Network would like to acknowledge all those who worked hard in organizing this symposium. Special thanks goes to Mekele University (MU) for hosting this symposium with great tenderness and hospitality and Addis Continental Institute of Public Health/SMMES project for playing a successful coordination role in organizing this symposium. The active engagement of researchers who present their scientific work was remarkable, we were privileged to have you all. A heartfelt thanks goes to all the participants of the symposium, especially MU graduate students who made the symposium colorful by attending the symposium even sitting on the stairs when the seats were full.

Last, but not least, a heartfelt gratitude goes to the American people who supported the financial expense of the symposium funding ACIPH through USAID/PMI. The symposium wouldn't have happened without your generosity.

Organizers

We are mindful of the contribution of many individuals in organizing the symposium behind the curtain and acknowledge their contribution in organizing such a successful symposium.

Individuals who played key role in the organization of the symposium include:

Dr. Ayele Zewde (ACIPH)

Dr. Seblewengel Lemma (ACIPH)

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Introduction

Malaria is one of the major public health problems in Ethiopia. Annually 9 million clinical and over 500,000 confirmed cases of malaria occur in the country. The Federal Ministry of Health (FMOH) has been implementing different strategies to prevent and control malaria. However, there only have been limited efforts to use findings and outputs of research studies to inform national malaria policy or affect the implementation of the national malaria control program. Furthermore, the limited malaria researches conducted are poorly coordinated amongst stakeholders including the FMOH and often findings/results are not well disseminated to be used for policy decision and program improvement, i.e. there is a chronic gap between the production of malaria research and use of its findings/outcomes by researchers, practitioners, policymakers and organizations involved in malaria prevention and control.

In response to the above problem Addis Ababa University in collaboration with the USAID/PMI-E conducted a malaria research workshop on May 7, 2010 at Ghion Hotel, Addis Ababa, Ethiopia. The workshop resulted in the establishment of a Malaria Research Network of Ethiopia, which will create a platform for researchers, policy makers and other stakeholders to strengthen the evidence-base of the national malaria control program and increase its impact on malaria morbidity and mortality. One of the activities of the network is to organize a research symposium in collaboration with local Universities where research papers will be presented. This is a report of the fifth malaria research network symposium organized by ACIPH/SMMES project in collaboration with Mekele University (MU), College of health Sciences.

In the current symposium, about 140 participants from different Universities, government offices, research institutes and regional health bureaus attended. Indeed, faculty and students of Mekele University take the major share of number of participants. The symposium was marked by presentation of outstanding research works, hot discussions, and compassionate hospitality of MU. A total of twenty two research works were presented in 6 sessions under the thematic areas listed below:

1. Malaria Epidemiology
2. Malaria case management
3. LLIN ownership, utilization and factors associated with it
4. Anti-malaria drug efficacy/resistance
5. Entomology and ecology of malaria

The sessions were moderated by senior public health professionals from universities, NGOs and research institutes.

Opening

The opening ceremony was decorated by key note address from USAID/PMI, opening speech by Tigray Regional Health Bureau, and two introductory presentations.

Ms. Hiwot Teka made key note address representing USAID/PMI and here is a quote of what she said: *“It gives me a great pleasure to deliver a key note address to the 5th Malaria Research Network forum on behalf of USAID/PMI. We have started the annual malaria research forum in 2010 in collaboration with Ethiopian Public Health Institute, Addis Ababa University and other Universities including Mekele University. The objective of the forum is: to create a platform for dialogue between the researchers and policy makers, to facilitate the creation of evidence to inform policy, and above all to enable students (next generation policy makers and researchers) to understand the importance of evidence based decision making & development. It is my hope that today we will achieve the objective set out for the forum.” She finally concluded her speech by the beautiful phrase; “Together we can eliminate malaria from Ethiopia!”*

Following the USAID/PMI key note address, Mr. Atakeltie K. deputy head of Tigray regional health bureau, the guest of honor, made an opening speech and officially opened the symposium. In his speech he mentioned the public health importance of malaria, explained the morbidity and mortality happening in the region due to malaria. He also marked the achievements made due to the malaria control measures taken by the regional government. He emphasized the importance of research work and such forums to monitor and disseminate the achievements made in the fight against malaria. He concluded his speech by wishing a successful symposium for the attendants and organizers.

Two presentations followed the opening speech. The first one entitled “Malaria Epidemiology in Tigray Region” was made by Mr. Goitom Mehari (Disease Prevention expert at TRHB). According to the presentation, malaria is a major public health problem of the region involving 75 % of the landmass, which accommodates 70% (3.6 million) of the population. There are two transmission seasons in the region, major transmission happens between September and December while the minor transmission seasons runs from April to May. The effort of the region in sustaining malaria control strategies such as IRS and bed net has shown dramatic changes; e.g. death due to malaria has been reduced from 87 in 2004 to 14 in 2007 E.C. He also mentioned some of the challenges that the region face in the fight against malaria. These include: insecticidal resistance, population movement and human settlement patterns (with the current national investment and development), underutilization of LLINs, limited resources, shortage and high turnover of skilled manpower and few number of operational researches.

The second presentation was made by Dr. Ayele Zewde (Chief of Party, SMMES project). His presentation gave background information about Strengthening Malaria Monitoring and Evaluation Systems of Ethiopia Program (SMMES) project and the implementing organization - Addis Continental Institute of public Health (ACIPH). According to the presentation, ACIPH's mission is: closing Knowledge gaps through south-to-north (S2N) and south-to-south (S2S) collaborations, promote public-private partnerships in public health, strengthen monitoring and evaluation practices to improve availability of evidence for decision making, conduct training and research for a better public health practices, create opportunities for affordable public health graduate education for Africans. ACIPH is working with national and international universities to achieve its mission. Strengthening Malaria Monitoring and Evaluation Systems (SMMES), is a five year (April 2014 – March 2019) USAID/PMI funded project implemented to support the malaria control M&E and operations research efforts in the country. The overall goal of the project is, strengthening M&E systems and operational research necessary to generate evidences to effectively monitor and evaluate the implementation and achievements of the malaria control program in Ethiopia. Tulane University in New Orleans, USA, and the Malaria Consortium in Ethiopia are sub-partners of the project. The project has four major focus areas: Malaria surveillance, Operational researches, Technical assistance, and Strengthen Malaria Research Network. Indeed the 5th malaria research network symposium is one of the activities related with the last focus area.

Session 1: Malaria Epidemiology

The first session of the forum was moderated by Dr. Alemayehu Worku. He is senior Biostatistician and senior M&E advisor for SMMES project. Four research works were presented in the session; (1) Trend analysis of malaria prevalence in Arsi-Negelle health center, Southern Ethiopia, (2) A five year retrospective study on malaria prevalence and vector control measures in Woreta town and the surrounding rural localities, Northwest Ethiopia. (3) Glucose-6-phosphate dehydrogenase deficiency among malaria suspects attending Gambella hospital, southwest Ethiopia and (4) the incidence of malaria and its distribution in the former epidemic detection sites of Oromia.

Here is the summary of the studies presented in this session; three of the studies were retrospective studies based on data collected from health facilities. One of the study done by Lemmu et al. collected primary data to determine the level of G6PD deficiency in Gambela, Southwest Ethiopia. Two of the researches were done in Oromia region, one in Gambela and the other one in Amhara region. Malaria test positivity rate ranged from 11.4% in Arsi-Negele to 59% in Gambela. *P. falciparum* is the dominant species in Gambela (96.6%) and Woreta area (percentage not reported) but *P. vivax* dominated in Arisi-Negelle and the 10 surveillance sites in Oromia. Differences regarding the prevalence of malaria across the study sites were reported. Malaria showed a fluctuating trend in Arsi-Negelle, reduction in 10 surveillance sites in Oromia and slight increase in Woreta. Regarding risk factors, the studies have indicated that residents of rural area, children between age 0 to 5, and males were found to be more at risk of malaria. According to the study done in Gambela, 7.3% of malaria suspected patients were G6PD-deficient with no significant difference between the sexes. The chance of being G6PD-deficient was significantly higher for the native ethnic groups (Anuak and Nuer) compared to the 'highlanders'/settlers. G6PD deficiency prevalence among the Nuer (14.3%) was significantly higher than that for the Anuak (5.1%).

Discussion

The discussion session that followed the presentation focused on data quality and inconsistency in findings. Data quality and methodological issues were the first issues to be discussed. Those studies that used secondary data were asked about the quality of the data and they gave explanations. For example the study done in Woreta area identified malaria prevalence to be high among those greater than 15 years old. However explanation was given regarding the data quality problem observed in the under-five registration books, which may have caused the difference. In addition the quality of rapid diagnostic tests (RDTs) such as the one used to asses G6PD deficiency was raised. One participant mentioned the presence of high false positivity rate in the

existing G6PD deficiency RDTs. However the researcher explained that the quality of the RDT was checked during the study time and found to be acceptable.

The other major discussion point was on the trend of malaria. Most researches indicated the reduction of malaria cases in their respective study sites. However the study done in woreda area reported the presence of slight increment in the prevalence of malaria despite the presence of interventions. The possible explanations given for the increment were some environmental factors which might be stronger than the intervention. It was indicated that if it is not for the interventions the prevalence could have been more than indicated in the study

Session 2: Malaria case management

Dr. Samuel Girma, Malaria Clinical Team Leader from ICAP, moderated the second session which deals with malaria case management. Four papers, listed below, were presented at the session. (1) Availability, Price, and Affordability of Artemisinin-Based Combination Therapies and other Anti-malarial Drugs in Oromia Regional State of Ethiopia: Implication on Universal Access to Malarial Treatments, (2) Acceptability of rapid diagnostics test (RDT) and pre-packed drug (Coartem) through community based volunteers for uncomplicated malaria in under 5 years children as home management of malaria (HMM) strategy in Jimma town, Ethiopia, (3) Evaluation of GENEDIA® Malaria P.f/panAg rapid test relative to microscopy in a malaria endemic area Ethiopia, 2013 and (4) Knowledge and practice on malaria diagnosis and treatment among health care providers working in private health facilities in Ethiopia.

Here are the summaries of the papers presented during this session: all the four papers were cross sectional studies. Three of them were conducted within the community while one study was facility based with health care providers as subjects of the study. According to the findings of the research works; the availability of anti-malaria drugs in public health facilities is fairly good, although there is room for improvement. In the private sector, however, the availability of AL was particularly low and the price was significantly high, making the medicine unaffordable for the majority of malaria patients who opt to be treated at the private facilities. The use of community health workers as means of home management of malaria was accepted by the community. The CHV, are very close to the community and their role in managing (with RDT and Coartem) febrile children is very much appreciated by the mothers/care takers. Health professionals working in private health facilities seemed to be less adherent to the national treatment guidelines. The adherence rate of healthcare providers on prescribing the recommended first line drugs was found very low, i.e., 44.2% for Chloroquine, 47.9% for ACT and 77.9% for Quinine. The diagnostic performance of GENEDIA® Malaria P.f/pan Ag rapid test has sensitivity, specificity, positive and

negative predictive values of 95.3%, 96.6%, 94.0%,97.4% respectively indicating the test's acceptability in diagnosing malaria.

Discussion

Most of the questions raised after the presentations were questions for clarifications. Researchers gave detailed explanation for the questions raised. For example participants asked how cost of drugs is regulated in Ethiopia. According to the response given by the presenter, there is some degree of drug regulation; however, since the country is following a free market economy, the regulation may not be intensive leading to cost variations among different facilities. The consensus reached with regard to minimizing the significant deviation of the private practitioners from the national malaria treatment guideline, is to strengthen the public private partnership initiative mainly by the government.

Session 3: LLIN ownership, utilization and factors associated with

The third session that focused on LLIN ownership and utilization was moderated by Dr. Mohamud Abdulkadir from Mekele University. Four researchers, with titles indicated below, presented their works in this session; (1) Assessment of prevalence of LLITNs ownership by householders, utilization among the household members and factors affecting utilization in Bako District, West Shewa, Oromia- Ethiopia June 2014, (2) Access to and use gaps of Insecticide-Treated Nets in Jimma Zone: Evidence from a Baseline Result from School and Faith Based Malaria Education Program: Implication for Behavioral Change Communication, (3) Rapid Assessment of Barrier to LLIN utilization among the trained lead person Under USAID –JU ACP malaria project, (4) LLIN/ITN ownership, utilization and factors associated with use: A literature review.

The session papers are summarized as: Three of the studies are community based cross-sectional studies while the fourth one was a literature review. All of the studies including the literature review that assessed findings of 13 studies concluded the existence of low bed net utilization despite the high coverage/ownership. Different factors that affect net utilization were identified by all studies. The findings indicated that living close to malaria breeding site, having higher income, being female/pregnant, and being under five children are the factors that are in favor of bed net utilization. Findings also identified shape and color of bed net as factors for utilization.

Discussion

The questions raised during discussion include, when was utilization measured? As season may affect net utilization. What should be done to improve net utilization? Beside this implementation questions, some methodological questions were also raised. According to the responses given

by the researchers, most of the studies were done during the season when net utilization is expected to be high. All researchers also recommended behavioral change communication as a strategy to improve net utilization.

Session 4: Malaria case management

This session was moderated by Prof. Ahmed Ali from Addis Ababa University. Here also four presentations, listed below, were presented: (1) In vivo efficacy of chloroquine in treatment of *P. vivax* malaria in southern part of Ethiopia, (2) Molecular evidence of *P. falciparum* resistance for anti-malaria drugs in Humera, Northern Ethiopia, (3) Efficacy and safety of Artemether /lumefantrine (coartem) for the treatment of uncomplicated *Plasmodium falciparum* malaria in Pawe/Felegeselam health center Benishangule-Gumuz Ethiopia and, (4) K13-propeller polymorphism in *Plasmodium falciparum* parasite from sub-Saharan Africa.

The papers were investigating the feared sign of Artemisinin-based Combination Therapy. The first three studies are looking at clinical occurrence of Artemisinin-based Combination Therapy resistance in different parts of Ethiopia, while the fourth study is looking at the prevalence of K13 mutation, which is responsible for the development of resistance for the drug in sub-Saharan Africa (SSA) countries. The good news is, all the four studies showed no significant evidence of resistance to Artemisinin-based Combination Therapy in Ethiopia to date.

Discussion

The discussion during this session is mainly on the methodology of the studies and some participants raised the issue of studying the safety of the anti-malaria drugs side by side to the study of the drug resistance. The low prevalence of the K13 mutation in our country was taken as a good news and the suggestion of further similar study was challenged by an audience but the researchers justified that the high prevalence of the mutation in the south-east region raise an alarm for the SSA countries to be on watch as this was the drug resistance story in all previous anti-malaria drugs; i.e., resistance to most anti-malaria drugs for some unknown reason started at south east Asia regions and rapidly expand to the SSA countries.

Session 5: Anti-malaria drug efficacy/resistance

This session was moderated by Dr. Araya Medhine from Mekele University. Once again, four papers, listed below, were presented; (1) In vivo efficacy of Artemether/lumefantrine and chloroquine against *Plasmodium vivax*: A randomized open label trial in central Ethiopia, (2) In vivo efficacy of artemether/lumefantrine against uncomplicated *P. falciparum* malaria in central

Ethiopia, (3) Malaria outbreak investigation; Erer district, Somali region, Eastern Ethiopia and, (4) Return of chloroquine-sensitive *Plasmodium falciparum* parasite and emergence of chloroquine-resistance *Plasmodium vivax* in Ethiopia

In summary, the first two open label clinical trials showed that AL is still very effective and feasible treatment option for uncomplicated *P.falciparum* malaria while chloroquine remains the drug of choice for the treatment of *P.vivax* because it gives longer time before recurrence than AL, which also was found to be effective even for *P.vivax* infection. The third paper shared experience of handling outbreak in a remote area and tries to indicate the possible reasons for the occurrence of the outbreak. The fourth paper came with a good news of the possible re-occurrence of chloroquine sensitive *P.falciparum* and a bad news of emergence of chloroquine resistance *P.vivax* species in Ethiopia.

Discussion

In depth discussions around the practical implication of drug resistance finding on prevention and control of malaria and the feasibility and recommendation of drug resistance study for countries was made. Recommendation to conduct drug efficacy study every 2 years in the sentinel sites, as WHO recommendation, was emphasized by the participants even if the resistance to AL is not yet on the horizon in the country. They also recommend to strengthen the anti-malaria drug policy implementation and providing treatment only as per the agreed current treatment guideline all over the country including private institutions to prevent or delay the occurrence of drug resistance.

Session 6: Entomology and ecology of malaria

The last session was moderated by Dr. Afework Mulugeta from Mekele University. Two papers from Mekele University were presented in this session; they are: (1) Impact of micro-dams on local microclimate and its relevance to malaria transmission in northern Ethiopia, and (2) Early biting rhythm in the afro-tropical vector of malaria, *Anopheles arabiensis*, and challenges for its control in Ethiopia. The first paper showed that the prevalence of malaria around the investigated dam area is seven times higher than similar areas with no dam around and calls for intensified intervention in such mega project areas where the country is currently embarked in full scale. The second paper showed the interesting change of mosquito behavior of early biting before people go to bed inside their Long Lasting Insecticidal Net (LLIN). This also has a great implication on the malaria prevention program in the country as the country is struggling to achieve universal

coverage of LLIN, which may not be as expected effective if the biting habit of the mosquito is changing as presented.

Discussion

The audience very well appreciated the relevance of both studies considering the high number of mega projects in the country and the massive distribution of LLIN in the country for prevention of malaria. However, they raised the concern of having a more recent study.

Way forward

History of Malaria research network: At the end of the scientific sessions, discussion was held regarding the future of malaria research network. At the start of the discussion Ms. Hiwot Teka from USAID/PMI, gave a brief background on the establishment of the malaria research network including the institutes involved in the establishment. Taking her own suffering as a student, she illustrated that the strengthening of the network will benefit the students, the researchers and the program people looking for recent information regarding malaria.

As indicated in the introduction, malaria research network was established in 2010 with main objective of generating quality research that inform policy decisions, create a platform that enables researchers share their works and avail research works related to malaria to all interested; i.e. students, researchers, etc... The network has an established TORs and bylaws and include the Ethiopian universities and individuals working in the field of malaria as members of the network.

The current challenge: currently the network members are not having regular meetings and even most are not attending the network symposium, which occur one or two times per year. There was no strong effort from the chair of the network, Addis Ababa University to strengthen the network forum to the expectation of the malaria community.

Future Direction: Participants discussed on the future direction of the network and agreed that there is a need to assign a new chair and secretary; after a thorough discussion, the participants agreed that EPHI being the research arm of the FMoH of Ethiopia is the right body to lead this network as chair and since the funder of the network USAID/PMI is represented by its implementing partner ACIPH and since the latter took the initiative and successfully organized this, fifth malaria research network symposium, the participants agreed that ACIPH be secretary of the network.

Annex

Annex 1: Schedule

Malaria Research Forum Jan 23-24, 2015

Tentative schedule

Schedule	Topics	Facilitator
	Day 1	
08:00-09:00	Registration	Mekele University/ACIPH
09:00 - 09:15	Key note address	USAID/PMI
09:15-09:30	Key note address	Dr. Kindeya G/Hiwot
09:30-09:45	Opening speech	Guest of Honor
09:45-10:15	Malaria Epidemiology in Tigray region	Tigray regional health bureau (Goitom)
10:15-10:30	SMMES project background	ACIPH
10:30-11:00	Tea Break	Organizers
Session I presentations (Malaria Epidemiology) / Moderator: Dr. Alemayehu Worku		
11:00 - 11:15	Trend analysis of malaria prevalence in ArsiNegelle health center, Southern Ethiopia	1. Mengistu Hailemariam,
11:15-11:30	A five years retrospective study on malaria prevalence and vector control measures in Woreta town and the surrounding rural localities, Northwest Ethiopia.	2. Nega Aleign,
11:30-11:45	Glucose-6-phosphate dehydrogenase deficiency among malaria suspects attending Gambella hospital, southwest Ethiopia	3. Lemu Golassa
11:45-12:00	The incidence of malaria and its distribution in the former epidemic detection sites of Oromia	4. Hanna/Semira
12:00 - 12:30	Discussion	Participants
12:30-01:30	Lunch	Organizers
Session II presentations(malaria case management)/ Moderator: Dr. SamuelGirma		

01:30-01:45	Availability, Price, and Affordability of Artemisinin-Based Combination Therapies and other Anti-malarial Drugs in Oromia Regional State of Ethiopia: Implication on Universal Access to Malarial Treatments	1. Fikadu Deme,
01:45-02:00	Acceptability of rapid diagnostics test (RDT) and pre-packed drug (Coartem) through community based volunteers for uncomplicated malaria in under 5 years children as home management of malaria (HMM) strategy in Jimma town, Ethiopia.	2. Morankar Sudhakar,
02:00-02:15	Evaluation of GENEDIA® Malaria P.f/pan Ag Rapid Test relative to microscopy in a malaria endemic area Ethiopia, 2013	3. Abeba G/Tsadike
02:15-02:30	Knowledge and practice on malaria diagnosis and treatment among health care providers working in private health facilities in Ethiopia.	4. USAID Private Health Sector Program
02:30-03:00	Discussion	Participants
3:00-03:30	Tea break	Organizers
Session I Presentations(LLIN ownership, utilization and factors associated with) Moderator: Dr. MohamudAbdulkadir		
03:30-03:45	Assessment of prevalence of LLITNs ownership by householders, utilization among the household members and factors affecting utilization in Bako District, West Shewa, Oromia- Ethiopia June 2014	1. Birhanu K. Sori,
03:45-04:00	Access to and Use Gaps of Insecticide-Treated Nets in Jimma Zone: Evidence from a Baseline Result from School and Faith Based Malaria Education Program: Implication for Behavioral Change Communication	2. Zewdie Birhanu
04:00-04:15	Rapid Assessment of Barrier to LLIN utilization among the trained lead person Under USAID –JU ACP malaria project	3. GemechisEtana Roro,
04:15-04:30	LLIN/ITN ownership, utilization and factors associated with use: A literature review	4. Seblewengel Lemma
04:30-05:00	Discussion	Participants
Day 2		
Session III Presentations (Anti-malaria drug efficacy/resistance)/Moderator: Prof. Ahmed Ali		
09:00-09:15	Molecular evidence of <i>P. falciparum</i> resistance to anti-malarial drugs in Humera, North Ethiopia (2007)	1. Musie Araya,
09:15-09:30	<i>In vivo</i> efficacy of chloroquine in treatment of <i>Plasmodium vivax</i> malaria in Southern parts of Ethiopia	2. Sisay Getachew

09:30-09:45	Efficacy and Safety of Artemether-Lumfantrine (Coartem®) for the Treatment of Uncomplicated Plasmodium falciparum Malaria in Pawe/FelegeSelam Health Center, Benishangul Gumuz, Ethiopia.	3. Tedla Mindaye
09:45-10:00	K13-propeller polymorphisms in <i>Plasmodium falciparum</i> parasites from sub-Saharan Africa. Edwin Kamau ...Tobias Apinjoh9	4. Lemu Golassa
10:00-10:30	Discussion	Participants
10:30-11:00	Tea Break	Organizers
Session IV: Presentations (Anti-malaria drug efficacy/resistance)/Moderator: Dr. Araya Medhine		
11:00-11:15	In Vivo Efficacy of Artemether-Lumefantrine and Chloroquine against <i>Plasmodium vivax</i> : A Randomized Open Label Trial in Central Ethiopia	1. Tesfaye Abreha
11:15-11:30	In vivo efficacy of artemether-lumefantrine against uncomplicated Plasmodium falciparum malaria in Central Ethiopia	2. Samuel Girma
11:30 - 11:45	Malaria Outbreak Investigation; Erer District, Ethiopia Somali Region, Eastern Ethiopia, Nov 2012	3. Yesuf Mohamed
11:45-12:00	Return of chloroquine-sensitive <i>Plasmodium falciparum</i> parasites and emergence of chloroquine-resistant <i>Plasmodium vivax</i> in Ethiopia	4. Seleshi Kebede
12:00-12:30	Discussion	Participants
12:30-01:30	Lunch	
Session II presentations (Entomology and ecology of malaria) /Moderator:Dr. Afework Mulugeta		
01:30-01:45	Impact of micro-dams on local microclimate and its relevance to malaria transmission in northern Ethiopia	1. Mekonen Yohannes
01:45-02:00	Early biting rhythm in the afro-tropical vector of malaria, <i>Anopheles arabiensis</i> , and challenges for its control in Ethiopia	2. Mekonen Yohannes
02:00-02:30	Discussion	
02:30-03:00	Tea break	
03:00-04:00	Panel discussion on strengthening the Malaria research Forum	MU/ACIPH/PMI
04:00-04:30	Closing remark	MU & PMI

Annex 2: Abstract of presentations

Trend analysis of malaria prevalence in Arsi Negelle health center, Southern Ethiopia

Mengistu Hailemariam, Solomon Gebre, Hawassa University, college of Medicine and Health sciences, Department of Medical Laboratory Sciences

Background: Malaria in Ethiopia which still there is no “Magic bullet” no quick or easy solution apart from extensive progress in malaria control over the past many years. Analysis of documents on malaria data from health care system is essentially important to assess achievement or failure of malaria control programmes. The aim of this study was to investigate trends of malaria prevalence in the area.

Methods: A retrospective record review was conducted in southern Ethiopia. All malaria cases reported from January 2009 to December 2013 were carefully reviewed and analyzed. Information about laboratory results and Socio demographic features were collected from patient’s registration book.

Results: A total of 22,025, malaria suspected patients gave blood films for malaria diagnosis in Arsi Negelle health center. 2511 (11.4%) microscopically confirmed malaria cases were reported with a fluctuating trend. Among the identified plasmodium species, *P. Vivax* accounted 74%, *P. falciparum* was 19.8% and mixed infection was 6.2%. Children in the age range 0-5 years were the most affected by the disease (22.8%), followed by 16-20 age groups (17.8%), which necessitate suitable consideration in the effort of malaria control. Despite the apparent fluctuation of malaria trends in the area, the highest peak of malaria cases was reported during spring seasons.

Conclusion: In conclusion, children under five years more affected by the disease imply presumed exposure therefore attention should be given to children under five years of age. The rate of malaria was moderate even though it is not as satisfactory as to malaria control strategy of the country. This might be due to the likely *P. vivax* drug resistance to chloroquine. In support of this health planners need further strong malaria control and assessment of drug resistance.

Keywords: Southern Ethiopia, Health service, Malaria trend, Malaria prevalence

A five years retrospective study on malaria prevalence and vector control measures in Woreta town and the surrounding rural localities, Northwest Ethiopia

Nega Aleign, Zinaye Tekeste, Beyene Petros

Background: Malaria is one of the leading causes of illness and death in Ethiopia. The disease has been consistently reported as the first leading cause of outpatient visits, hospitalization and death in the country. The present study was carried out in Woreta and surrounding rural localities to determine five years trend in malaria prevalence.

Method: A retrospective study was conducted from 2007/08-2011/12 in Woreta town and surrounding rural localities. All malaria cases reported and vector control activities undertaken in the study areas during the study periods was carefully reviewed and analyzed.

Result: A total of 128,399 blood films were examined for malaria and 17483 (13.62%) and 24027 (18.71%) individuals were microscopically confirmed malaria cases at Woreta health center and surrounding rural localities, respectively. Despite the different control measures taken, recently, a slight increase in the malaria prevalence was observed in the study areas. A significantly higher number of malaria parasite positive cases were observed in rural health posts (24027) than at Woreta health center (17483) ($P < 0.01$). As compared to *Plasmodium vivax*, there was high case of *Plasmodium falciparum* in both study sites. Age was found to be a risk factor for malaria, with individuals within the age group of >15 years having the highest prevalence (16.82%) ($P < 0.01$). There was a positive correlation between vector control measures taken and the yearly total malaria cases in Woreta town and the rural localities ($r = 0.7$).

Conclusion: The present study revealed high prevalence of malaria regardless of the vector control measures taken in the study areas. Therefore, there is a need to identify factors responsible for malaria infection and design strategies that help to reduce the burden of malaria in the study areas.

Key words: Control, Malaria, Prevalence, Woreta

Glucose-6-phosphate dehydrogenase deficiency among malaria suspects attending Gambella hospital, south-west Ethiopia

Arega Tsegaye, Lemu Golassa, Hassen Mamo, Berhanu Erko

Background: Glucose-6-phosphate dehydrogenase deficiency (G6PDd) is widespread across malarious regions. G6PD-deficient individuals are at risk of hemolysis when exposed, among other agents, to primaquine and tafenoquine which are capable of blocking malaria transmission by killing *Plasmodium falciparum* gametocytes and preventing *P. vivax* relapses by targeting hypnozoites. It is evident that no measures are currently in place to ensure safe delivery of these drugs within the context of G6PDd risk. Thus, determining G6PDd prevalence in malarious areas would contribute towards avoiding possible complications in malaria elimination using the drug. This study, therefore, was aimed at determining G6PDd prevalence in Gambella, western Ethiopia, using CareStart™ G6PDd screening test.

Methods: Venous blood samples were collected from febrile patients (n=449) attending Gambella hospital in November-December 2013. Malaria was diagnosed using blood films and G6PDd was screened using CareStart™ G6PDd screening test. Hematological parameters were also measured. The association of G6PD phenotype with sex, ethnic group and malaria smear positivity was tested.

Results: Malaria prevalence was 59.2%, 96.6% *P. falciparum* cases. Totally 33 participants (7.3%) were G6PD-deficient with no significant difference between the sexes. The chance of being G6PD-deficient was significantly higher for the native ethnic groups (*Anuak* and *Nuer*) compared to the 'highlanders'/settlers (odds ratio (OR)=3.9, 95% confidence interval (CI) 0.481-31.418 for *Anuaks* 'highlanders'; OR=4.9, 95% CI 0.635-38.00 for *Nuervs* 'highlanders'). G6PDd prevalence among the *Nuer* (14.3%) was significantly higher than that for the *Anuak* (5.1%).

Conclusions: G6PDd prevalence in the area is substantial and the indigenous Nilotic people tend to have a higher chance of being G6PD-deficient. Despite the ongoing control efforts, malaria remains highly prevalent among outpatients in Gambella town raising questions about the efficacy of the intervention activities or the existence of some peculiar local risk factors.

Keywords: Malaria, Glucose-6-phosphate dehydrogenase deficiency, Phenotype, Prevalence, Gambella, Ethiopia

Availability, Price, and Affordability of Artemisinin-Based Combination Therapies and Other Anti-malarial Drugs in Oromia Regional State of Ethiopia: Implication on Universal Access to Malarial Treatments

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Background: Malaria is one of the major public health challenges in Ethiopia. According to Ethiopian Public Health Emergency Management (PHEM) data, 18% of malaria cases reported in Ethiopia are in the Oromia Region. The availability, pricing, and affordability of anti-malarial drugs (AMDs) are key indicators of access to malaria treatments. In Ethiopia, very few studies have been conducted about those indicators, particularly for anti-malarial medicines.

Objective: to assess the availability of ACTs and other anti-malarial drugs recommended in the national malaria treatment guideline at randomly sampled Oromia zones and evaluate the affordability of such drugs to the low-income patients in those areas.

Methods: A cross-sectional survey was conducted in December 2013 on availability and patient prices of 8 anti-malarial drugs in Oromia Region using a standardized methodology developed by the World Health Organization and Health Action International. The survey was conducted in 67 medicine outlets in three health care sectors (30 public, 30 private, and 7 nongovernmental organizations [NGOs]) in six geographical zones in the Oromia Region of Ethiopia. Medicine prices were expressed as ratios relative to the International Reference Price. The salary of the lowest-paid unskilled government worker was used to evaluate the affordability of standard treatments for malaria.

Results: Availability of Anti-malarials: The chloroquine tablet (tab) was the most widely available anti-malarial medicine, with more than 80% in all of the sectors. The availability of artemether-lumafentrine (AL), however, varied considerably, with 80%, 26.8%, and 6.7% availability at public, NGO, and private sector medicine outlets, respectively. Quinine tablet availability was 20% in public, 3.3% in private, and 57% in NGO sectors, while the availability of artesunate injections (inj) was 43% in public, 3.3% in private, and 0% in NGO sectors. Cost and affordability of malaria treatment: All of the public health facilities surveyed provide AL tablets and artesunate injections free of charge to patients. Because the availability of AL and quinine tablets was remarkably low in the private sector, representative price data could not be obtained from the survey. Whereas a full course of the standard AMD treatment with the lowest-price generic drug chloroquine cost less than a day's wage for the lowest-paid unskilled government worker in the public and private sectors, quinine tablets cost nearly two days' wage in both sectors. Furthermore, when available, for a three-day course of treatment for *P. falciparum* malaria, patients have to pay about a week's wages for lowest-priced generics and two weeks' wages for originator brand AL.

Conclusion: The availability of AMDs in public health facilities is fairly good, although there is room for improvement. In the private sector, however, the availability of AL was particularly low and the price was significantly high, making the medicine unaffordable for the majority of malaria patients. Strengthening of the public private partnership including consideration of provision of subsidized ACTs through the private retail sector and promoting the use of quality-assured generic antimalarial medicines are important first steps to increasing universal access to antimalarial drugs and malaria treatments. **Keywords:** Ethiopia, Oromia, availability, price, and affordability of antimalarial drug

Acceptability of rapid diagnostics test (RDT) and pre-packed drug (Coartem) through community based volunteers for uncomplicated malaria in under 5 years children as home management of malaria (HMM) strategy in Jimma town, Ethiopia

Morankar Sudhakar, Yihenew Alem, Ayalew Tegegn

Background: This was a multi-country TDR/WHO funded study designed to be carried out in three phases. Phase –I was preparatory, phase –II implementation and phase – III was evaluation. Mothers/caretakers of children preferred to community based volunteers (CHVs) to use RDT and receive Coartem for malaria treatment to under 5 years children. Accordingly we approached Jimma town administration, Kebele (Zone/village) and Idir (community based social organization) leaders to select the CHVs. Kebele and Idir leaders selected 130 CHVs. They were recruited, trained, assigned the areas, and implemented the second phase October 2007 – July 2009. The RDT and Coartem were supplied by the Oromia Regional Health Bureau free of cost. The CHVs were given a certificate as trained person after rigorous training by Jimma University. The community was made aware of this project through Kebele and Idir meetings and CHVs made visit to every household to make aware the community of this project and the services they will be providing. The activities of CHVs were supervised by the supervisors from the Jimma town and Jimma Zone health office. Also their activities were being evaluated and monitored in the monthly monitoring meetings by the project staff. CHVs were working in Jimma town diagnosing and treating children. Following preliminary results are for the project period October 2007 to September 2008 from the raw data.

Results: During this period 1875 children were seen by the CHVs with median age of 22 months (Range minimum 3 month to maximum 59 months). About equal number of male (49.9%) and female (50.1%) children reported to the CHVs. Only 15% of mothers/caretakers took some measures such as home treatment, traditional treatment and visiting health facilities before bringing febrile child to CHVs. Remaining 85% brought the febrile child directly to CHVs. About 51.7% were tested as positive through RDT diagnosis and 96.6% mothers/caretakers whose children tested positive agreed to take recommended Coartem treatment. Out of them 96.1% complied with the treatment. The 95.3% who were RDT positive improved their health and remaining were referred to health facility as some of them had side effects of drug such as dizziness, loss of appetite, abdominal pain and vomiting and skin rash. The RDT negative children were referred to health facility giving them a dose of baby paracetamol.

Conclusion: As CHVs were available very close to the home anytime the mothers/caretakers took their febrile child to them. Almost all the RDT positive children improved their health with Coartem with a very small number who could not improve their health due to side effects. Thus these results are very much encouraging to accept the CHVs as home management of malaria as a strategy in urban areas of Ethiopia.

Health workers' knowledge to and administration of injectable Artesunate in Oromia and SNNPR region, Ethiopia

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Introduction: The World Health Organization (WHO) recommends injectable artesunate as the first drug of choice for the treatment of severe malaria. Ethiopia adopted the WHO malaria case management guidelines in 2012. Despite the adaptation of the WHO guidelines, health workers in Ethiopia lack the proper knowledge to administer injectable artesunate.

Objective: the objective of the study was to assess the knowledge of health workers about injectable artesunate and its proper administration for treatment of severe malaria cases.

Method: The study was conducted in 230 health professionals selected from Oromia and South Nation Nationality Regional State (SNNPR). Health workers were recruited from health facilities with a high burden of malaria. Through official letter, directors of health facilities were requested to send to central location at least three health workers involved in management of severe malaria. Self-administered pre-test questions were used to assess the knowledge to and proper administration of injectable Artesunate.

Result: Of the total participants, 66.3% and 33.7% were from Oromia and SNNPR, respectively. Of the total participants, 15.65%, 54.7%, 12.25% were physicians, nurses and health officers respectively; the remaining were other health workers. Of the total, 94.1 % responded that injectable artesunate is recommended for treatment of severe malaria. Only 11 (3.4%) of all could demonstrate steps for proper preparation and administration of injectable artesunate. Only 2% said that it is safe to administer injectable artesunate during all trimesters of pregnancy. Only sixty three percent of participants cited that proper administration site for injectable artesunate.

Conclusion: Most health workers know that injectable artesunate is a first drug of choice for treatment of severe malaria in Oromia and SNNPR. However, the study demonstrated that there is a lack of knowledge to preparation and administration of injectable artesunate.

Recommendation: An intensive training that focuses on practical sessions should be given to all health professionals managing severe malaria cases. Distribution of injectable artesunate, without building the capacity of health workers may result in risk of misuse of and development of resistance to artesunate.

Knowledge and practice on malaria diagnosis and treatment among health care providers working in private health facilities in Ethiopia.

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Background: As many as 60–80% of people in developing countries first seek malaria treatment at private than public health facilities, but the technical quality of private services is questionable. Assessing the perception and practice of health care providers helps to make evidence based decision by program managers, policy makes and the private health sector on quality of malaria diagnosis and treatment services.

Objective: Assess the perception and practice on malaria diagnosis and treatment among health care providers working in Private Health Facilities in Ethiopia.

Methodology: Facility based cross-sectional study was conducted in four regional states of Ethiopia from April to June 2012. Data was collected using interviewer-administered questionnaire and observation checklist to study the perception and practices of health care providers working in private health facilities. The data was entered and analyzed using SPSS version 17.

Result: In this survey we enrolled 264 private health facilities and 264 health care providers from four Regional States of Ethiopia. The perception of health care providers on the national malaria control strategies was measured using the mean knowledge score with 95%CI 2.52 (2.32 - 2.72). A little lower than half 40.5% of the health care providers scored above the mean score. Nevertheless, the study participants had a high level of knowledge on the national recommended treatment 91.3% for *P. vivax* & 88.6% for *P. falciparum*. But only one third of them correctly know the recommended treatment for presumptive diagnosis.

Almost all malaria suspected cases 92.4% were investigated for confirmed parasitological diagnosis. Despite this high rate of lab investigations, only 60.6% of confirmed and 39.6% probable cases were treated for malaria. The adherence rate of health care providers on prescribing the recommended first line drugs was found very low i.e. 44.2% for Chloroquine, 47.9% for ACT and 77.9% for Quinine.

In this study (64.4%) health providers had received supportive supervision both either form internal senior staff and/or external form public facilities. However, the support was on maintaining regulatory directions. The prevalence of job aid was 34.1% for drug dosing schedule, 14% for National Malaria Guidelines and almost there were no patient information brochures or posters in the surveyed facilities.

Conclusions and recommendations: Ethiopia embarks on malaria to achieve beyond sustained control to elimination during the implementation of the second national Malaria strategic plan (2010-2015). Considering the private health providers as potential stakeholders, the level of perception and practice was found very low. To improve the quality of services and benefit from the large size private health sector provision of malaria diagnosis and case management training, supportive supervision, job aids is recommended.

Assessment of prevalence of LLITNs ownership by householders, utilization among the household members and factors affecting utilization in Bako District, West Shewa, Oromia- Ethiopia June 2014

Birhanu K. Sori, Peter Wasssa, Tesfaye G. Ideti, Daddi .Jima

Background: Many countries across Sub-Saharan Africa are rapidly increasing the distribution of LLITNs coverage to combat malaria. However data on the use and the factors affecting its utilization are scarce for the Health planners and decision makers. Therefore, we aimed to assess factors associated with LLIN use at the household level.

Methods: A cross sectional study was conducted in Bako District of Western Ethiopia from May 1 to May 20, 2014. A total of 1320 households were selected using multistage cluster sampling technique. The data were collected by interviewing, direct observation of LLINs conditions and use. Multivariate logistic regression analysis was used to determine independent predictors of LLIN non-use.

Results: Of the total surveyed households 1175(92.45%) had at least one LLIN, but 643(51%) LLINs owned households used at least one LLIN the night before the study. Households with nearby malaria breeding site with Adjusted Odds Ratio(AOR) of 26.97(95%CI17.91-40.61), householders with monthly income greater than 1500 birr per month, householders with pregnant mothers AOR 1.56 (95%CI 1.02-2.38), householders with occupation with daily laborer and unemployed AOR 1.56(95% CI 1.02-2.38), were more likely to use their nets than their counter parts. Place of residence either urban or rural, sex of respondents and size of the family members were some of the factors not significantly associated with LLITNs utilization in this study.

Conclusions: This study indicated that despite high universal LLITNs coverage in the district, only half of the households were using LLIN for protection against mosquito bite. Thus, majority of the residents are at high risk of mosquito bite and acquiring of malaria infection. Therefore we recommend community health education to bring root behavioral change in using the LLITNs.

Key Words: LLITNs, LLITNs ownership, prevalence of LLITNs utilization

Access to and Use Gaps of Insecticide-Treated Nets in Jimma Zone: Evidence from a Baseline Result from School and Faith Based Malaria Education Program: Implication for Behavioural Change Communication

Zewdie Birhanu, Lakew Abebe, Morankar Sudhakar, Guda Alemayehu

Background: Despite tremendous efforts, malaria remains one of the major health and socio-economic burden in Ethiopia. The government has planned to eliminate and achieve near zero malaria related death by 2015. However, the progress on key malaria prevention methods, mainly proper use of ITN is far behind expectations.

Objective: This article presents access to and use gaps of insecticide-treated nets in selected districts of Jimma zone, Oromia, with intention to appraise implication for behavioral change communication.

Methods: This analysis used data collected from 798 households to establish baseline indicators for school and faith based malaria education program funded by USAID and being implemented in three districts of Jimma zone; namely Mana, Kersa and Gomma. The data were collected from thirteen kebeles from December 2013 to January 2014 by trained data collectors and analyzed by SPSS 17.0. To calculate ITN ownership, access and user gaps, the recommendations developed in 2011 by Survey and Indicator Task Force of the Roll Back Malaria Monitoring and Evaluation Reference Group (MERG) was used. This calculation contains six ITN indicators and helps to roll-out behavioral driven gaps.

Results: Overall, 70.9% (95%CI: 67.8%, 74.1%) of the sampled households had at least one ITN (spatial coverage gap of 29.1%), and 63.0% (95%CI: 59.6, 66.3) of the households had enough ITN for every member of the household. When the analysis is restricted to households with any net, the ownership of at least one ITN for every two people was 88.9% (95%CI: 86.3, 91.4) with intra-household net gap of 11.1%. With respect to access to nets, 51.9 % (95%CI: 50.5, 53.5) of the population had access to ITN within the households, with overall mean access of 54.7% (9%CI: 51.9, 57.5). Overall 38.4% (95%CI: 36.9%, 39.9%) of the studied individuals slept under ITN previous night with females more likely to sleep under net across all age groups. However, previous night ITN use was increased to 73.1% (95%CI: 71.2,74.9) among households with sufficient access. This yields overall ratio of use to access of 70.2% implying that 29.8% of the population who had access to the net did not actually use which is due to behavioral failure. The magnitude of behavioral failure was found to be high among people in age group of 10-19 years. Among households with full ITN access, females (P=0.001, AOR=1.52; 95%CI: 1.25, 1.83) and; children age 0-4 years (P=0.001; OAR= 2.28; 95%CI: 1.47, 3.53) were more likely to use nets. However, in insufficient access leads to gender disparity where males were given priority in under five children. Several barriers were identified against ITN use including shape of nets and sleeping arrangements; lower perceived susceptibility; saving nets; insufficient access, awareness and irresponsibility, negligence, using for other purposes and perception of degraded efficacy of the nets.

Conclusion and recommendations: ITN utilization was hampered by spatial coverage gap and most importantly by behavioral driven gaps. This call for well-designed and appropriate behavioral change communication interventions to deal with behavioral failure as first instance while improving access as second instance. Further, the finding calls for going beyond the traditional messaging approach to address specific needs and gaps by taking into account gender and age. **Key words:** Insecticide treated net, Net ownership, net coverage, ITN use, ITN access, Jimma

Rapid Assessment of Barrier to LLIN utilization among the trained lead person Under USAID –JU ACP malaria project

Gemechis Etana Roro, MorankarSudhakar, LakewAbebe, ZewdieBerhanu, Guda Alemayehu

Background: Health Policy of Ethiopia is with main focus of prevention by promoting healthy life style among the citizen by establishing system for universal access to primary health care services. Even if there is tremendous improvement, despite of the availability and accessibility (LLIN, free drug, rapid diagnostic test (RDT), presence of health post in the community and availability of HEWs) of the services at community level for malaria prevention and elimination the behavioral gaps of the service utilization were observed. The gaps comprise inconsistent LLIN utilization, poor health service seeking behavior, taking under dose due to sharing and keeping the drug prescribed for another infection time.

Objective: To assess barriers to LLIN utilization among the lead person who come for training on Advanced Community Practice for malaria Prevention Project.

Methodology: One of the strategies employed for USAID-JU Advancing community practice for malaria prevention project is training of lead person who should be real model in impressing the entire community in utilizing the services in their respective locality. The study groups were those participants who came to the malaria communication training. After the training these individuals are expected to cascade down the eight malaria actions. Training was imparted to school teachers, students, Health Extension Workers, health club members and religious leaders in Goma, Manna, Kersa, Dedo and Sokoruworeda. The training of lead person involved practical session of reflection on which each participant were categorized as “**without bed net, Non-utilizer, intermittent utilizer and consistent utilizer**” Discussion was initiated among the trainees to identify barriers and behavior determinants.

Result: 195 individuals were included in the study and 22 (11.3%) of them were without bed net and 66 (33.9%) were consistent utilizers. Even if they possess LLIN the remaining 33 (16.9%) and 74 (38.%) found to be non-utilizers and intermittent utilizers respectively. During the discussion the reasons listed by non-utilizers and intermittent utiliser were burning sense from chemical, forgetfulness, carelessness, absence of experience of malaria infection, inconvenience of shape of LLIN, undermining the effect of malaria infection, staying away from home for field activities and other activities and thinking that malaria is seasonal. The consistent utilizers mentioned that they were initiated to do so because of the history of malaria case which forced them or their family member to visit health institution so many times including admission in hospital, health education they get from health institution including health post level and due to peer encouragement.

Conclusion: Past exposure to the disease has a major effect on the utilization behavior by fear arousal those individuals who were infected once dare to use LLIN consistently than those who has no experience of infection on themselves as well as on their family member. Being in endemic area if there is no past experience of infection creates lower perceived susceptibility and a perception of no risk of malaria infection which can happen at any time. Except the consistent utilizers 66 (33.9%) who are safe and without risk of infection, the remaining percentage of the lead person were at the risk of contracting malaria at any time. Those without bed net and the non-utilizers considered as high risk and the intermittent utilizer as low risk still with the possibility of infection. Finally, the lead persons through reflection come to consensus to be consistent utilizer to be a model in cascading down the basic malaria training they get.

Molecular evidence of *P. falciparum* resistance to anti-malarial drugs in Humera, North Ethiopia (2007)

Musie Araya, Asrat Hailu, Abrahm Aseffa, Engers Howard, Asfaw Getachew and Jurgen Kun

Background: Rapid development and widespread of multidrug resistant *P. falciparum* in Africa, specially to effective, cheap and affordable drugs, it remains a major challenge to malaria prevention and control strategy in the region.

Objective: this study assess current efficacy of Artemether-lumefantrine against uncomplicated *P. falciparum* malaria and estimate frequency of resistance molecular markers to CQ/SP in *pfdhfr*, *pfcr76T*, and *pfmdr86Y* alleles in Humera district, North Ethiopia.

Methods: A prospective study was conducted during September to mid-December, 2007. One hundred and eighteen microscopically confirmed malaria patients who fulfill inclusion and exclusion criteria were recruited- WHO standard protocol. All patients were treated by standard fixed six-dose regimen (Coartem) twice a day for three days.

Patients were followed for clinical and parasitological evaluation over 14 days. Moreover, about 4 drops of finger pricked blood was blotted on filter paper for genotyping by real-time PCR.

Results: of 118, one hundred and two patients completed the follow-up successfully with 100% adequate clinical and parasitological treatment response. Complete fever and parasitaemia clearance was achieved at day three in all patients. Parasitaemia clearance time was associated with initial parasitaemia carriage (p -value, 0.011). In this study, the frequency of field isolates carried triple mutant in *pfdhfr* gene was 12% with a single point mutation of *pfdhfr108N*(91.7%) *pfdhfr511* (78%), and *pfdhfr59R* (17%). But, no mutation was observed in *pfdhfr108* with amino acid substitution from Serine to Theronine. In addition, the Frequency of single point mutation in *pfcr76T* and *pfmdr86Y* was 74.3% and 69.7% respectively with 51.4% of the field isolates demonstrated mutations in both *pfcr76T* and *pfmdr86Y*. Field isolates carried mutation in *pfdhfr51* tends to cause infection in younger age (p -value, 0.028). parasitaemia clearance time was prolonged in patients infected with parasite carried mutation in *pfcr76T* (p -value=0.0001) and *pfmdr86Y* (p -value=0.011) alleles. Moreover, strong association was displayed in field isolates demonstrated in both *pfcr76T* and *pfmdr86Y* (p -value=0.0001). While, no association was found between genotypes and ages in all age groups.

Conclusion: The molecular evidence reveals that this drug, could be continued as first line treatment against uncomplicated falciparum malaria and, is also effective in this district where high prevalence of *pfdhfr*, *pfcr76T*, and *pfmdr86Y* mutant parasites were observed. Therefore, for better understanding, similar study should be conducted in multi-centered fashion to represent the epidemiology of the country.

Key words: Artemether-lumefantrine treatment response, *pfdhfr*, *pfcr76T*, *pfmdr86Y*, *P. falciparum*, RT-PCR and Humera, Ethiopia.

***In vivo* efficacy of chloroquine in treatment of *Plasmodium vivax* malaria in Southern parts of Ethiopia**

Sisay Getachew, Sarah Auburn, Richard N Price, Abraham Aseffa, and Beyene Petros

Background: Chloroquine is in use as a first line drug for treatment of *Plasmodium vivax* malaria in different parts of the world. However, its use has been compromised by the emergence of drug resistance. This work aims at providing a preliminary result on the therapeutic efficacy of CQ against *P. Vivax* malaria in the southern parts of Ethiopia between 2010 and 2013. Using data derived from a standard 28 day follow up surveillance from 4 sites in Southern parts of Ethiopia, additionally evidence of local heterogeneity were sought in *P. vivax* CQ efficacy in the areas.

Methods: 57,56,100,89 study participants, aged between 8 month and 65 years, with microscopically confirmed *P. vivax* mono-infection were recruited after informed consent from Batu (Ziway), Guba (Halaba), Shonie (Hadiya) and Kola Shele (Arbaminch) health centers respectively. The study participants were treated with 25 mg/kg quality assured chloroquine drugs over three consecutive days under supervision and followed for 28 days. On each visit parasitological and clinical assessments were made. To differentiate whether the parasite strains present on the day of admission and on day of recurrence were the same or different, the samples were genotyped at 9 microsatellite markers namely, MS1, MS10, MS8, MS12, MS20, MS5, pv3.27, MS16 and msp1F3.

Results: On enrolment 43.9%, 1.15%, 23.4%, 34.5% have history of fever and 56.1% 98.85% 76.6% 65.5% have with documented fever from Batu (Ziway), Guba (Halaba), Shonie (Hadiya) and Kola Shele (Arbaminch) health centers respectively. The major clinical symptoms observed at the time of recruitment were fever followed by headache and chills. Age and parasite density were negatively correlated in all sites at initiation of the follow up. Parasitaemia and fever cleared in all treatment success cases at day 7. The preliminary result showed that 2, 9, 8 and 2 study participants were shown to have recurrent parasitemia after day 7 in Batu (Ziway), Guba (Halaba), Shonie (Hadiya) and Kola Shele (Arbaminch) health centers respectively some with the same genotype as that of the day of admission.

Conclusion and Recommendation: The observed treatment failure in the study areas signals the need for regular monitoring activity. Furthermore, a nationwide survey has to be undertaken to determine the extent of the problem in Ethiopia.

Key Words: Chloroquine, Treatment Failure, Southern parts Ethiopia, *P. vivax*, *Microsatellites*

Efficacy and Safety of Artemether-Lumfantrine (Coartem®) for the Treatment of Uncomplicated Plasmodium falciparum Malaria in Pawe/Felege Selam Health Center, Benishangul Gumuz, Ethiopia

Walelign Dessie, Tedla Mindaye, Gebru Mullugeta, Moges Kassa

Background: Malaria prevention and management in Ethiopia aims to reduce the overall burden of the disease. The recommended first-line treatment of all clinically and parasitologically diagnosed uncomplicated *Plasmodium falciparum* malaria in Ethiopia is an artemisinin-based Combination Therapy (ACT) called artemether-lumefantrine (AL). If AL is not available, oral quinine is recommended for all patients as a second-line treatment. Since therapeutic efficacy studies remain the gold standard for guiding drug policy and should be undertaken at least every 2 years, efficacy and safety of AL therapy was conducted in the present study.

Objective: To assess the efficacy and safety of artemether-lumefantrine (Coartem®) for the treatment of uncomplicated *P. falciparum* infections in Pawe /Felege Selam Health Center, Benishangul Gumuz regional state.

Methods: Anti-malarial drug efficacy trials were conducted in Pawe/Felege Selam health center, Benishangul Gumuz regional state, Ethiopia. After informed written consent obtained for the study, all patients who met inclusion criteria were conveniently enrolled into the study. The participants were febrile people over 6 months of age with confirmed uncomplicated *P. falciparum* infection. Patients were treated with 3-day, six-dose regimen of AL combination. Clinical and parasitological parameters were monitored over a 28-day follow-up period to evaluate drug efficacy. The data were analyzed by using SPSS and Kaplan Meier survival analysis. Tables and figures were used to present the data. The study was conducted from October to December, 2013.

Result:- The cure rate, adequate clinical and parasitological response (ACPR) was found to be high 96.7% (PCR uncorrected) over a 28 day follow up period in this study. The parasite and fever clearance time was also rapid. AL for the treatment of acute uncomplicated *P. falciparum* malaria in the study area showed PCR corrected cure rate of 97.8% and only 2.2% failure rate. The cure rate exceeded 95.8% in each body weight group (P=0.338) with no indication that outcome differed between groups. There were also no clinically relevant differences in safety or tolerability between body weight groups.

Conclusion: The result showed that the six-dose regimen of AL is a good choice for managing uncomplicated *P. falciparum* malaria in all body weight groups of ≥ 5 kg, with a high efficacy and a good tolerability in the study area. However, the efficacy of AL needs to be carefully monitored periodically in sentinel sites representing different areas of the country.

K13-propeller polymorphisms in *Plasmodium falciparum* parasites from sub-Saharan Africa

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Mutations in the *Plasmodium falciparum* K13-propeller domain have recently been shown to be important determinants of artemisinin resistance in South-East Asia. This study investigated the prevalence of K13-propeller polymorphisms across sub-Saharan Africa. 1212 *P. falciparum* samples collected from twelve countries were sequenced. None of the K13-propeller mutations previously reported in South-East Asia were found, but 21 unique mutations were detected, of which seven were non-synonymous. Allele frequencies ranged between 1-3%. Three mutations were observed in more than one country, and the A578S was present in parasites from five countries. This study provides baseline prevalence of K13-propeller mutations in sub-Saharan Africa.

Key words: K13-propeller, artemisinin resistance, sub-Saharan Africa

In vivo efficacy of artemether-lumefantrine against uncomplicated Plasmodium falciparum malaria in Central Ethiopia

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Background: In vivo efficacy assessments of the first-line treatments for Plasmodium falciparum malaria are essential for ensuring effective case management. In Ethiopia, artemether-lumefantrine (AL) has been the first-line treatment for uncomplicated P. falciparum malaria since 2004.

Methods: Between October and November 2009, we conducted a 42-day, single arm, open label study of AL for P. falciparum in individuals >6 months of age at two sites in Oromia State, Ethiopia. Eligible patients who had documented P. falciparum mono-infection were enrolled and followed according to the standard 2009 World Health Organization in vivo drug efficacy monitoring protocol. The primary and secondary endpoints were PCR uncorrected and corrected cure rates, as measured by adequate clinical and parasitological response on days 28 and 42, respectively.

Results: Of 4426 patients tested, 120 with confirmed falciparum malaria were enrolled and treated with AL. Follow-up was completed for 112 patients at day 28 and 104 patients at day 42. There was one late parasitological failure, which was classified as undetermined after genotyping. Uncorrected cure rates at both day 28 and 42 for the per protocol analysis were 99.1% (95% CI 95.1-100.0); corrected cure rates at both day 28 and 42 were 100.0%. Uncorrected cure rates at day 28 and 42 for the intention to treat analysis were 93.3% (95% CI 87.2-97.1) and 86.6% (95% CI 79.1-92.1), respectively, while the corrected cure rates at day 28 and 42 were 94.1% (95% CI 88.2-97.6) and 87.3% (95% CI 79.9-92.7), respectively. Using survival analysis, the unadjusted cure rate was 99.1% and 100.0% adjusted by genotyping for day 28 and 42, respectively. Eight P. falciparum patients (6.7%) presented with Plasmodium vivax infection during follow-up and were excluded from the per protocol analysis. Only one patient had persistent parasitaemia at day 3. No serious adverse events were reported, with cough and nausea/vomiting being the most common adverse events.

Conclusions: AL remains a highly effective and well-tolerated treatment for uncomplicated falciparum malaria in the study setting after several years of universal access to AL. A high rate of parasitaemia with P. vivax possibly from relapse or new infection was observed.

In Vivo Efficacy of Artemether-Lumefantrine and Chloroquine against Plasmodium vivax: A Randomized Open Label Trial in Central Ethiopia

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Background: In vivo efficacy assessments of antimalarials are essential for ensuring effective case management. In Ethiopia, chloroquine (CQ) without primaquine is the first-line treatment for Plasmodium vivax in malarious areas, but artemether lumefantrine (AL) is also commonly used.

Methods and Findings: In 2009, we conducted a 42-day efficacy study of AL or CQ for P. vivax in Oromia Regional State, Ethiopia. Individuals with P. vivax mono infection were enrolled. Primary endpoint was day 28 cure rate. In patients with recurrent parasitemia, drug level and genotyping using microsatellite markers were assessed. Using survival analysis, uncorrected patient cure rates at day 28 were 75.7% (95% confidence interval (CI) 66.8–82.5) for AL and 90.8% (95% CI 83.6– 94.9) for CQ. During the 42 days of follow-up, 41.6% (47/113) of patients in the AL arm and 31.8% (34/107) in the CQ arm presented with recurrent P. vivax infection, with the median number of days to recurrence of 28 compared to 35 days in the AL and CQ arm, respectively. Using microsatellite markers to reclassify recurrent parasitemia with a different genotype as non-treatment failures, day 28 cure rates were genotype adjusted to 91.1% (95% CI 84.1–95.1) for AL and to 97.2% (91.6– 99.1) for CQ. Three patients (2.8%) with recurrent parasitemia by day 28 in the CQ arm were noted to have drug levels above 100 ng/ml.

Conclusions: In the short term, both AL and CQ were effective and well-tolerated for P. vivax malaria, but high rates of recurrent parasitemia were noted with both drugs. CQ provided longer post-treatment prophylaxis than AL, resulting in delayed recurrence of parasitemia. Although the current policy of species-specific treatment can be maintained for Ethiopia, the co-administration of primaquine for treatment of P. vivax malaria needs to be urgently considered to prevent relapse infections.

In vivo* antimalarial activity of hydromethanolic extract from the stem bark of *Syzygium guineense* (Willd.) DC. (Myrtaceae) in mice infected with *Plasmodium berghei

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Background: Malaria is one of the world's most deadly infectious diseases. According to the latest estimates in 2013, about 198 million cases and 584, 000 deaths of malaria occurred globally. An estimated 90% of all malaria deaths occur in Africa particularly in children less than 5 years age. Spread and emergence of resistance to front line antimalarial drugs including artemisinin is the major challenge that endangers all recent gains in malaria control. As a result, there is an urgent need to increase efforts in antimalarial drug discovery to develop new drugs that counter spread of drug-resistant parasites. Medicinal plants are the indisputable source of effective antimalarials. *Syzygium guineense* has a wide range of therapeutic applications against various diseases including malaria. Decoction of stem bark of *Syzygium guineense* (dok'ma), the most abundant medicinal plant in Ethiopia, is commonly used by traditional healers' in many parts of Africa for treatment of malaria.

Methods: A rodent malaria parasite, *Plasmodium berghei* (ANKA strain), was used to inoculate healthy male Swiss Albino mice of age 8–12 weeks and weight 25–33g. In the present study, 100,200, 400 mg/kg body weight of eighty percent methanolic extract of stem bark of *S. guineense* (dok'ma) was evaluated for *in vivo* malaria four-day suppressive, curative and prophylactic activities against *P.berghei* infected mice. Parameters, including percent parasitemia, survival time, body weight, body temperature, and packed cell volume were then determined using standard procedures.

Results: Significant ($p < 0.001$) parasite suppression of 11.20%, 34.04%, 45.05% and 100% was showed by 100,200, 400 mg/kg body weight of the hydromethanolic extract of stem bark of *S. guineense* and 25mg/kg the standard drug (Chloroquine), respectively on early malaria infection and 26.91%, 37.13%, 58.24% and 91.15%, respectively on malaria prophylactic study. In addition, the extract had shown a significant ($p < 0.001$) parasite suppression on established malaria infection with maximum of 36.27% at the dose of 400 mg/kg/day. The 200 and 400 mg/kg body weight of the extract significantly ($p < 0.05$) prevented PCV and body temperature reduction on early malaria infection and on malaria prophylactic test, which is comparable with the standard drug with no significant difference. The phytochemical screening of the extract showed the presence of Alkaloids, Anthraquinones, Terpenoids, Saponins, Tannins, Phenols and Flavonoids.

Conclusion: It can be concluded that the extract had a moderate anti-plasmodial activity against *P. berghei* on early infection and in prophylactic study that signifies the potentially usefulness of the plant for the development of new anti-malarial agent.

Evaluation of GENEDIA® Malaria P.f/pan Ag Rapid Test relative to microscopy in a malaria endemic area Ethiopia, 2013

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Background: Early and accurate diagnosis of malaria followed by prompt treatment reduces morbidity and mortality in endemic regions. Presumptive treatment of malaria is widely practiced where microscopy or rapid diagnostic tests are not readily available. Introduction of rapid diagnostic tests (RDTs) for the treatment of malaria in many low-resource settings need evaluation of their performance. This study evaluated the performance of GENEDIA® Malaria *P.f*/pan Ag Rapid Test in malaria endemic area Ethiopia.

Objective: To evaluate the diagnostic performance of GENEDIA® Malaria *P.f*/pan Ag Rapid Test relative to microscopy for the diagnosis of *P. falciparum* and *P. vivax* malaria in Ethiopia.

Methods: In this cross-sectional study from November to December 2013, patients who had malaria symptoms and visited malaria control center in Adama, Oromia Region were recruited. Thin and thick blood smears were prepared from finger prick and stained by 10% Giemsa. Microscopic examination was done under 100x magnifications for *Plasmodium* species identification and determination of parasitaemia. The RDT was performed as per the manufacturer instruction.

Results: A total of 417 febrile patients were diagnosed, of which 149 were microscopy positive for *Pf* (n=47) , *Pv* (n=93) and *P.f* and *P.v* or mixed(n=9) The sensitivity, specificity, positive and negative predictive value of GENEDIA® Malaria *P.f*/pan Ag rapid test was 95.3%, 96.6%, `94.0%, 97.4 % respectively.

Conclusion: The diagnostic performance of GENEDIA® Malaria *P.f*/pan Ag rapid test has sensitivity, specificity, positive and negative predictive value of 95.3%, 96.6%, `94.0%, 97.4% respectively with respect to malaria microscopy in this study.

Key words: Malaria, RDTs, GENEDIA® Sensitivity, Specificity

Malaria Outbreak Investigation; Erer District, Ethiopia Somali Region, Eastern Ethiopia, Nov 2012

Yusuf Mohammed, (Ethiopia Somali Region, Public Health Emergency Management)

Introduction: Malaria remains a major public health problem particularly in sub-Saharan Africa. Ethiopia is one of the most malaria-epidemic countries in Africa. In September, 2012, during weekly surveillance data analysis, an increment of malaria cases was detected from Erer Woredas of Somali region. We investigated to verify the existence of an outbreak, identify risk factors and to recommend control and preventive measures.

Methods: Both descriptive & unmatched a case-control study was conducted .We reviewed records at health facility to get baseline incidence. Malaria Monitoring chart was used .We defined confirmed malaria case as an acute febrile illness with a peripheral blood smear positive for malaria or a positive rapid antigen test (RDT) in residents of Erer town & surrounding kebeles from September 2012 to Nov 2012. For each 25 cases 50 controls was selected. Multivariate analysis was performed using Epi Info version 3.5.1.

Result: During study period, a total of 555 confirmed cases were reported. The baseline incidence rate for malaria prior to the outbreak was (1/1000 population). During our study the incidence rate was [Incidence: 37 per 1,000 and 1 deaths (Case fatality rate: 0.2 %). The mean age of malaria patients in this outbreak was 21 years (male 22, and female 19 yrs). High attack rate 27/1000 was reported from Erer kebeles. Plasmodium falciparum constitute 97% of the parasite. About 273(49.2%) of the cases were from age group >15 years. Using insecticide treated bed nets (ITNs) [OR: 0.07; 95%CI 0.02:0.23], and being sprayed their houses with indoor residual spraying (IRS) [OR: 0.03; 95%CI 0.01:0.21], are protective factor for malaria. While, presence of malaria cases in home [OR: 12; 95%CI 4.9:32.5], & presence of mosquito breeding site near their home [OR: 9; 95%CI 1.2:75.5], were risk factor for malaria.

Conclusion: In this outbreak, we identified factors that contributed to the outbreak, which included a low coverage of ITNs, presence of vector breeding site and low IRS coverage. We recommended distribution of ITNs, clearing of mosquito breeding site, and indoor residual spray.

Key words: outbreak, malaria, odds ratio, Erer

Therapeutic Efficacy of Artemether-Lumefantrine for the Treatment of Uncomplicated *Plasmodium falciparum* Malaria in Northern Ethiopia

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Background: Multidrug resistance of *Plasmodium falciparum* is spreading throughout Africa. This has posed major challenges to malaria control in sub-Saharan Africa. **Objective.** The aim of the study was to evaluate the efficacy of artemether-lumefantrine for the treatment of uncomplicated *Plasmodium falciparum* malaria in North Ethiopia.

Methods: This prospective study was undertaken during August–November 2009 on 71 malaria patients that fulfilled the inclusion criteria set by the WHO. Patients were followed up for 28 days. Thick and thin blood films were prepared by Giemsa stain for microscopy to determine parasite density. A standard six-dose regimen of artemether-lumefantrine was administered over three days and was followed up with clinical and parasitological evaluations over 28 days. **Results:** The cure rate (ACPR) was found to be high (97.2%) in this study. The parasite and fever clearance time was also rapid. Artemether-lumefantrine for the treatment of acute uncomplicated *Plasmodium falciparum* malaria in the study area showed 97.2% cure rate and only 2.8% failure rate.

Conclusion: The result showed that the drug could continue as first line for the treatment of uncomplicated *Plasmodium falciparum* malaria in the study area. The efficacy of artemether-lumefantrine needs to be carefully monitored periodically in sentinel sites representing different areas of the country.

Return of chloroquine-sensitive *Plasmodium falciparum* parasites and emergence of chloroquine-resistant *Plasmodium vivax* in Ethiopia

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Background: Increased resistance by *P. falciparum* parasites led to the withdrawal of the anti-malarial drugs Chloroquine (CQ) and Sulphadoxine-Pyrimethamine (SP) in Ethiopia. Since 2004 Artemether-Lumefantrine (AL) has served as a first-line drug to treat uncomplicated *P. falciparum* malaria. However, increasing reports on delayed parasite clearance in those administered artemisinin opens up a new challenge in anti-malarial therapy. With the complete withdrawal of CQ more than a decade ago, this study assessed the evolution of CQ resistance in Ethiopia by investigating the prevalence of mutant alleles in the *pfmdr1* and *pfcr1* genes in *Plasmodium falciparum* and the prevalence of mutant alleles in the *pvmdr1* gene in *Plasmodium vivax* in clinical isolates from Southern and Eastern Ethiopia.

Methods: Of the 1,416 febrile patients attending primary health facilities in Southern Ethiopia, 329 febrile patients whose slides were positive for *P. falciparum* or *P. vivax* were recruited. Similarly of the 1,304 febrile patients from Eastern Ethiopia, 81 febrile patients whose slides were positive for *P. falciparum* or *P. vivax* were included in the study. Of the 410 finger-prick blood samples collected from malaria patients, we used direct sequencing and by real-time PCR to investigate the prevalence of mutations in *pfcr1* and *pfmdr1*. This included determining the gene copy number in *pfmdr1* in 195 *P. falciparum* clinical isolates, and mutations in the *pvmdr1* locus in 215 *P. vivax* clinical isolates.

Results: The *pfcr1* K76 (Lys76) CQ-sensitive allele was observed in 84% of the investigated *P. falciparum* clinical isolates. The *pfcr1* double mutations (K76T and C72S) were observed less than 3%. The *pfcr1* SVMNT haplotype was also found to be present in clinical isolates from Ethiopia. The *pfcr1* CVMNK-sensitive haplotypes were frequently observed (96%). The *pfmdr1* mutation N86Y was observed only in 14.9% compared to 85.1% of the clinical isolates that carried sensitive alleles. Also, the sensitive *pfmdr1* Y184 allele was more common, in 96% of clinical isolates. None of the investigated *P. falciparum* clinical isolates carried S1034C, N1042D and D1246Y *pfmdr1* polymorphisms. All investigated *P. falciparum* clinical isolates from Southern and Eastern Ethiopia carried only a single copy of the mutant *pfmdr1* gene.

Conclusion: The study reports for the first time the return of chloroquine sensitive *P. falciparum* in Ethiopia. These findings support the rationale for the use of CQ-based combination drugs as a possible future alternative.

Impact of micro-dams on local microclimate and its relevance to malaria transmission in northern Ethiopia

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Background: In drought-prone Tigray, introduction of micro-dams, mainly for irrigation purposes, resulted in dramatic increases of malaria in local villages. It was hypothesised that part of the reason for this increase was the dams alter the microclimate, notably increase temperature locally, resulting in elevated rates of malaria.

Methods: To investigate the impact of micro-dams on local microclimate and malaria transmission and in order to develop appropriate methods for the control of this disease, a longitudinal microclimatic, entomological, and clinical study was conducted in two topographically similar villages: Deba, near a micro-dam and Maisheru, 3-4km away, in Tigray where an extensive dam construction is in progress in epidemic prone areas. The weather was recorded in both villages, on the dam embankment and at different mosquito habitats over 19 months. A community-led larval intervention study followed the impact assessment phase in the dam village.

Results: There was a 3.1 times greater prevalence of an enlarged spleen and 2-5.5 times higher incidence of falciparum malaria in children under 10 years of age in the dam village compared to the remote village. *Anopheles arabiensis*, which was highly anthropophilic, partially exophilic, and showed early biting peak (19:00-20:00hr), was 6.5-8 times more abundant in the dam village compared to the remote village and this was even higher during the dry season (x16). This corresponded to when the fields were irrigated indicating that transmission of malaria was no longer restricted to the rainy season in the dam village compared to the remote village. The dam not only created abundant mosquito breeding sites throughout the year, but also resulted in significant microclimate changes; notably elevated minimum atmospheric temperature, the influence weakening with distance from the dam. The dam site was 1.5 °C warmer than the dam village and that of the dam village was 1.3 °C higher than the remote village and was especially pronounced (>3.5 °C) in the cool/dry season. Mean air temperature recorded under vegetation was 1.7 °C lower than outside and the dam provided numerous cool and humid microhabitats elsewhere by raising the water table, increasing water seepage, saturating the soil and promoting abundant growth of vegetation. Indoor temperature was relatively stable with higher minima and lower maxima than outdoors and on the average 2.8-3.4 °C warmer than outdoors. The warming effect of the dam, together with profuse breeding sites, suitable indoor and outdoor resting microhabitats may have contributed to the extended and dramatic increased risk of malaria observed in near dam communities in the Ethiopian highlands in Tigray. Most importantly the larval intervention study, which involved minimal community participation, showed a 49% relative reduction in *An. arabiensis* abundance in the dam village compared with the pre-intervention period.

Thus, if dams could be constructed further away from settlements and if serious and sustainable community-led environmental management measures could be introduced as a package, it would be possible to mitigate the impact of micro-dams to an appreciable extent and calls for an integrated approach to malaria control, in fringe areas of malaria, such as the Tigray highlands, particularly near micro-dams.

Key words: Dams, microclimate, mosquito ecology, Ethiopia, Tigray, malaria, *Anopheles arabiensis*, highland fringes.

Early biting rhythm in the afro-tropical vector of malaria, *Anopheles arabiensis*, and challenges for its control in Ethiopia

Mekonnen Yohannes and E. Boelee

Abstract. The biting cycle of the malaria vector *Anopheles arabiensis* Patton (Diptera: Culicidae) was assessed by hourly light trap collections in three villages in Tigray, northern Ethiopia. Hourly catches were conducted in two houses in each village, for four consecutive nights. Light traps were set from 18.00 hours to 07.00 hours in houses in which people slept under untreated bednets. *Anopheles arabiensis* showed early biting activities, which peaked between 19.00 hours and 20.00 hours in the three villages; over 70% of biting activity occurred before 22.00 hours, when people typically retire to bed. This early biting activity may have a negative impact on the efficiency of bednets to control malaria.

Key words. *Anopheles arabiensis*, biting rhythm, malaria vector, Ethiopia, Tigray.

LLIN/ITN ownership, utilization and factors associated with utilization in Ethiopia: a review literature

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Background: LLIN is one of the three prevention strategies against malaria globally including Ethiopia. Despite its increasing availability, the utilization did not reach the WHO recommendation which is 80%. Different studies documented varying factors which could affect household utilization of nets and these factors differ across studies. In this exercise we have reviewed the available literatures on net use in Ethiopia and presented the commonly reported factors affecting net use to inform programs in the country.

Methodology: We performed a systematic search using PubMed and Google scholar; the following key terms were used while performing the search: malaria, Ethiopia, ITN, LLIN, utilization and predictors. A total of 23 articles were downloaded of which only 13 were directly related to the topic of interest which is ownership, use and predictors of use. All the 13 articles were reviewed and the results are presented as follow.

Result: The majority of the studies were conducted predominantly in the three big regions namely, Amhara, Oromia and SNNP (except for the MIS study which provided a national and regional estimate for the rest of the regions). The ownership of LLIN/ITN goes as low as 37% in a study conducted in 2006 and as high as 98.4% in a study conducted in 2011. The ownership varies by time, region and whether the sample is predominantly taken from urban or rural areas. The ownership was higher among rural residents and per-urban areas. Not all studies calculated mean number of nets owned per household but for the studies captured this information the mean number of net ranges from 0.6 to 2.5 across the studies. The later was following recent mass free distribution. All studies captured net use prior to the survey night; the use varies significantly by year of data collection and region where the study was conducted. Utilization of ITN/LLIN did not exceed 65% in these studies. The lowest utilization was documented in Gursum which was 21.5% by Sibihatu et.al, 2012. The national estimate for LLIN use from MIS 2011 was somehow comparable with the report by the pocket studies (60.1% of <5 children and 58% of women).

The factors which influence net use by the household members could be classified in to socio-demographic, household condition, net characteristics, perception towards malaria and presence of other malaria intervention. From the socio-demographic characteristics, younger age(<5 years), female gender, household head occupation as daily laborer are more likely to use LLIN/ITN/. In addition, a statically significant regional as well as residence deference was also documented. The household conditions such as living in traditional housing, having more number of sleeping place in the household and higher household family size were also associated with non-use of ITN/LLIN. The number of nets in the household, the age of the net and the shape of the nets were also important factors which negatively affect net use by the household members. Though the researchers did not carry out statistical test, individuals' perception towards malaria as perceived severity, perceived susceptibility and perceived effectiveness of ITN/LLIN as malaria prevention strategy were important reasons for not using the net. In addition, discomfort and inconveniences while hanging the net and while sleeping under were also reported as reasons for not using the net. Moreover, living in high land area and where there is no mosquito breeding sight are negatively associated with net use. One study reported that the presence of IRS intervention simultaneously resulted in non use of LLIN/ITN.

Conclusion: Despite more than 90% ownership of LLIN/ITN, utilization is still lower than expected. Household members are more likely to give priority to their under five children and females. The household condition and the current state of nets are also important in shaping utilization in the household. Moreover, the decreasing trend in malaria morbidity and mortality might have shaped individuals perception towards malaria and their use of the intervention negatively.

Recommendation: further studies might need to consider, wide and diverse socio-geographic areas and more emphasis should be given on behavioral change communication.

The incidence of malaria and its distribution in the former epidemic detection sites of Oromia

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Back ground: Malaria is one of the most important public health problems in Ethiopia. More than 50 million people in the country live in areas where risk of malaria is considered present. In which women (pregnant) and under five children are considered vulnerable group and given special attention. Annually an estimated 9 million malaria cases occur. Among these *Plasmodium falciparum* accounts for 77% of malaria case according to MIS 2011.

Objective: This study was aimed to see malaria incidence and its distribution along different age categories and sex. As well the study aimed to identify patterns of malaria distribution by species in the former epidemic detection sentinel surveillance sites.

Methodology: This is a descriptive retrospective study based on the analysis of malaria epidemic detection sentinel surveillance data. The project data were collected from April, 2010 to August, 2013 from 10 sentinel surveillance sites in Oromia region. The data were registered by health providers in the facility as a routine data source through registration book prepared by the project and provided uniformly for all the sentinel sites. The data collated monthly by trained surveillance officers from the sites to central data base at Addis Continental Institute of Public Health. Descriptive statistics was done for the analysis.

Result: During the project stay a total of 132,511 patient data were collected. Among these 28,990 were confirmed malaria cases in all age group. Highest percentage of malaria incidence was seen in age group 0-4 years followed by age group 5-9 years which is 19.1 % (5,587) and 15.6% (4,562) respectively. Incidence of malaria were higher among males 57.6 % (16,849) compared to female 42.4% (12,380). Regarding the species *Plasmodium Vivax* accounts for 50.5% (14649) , *Plasmodium falciparum* case 41.3 % (11998) and mixed case 8% (2342) of confirmed cases.

Conclusion: Malaria incidence was seen higher in age group 0-4years followed by age group 5-9 years which enlighten the need for equal attention. Though males are not one of the vulnerable groups the highest incidence in this group capitalizes the need for adequate attention. The species distribution has also shows unusually trend compared to the national epidemiology.



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