

2016

The Seventh Malaria Research Network Symposium Proceeding



Ethiopian Public Health Institute
Addis Continental Institute of Public Health
Jimma University
March 8-9, 2016

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Acknowledgment

The seventh Malaria research network symposium was a result of a concerted effort of different organization and individuals. The Malaria Research Network of Ethiopia (MRNE) would like to extend its heartfelt appreciation to those organizations and individuals who participated in organizing this symposium. Our special thanks goes to Ethiopian Public Health Institute (EPHI) for playing the leadership role and Jimma University for hosting the symposium with great hospitality. Addis Continental Institute of Public Health/Strengthening Malaria Monitoring and Evaluation Systems (ACIPH/SMMES) project's role in organizing the symposium was paramount. The young and senior researchers who presented their research work are the jewels of the symposium. All the participants of the symposium gave live to the symposium and are highly appreciated. Our heartfelt gratitude goes to USAID/PMI without their generous support it is hard to imagine the organization of this symposium.

Summary

The Ethiopian Public Health Institute in collaboration with USAID/PMI's ACIPH/SMMES project and Jimma University's Tropical and Infectious Diseases Research Center, organized a two day malaria research network symposium at Jimma University on March 8-9, 2016. The theme of the symposium was **“Defeat the Mosquito: Eliminate Malaria”**. The symposium was organized in line with the overall purpose of the network, which was, create platform for researchers to share their research findings for policy makers, students and other stakeholders that implement malaria prevention and control activities. The objective of the research network was to strengthen link between researchers, universities, policy makers, and other malaria stakeholders.

The symposium started by a welcoming speech made by Dr Delenesaw Yehuala, on behalf of Tropical and Infectious Diseases Research Center of Jimma University. Followed by key note addresses by Dr. Gunawardena Dissanayake, representing the USAID/PMI and Dr. Adugna Woyessa representing EPHI, the symposium was officially opened by Ato Kora Tushine of Jimma University, Vice President for Business & Development.

Around 80 participants from FMoH, Regional Health Bureaus, local universities, WHO, non-governmental organizations (NGO) etc. attended the symposium. Thirteen oral and three posters on malaria epidemiology, therapeutic efficacy and entomology were presented. Presentation on implication of climate variability on malaria epidemiology in Ethiopia and challenge mapping of the Ethiopian malaria program was made by senior experts in the field. Overview of the Jimma zone malaria problem and program was presented by representative of the Jimma zone.

The final session of the symposium, focused on finalization of the TOR/by-law of MRNE and discuss the way forward points for the network's future direction, where important comments and direction forwarded.

Acronyms

AAU	Addis Ababa University
ACIPH	Addis Continental Institute of Public Health
ACPR	Adequate Parasitological and Clinical Response
ACTs	Artemisinin Combination Therapies
AIDS	Acquired Immuno Deficiency Syndrome
AL	Artemether-Lumefantrine
ALIPB	Aklilu Lema Institute of Patho Biology
AMU	Arba Minch University
CDC	Centre for Disease Control
CI	Confidence Interval
CQ	Chloroquine
CQS	Chloroquine Sensitive Strain
DBS	Dried Blood Spot
DDT	Dichlorodiphenyltrichloroethane
EAs	Enumeration Areas
ELISA	Enzyme-linked Immunosorbent Assays
ENSO	El-Nino Southern Oscillation
ENACTS	Enhanced National Climate Services
EPHI	Ethiopian Public Health Institute
FMOH	Federal Ministry of Health
GPS	Global Positioning System
HDAs	Health Development Armies
HEWs	Health Extension Workers
HF	Health Facility
HHs	House Holds
HLC	Human Landing Catches
HMIS	Health Management Information System
ICAP	International Center for AIDS Care and Treatment Program
IIRS	Indoor Residual Spray
ITNs	Insecticide Treated Nets
JU	Jimma University

LBW	Low Birth Weight
LLCF	Late Clinical Failure
LLINs	Long Lasting Insecticide Treated Nets
LQAS	Lots Quality Assurance Survey
MC	Malaria Consortium
MIS	Malaria Indicator Survey
MRN	Malaria Research Network
MTT	Methyl-Thiazol Tetrazolium
NGO	Non-Governmental Organization
ODK	Open Data Kit
OR	Odds Ratio
PCR	Polymerase Chain Reaction
PCV	Packed Cell Volume
PHEM	Public Health Emergency Management
PMI	President's Malaria Initiative
PPM	Public Private Mix
PSCs	Pyrethrum Spray Catches
PTD	Preterm delivery
RDT	Rapid Diagnostic Test
RHB	Regional Health Bureaus
SD	Standard Deviation
SHOPS	Strengthening Health Outcomes through the Private Sectors
SMMES	Strengthening Malaria Monitoring and Evaluation Systems of Ethiopia
SPSS	Statistical Package for Social Sciences
STATA	Data Analysis and Statistical Software
TB	Tuberculosis
TIDRC	Tropical and Infectious Disease Research Centre
USAID	United States Agency for International Aid
WHO	World Health Organization
YHMC	Yirgalem Hospital Medical College

Opening Ceremonies

A welcome speech was made by Dr Delenesaw on behalf of Tropical and infectious Diseases Research Center (TIDRC), Jimma University. On his speech Dr.Delnesaw highlighted the challenge to bring together professionals, researchers, program managers and stakeholders to have a platform and common network to foster collaboration in the field of malaria research for long to share experiences, scientific information and practical procedures, which will inform the policy for malaria prevention and control. Thus, the new national initiative (The Malaria Research Network of Ethiopia) offers a good opportunity to put joint efforts to undertake research in the context of local situation to provide evidence-based information to develop and implement prevention and control strategies to combat malaria in Ethiopia.

He stressed that as the national malaria control program is currently moving towards elimination, understanding the potential environmental, biological, social and behavioral factors associated with malaria control and prevention need to be well understood and interventions targeting these factors need to be optimized. He also mentioned that such a network is timely and will enhance malaria elimination efforts to reach our eventual goal of malaria free Ethiopia. He strongly believe that, like the previous symposia, the 7th malaria research network symposium will hopefully address key issues with regard to malaria elimination. Finally, on behalf of the organizers and TIDRC, he welcomed the participants and assure them his institute will always be around to solave any problem they may encounter during their stay in Jimma.

Following Dr. Delenesaw's speech, Ato Kora Tushine, Vice President for Business & Development of Jimma University and the guest of honor of the symposium, on behalf of the University welcomed all guests to this malaria research network symposium; jointly organized by TIDRC of JU, EPHI, and ACIPH. On his speech Ato Kora, stressed malaria is still a public health problem and a major cause of morbidity and mortality in Ethiopia and a burden to our community. Prevention and control efforts have become more complicated and challenging due to emerging global and national phenomena including climate and ecological changes, water resources management activities, and resistance of the parasites to drugs and insecticides. Jimma University believes that creation of the MRNE is a positive development in creating a platform for collaboration of academics, researchers, policy makers and practitioners in promoting evidence-based malaria prevention, control, treatment, and elimination strategies at different levels. In developing countries like Ethiopia infectious diseases researches are usually

fragmented; there is also detachment of policy and practice from the domain of research which leads to ineffective intervention strategies and poor value for money. He further stressed that the MRNE offers a rare opportunity to bring together the three domains of research, policy and practice. Finally, on behalf of the University, He expressed his sincere appreciation to all those who worked hard to make symposium a reality. He acknowledged MRNE members for deciding to hold this scientific meeting in Jimma and also acknowledged PMI for funding the symposium through ACIPH, and last but not the least, he thanked the Jimma team for their dedication to make this symposium possible. After his brief speech, he officially opened the symposium and wished to the participant a fruitful and pleasant stay in Jimma.

Following the opening remark by the guest of honor, key note address was given by Dr. Gunawardena Dissanayake, representing the PMI. He first introduced Dr. Matthew Murphy, PMI Ethiopia's resident advisor from CDC-Atlanta. On his speech Dr. Guna, highlighted the historical background of PMI support to the MRNE since 2008 with an overarching aim of closing the gap between the academia/researcher with the national malaria control program and to generate local evidences for program implementation. The other related aim of PMI to support the MRNE, according to Dr. Guna, is capacity building of Ethiopian scientists, especially young researchers to present their scientific work in a local forum, get comments and fine tune their work to present it to international forum and/or publish on peer reviewed journal. Finally, on behalf of PMI, wished the participants all the best in the coming two days deliberations.

The next key note address was made by Dr. Adugna Woyessa, representing EPHI. Dr Adugna gave background introduction of EPHI indicating how the institute evolved into a national public health institute passing different stages of growth and development. Furthermore, he elaborated the institute's portfolio, which can be categorized into three major thematic areas. The first thematic area is research, which encompass seven units each focusing on specific program. The second thematic area is building the national capacity for the laboratory system and the third thematic area is public health emergency management system. He also mentioned a new emerging activity of the institute which is establishment of a training center.

With regard to E-MRN, Dr. Adugna indicated the commitment of EPHI in strengthening the network and also listed the major advantages of the network, which includes creating forum for researchers to connect and share experience and ideas and create forum for dissemination of malaria research works in the country, which was identified as one of the gaps during the

stakeholders meeting held two years back. However, he stressed that the work of the network should not be limited to organizing such forum every year only but the network members who are malaria researchers have to be able identify the malaria related thematic areas which are well covered with malaria research and those less covered, which in turn will help in identifying priority thematic areas related to malaria research.

Session II: Current Malaria Affair

In this session there were three presentations; on the epidemiology of malaria in Jimma zone, climate variability and malaria epidemiology in Ethiopia and mapping of existing challenges during transformation of malaria control to elimination. This session was moderated by Prof. Abraham Haileamlak from Jimma University.

Overview of malaria situation in Jimma Zone

Ato Nasir Abdo, Jimma Zone Malaria Focal Person

Ato Nasir's presentation focusing on the current malaria situation and burden in Jimma zone started by providing the background of Jimma Zone; accordingly the zone is stratified into three climate zones and among the total population more than 75% are at high and moderate risks of malaria infection. Three district hospitals, 114 health centers and 523 health posts are found in the zone. Looking at the malaria epidemiology, *p.falciparum* is the most dominant species in the zone as is seen in most parts of the country and among woredas Shabe and Sombo are with the highest number of malaria cases due to *P. falciparum*.

Finally he mentioned the following points as major challenges in the malaria prevention and control activities in the zone:

- Shortage of budget for implementing malaria prevention and control activities in general and IRS in particular.
- High turnover of woreda malaria focal person & trained health professionals.
- Inadequate monitoring mechanism of LLIN utilization.
- Problem faced on management of old LLINs.
- Poor monitoring and supportive supervision of malaria related activities at all levels.
- Problems in quality, timeliness, accuracy and consistency of registers and reports

The 2015-16 El Niño – Its implications for Malaria Epidemiology in Eastern Africa

Dr. Adugna Woyessa, Bacterial, Parasitic and Zoonotic Disease Research Directorate, Director, EPHI

The presentation mainly focused on the El Niño-Southern Oscillation (ENSO) (El Niño and La Niña), the most prominent mode of climate variability that operates on season to yearly time scales (2-7 years). El Niño conditions in the Pacific typically persist for 9-12 months or longer, starting around June and peaking between November-January. It is possible to use observations of the current ENSO state and other aspects of the current climate to generate skillful probabilistic seasonal rainfall forecasts months in advance. Rainfall related impacts generally occur during a region's traditional rainy season, whereas impacts associated with temperature may extend through-out the event and into subsequent months.

Dr. Adugna mentioned that Ethiopia is by far the most at risk of all the countries in Eastern Africa where the current El Niño will likely impact malaria trends. Over half of Ethiopian population lives in epidemic prone areas and numerous studies have shown that malaria in these areas is highly sensitive to climate anomalies. The unusually high temperature that occur across the tropics during and immediately following an El Niño event pose a significant risk for malaria in Ethiopia.

He stressed that the lack of access to local ground observations from national archives and monitoring systems has played a significant role in limiting the use of climate information for evidence-based health policy decision making including malaria.

Ethiopia from sustaining malaria control to elimination: mapping existing challenges

Dr. Delenasaw Yewhalaw, Associate Professor of Medical Entomology Director, Tropical and Infectious Diseases Research Center (TIDRC), Jimma University

Dr. Delenasaw start his talk by giving some background information about the Ethiopian malaria control program achievements justify the relevance of his talk which is in line with one of the national malaria strategic plan goal, which is to eliminate malaria in selected low transmission Woredas by 2020. He mentioned draught and famine, political instability in neighboring countries, migration in search of work and civil war as some of the risk factors for malaria and

concluded his speech by listing some of the important conditions needed and the challenges faced in moving from control and prevention to elimination.

The points he listed include:

- Strong political commitment
- Continued and strengthened Stakeholders/funders commitment
- Emergence of chloroquine resistant *p. vivax*
- Increased virulence of *P. vivax* and Higher prevalence of *P. vivax* in some areas
- Higher prevalence of gametocyte carriage in asymptomatic cases
- High vector competence of secondary vectors and potential role of suspected vectors in malaria transmission
- Shift in the biting and resting behavior of *An.arabiensis*
- Increased risk of malaria transmission the development corridors
- Multiple resistance of the parasite to malaria drugs and the vector to insecticidal chemicals

He continued his speech and stressed that strengthening the following activities as a recommendation in moving from control to elimination:

- Disease and parasitological surveillance
- Monitoring drug efficacy
- Rapid and accurate diagnosis
- Vector distribution, vector bionomics and insecticide susceptibility tests for appropriate monitoring of vector resistance status
- Characterizing resistance mechanisms
- Mapping the distribution of the vector species and their resistance based on climate, vegetation and other relevant databases

Session Discussion

In this session many questions were raised and the major ones including the response are indicated here:

The first was regarding the national malaria reporting in HMIS. In HMIS reports, malaria is dichotomized as *p.falciparum* and non- *p.falciparum*, which may undermine the *P.vivax*. In the report *p.vivax* is reported as non-falciparum species and mixed infections are reported as

p.falciparum for the latter the reason is that drugs used to treat *p.falciparum* are also used to treat mixed infections.

The second point raised was regarding availability of standard climate data in Ethiopia, which is utilized by the NMCP team. Dr. Adugna explained the change over time in malaria forecast from the earlier days, when malaria forecast depends on occurrence of famine to the current time where the forecast is made more accurately and at earlier time using the climate information and geographic information system (GIS). He informed the audience that use of climate information to predict malaria at Woreda level is a work in progress. More recently, malaria prediction can easily be made by using satellite images and there is a project that supports students who are doing their research on climate related issues. He finally made clear that the climate information is vital in malaria control since it will help for early preparedness, provide timely information and even help in identifying malaria resurgence following the current significant reduction.

Dr. Adugna admitted that climate information must be standardized and calibrated, and mentioned the effort being made by the national metrology agency in utilizing satellite images and information/data and compares it with the ground data as means of validations. Dr. Adugna further explained how El Nino causes shifting of rainy to dry seasons and disrupts seasonal patterns enhancing malaria transmission.

The other discussion point was regarding the extent of change on mosquito feeding habit or life style and virulence of *p.vivax* which can be explained due to various factors such as biological factors, which can be due to interventions and in this way the principal mosquito may replace the older one which could have significant impact on existing intervention strategies.

With regard to dominance and virulence of *p.vivax*, Dr Delenasaw explained that suppression of *p.falciparum* might be due to change in genetic factors which in turn can be due to the interventions. This contributes for increasing prevalence of *p.vivax* and hence need to understand the dynamics of *p.vivax* in planning elimination of malaria.

The other issue discussed was the effect of development projects in general and water development projects in particular on malaria transmission, Dr Delenasaw addressed the issue by stating that development projects are opportunities are essential for the growth of the country and are very much welcomed. However, he emphasized the importance of integration of malaria control programs in all development projects and more so in water development projects.

Session III Malaria epidemiology and others

Session III to Session VI were paper presentations and the sessions are categorized by thematic areas. Session III papers are related to malaria epidemiology and others and two papers were presented. The session was moderated by Prof. Ahmed Ali from Addis Ababa University, school of public health. The topics of the papers were: *Ethiopian malaria indicator survey (MIS-2015): a work in progress* By Meseret Yenehun, MIS coordinator and *Malaria Related Perceptions, Seeking Care after Onset of Fever and Anti-Malarial Drug Use in Malaria Endemic Settings of South West Ethiopia* by Zewdie Birhanu from Jima University. The summary of the papers were annexed as abstracts and we address the discussion points here.

Session Discussion

Time interval of conducting different MIS and availability of standard operating procedure in conducting the MIS was raised by the participants. The presenter replied that the MIS team has tried to follow the standard guideline developed by Roll back malaria (RBM) in conducting MIS 2015, however, the interval stated in the guideline wasn't fully followed because of competing priorities and other issues.

A concern was raised by a participant who mentioned that if the study area is not IRS targeted area, then interpretation of the finding about IRS might not be valid. Ato Zewdie explained that survey has been conducted in areas with high malaria risk where all key malaria interventions activities including IRS is implemented and hence, people attitude towards IRS was assessed among households or communities who had real experience or exposure to IRS and is less likely that the result of IRS is underestimated due to unfamiliarity of the community for IRS.

Finally point of discussion on the actual contribution of HEWs in malaria prevention and control program was raised and Ato Zewdie explained that HEWs are implementing a number of activities at community level related to malaria control and prevention and definitely they have contributed a lot, however, He ascertained that studies may be needed to clearly articulate actual contribution of HEWs in malaria program.

Session IV: Malaria entomology: Vector Behavior

This session was about malaria entomology with emphasis on vector behavior and four papers were presented. The titles of the papers were; *Anopheline Mosquito Species Composition, Density, Longevity and Malaria Prevalence around Gilgel-Gibe Area, Southwest Ethiopia* By Alemayehu Dagne from Jima University; *Assessment of Current Malaria Status in Light of the Ongoing Control Interventions, Socio-Demographic and Environmental Variables in Jiga Area, Northwest Ethiopia* by Hassen Mamo from Addis Ababa University college of Natural Science; *Vector Behavior and Density Monitoring in Southwestern Ethiopia in Relation to Pre- and Post-Indoor Residual Spray Operation: Implications for Malaria Control* by Kidane Lelisa from Dila University and *Seasonal dynamics, biting activity and longevity of Anopheles mosquitoes in Southwestern Ethiopia* by Behailu Taye from Gambella University. The session was moderated by Dr. Birehanu Belay from Jima University.

Session Discussion

The session discussion was very hot and a number of study design and methodology comments were given to the young researchers from senior researchers. Some specific comments include: Concern was raised regarding Dr. Hassen's recommendation for improving LLIN utilization as he mentioned the sleeping space "Medebe", used widely in rural area is not convenient for hanging of the LLIN. Dr. Hassen stressed that despite high level of intervention using LLIN and IRS, there is high malaria burden at the study site and finally agreed that the reason for the high burden seen could be multi-factorial. He agreed that there is difficulty of identifying the exact source of infection, it's about association not causality as we cannot establish cause and effect relationship and he recommended the following points: increase knowledge and practice on how to implement LLIN accompanied by financial support and also increasing the socioeconomic status of the population. Strong risk factors must be known by conducting studies with high sample size and with integrated detection methods.

An in depth discussion on indoor biting/indoor resting and outdoor biting/outdoor resting of mosquito behavior was conducted based on the last paper by Behailu and Kidane. The importance of having operational definition was emphasized by senior researchers; the example was one of the paper was stressing pre- and post- IRS and the senior researcher indicates that this may interpreted as before IRS was introduced in the country which is about 40 years back and suggest to avoid ambiguity to make operation definition. An interesting phenomena that the researchers

mentioned is that looking at the abdominal status of mosquitoes it can be decided where they prefer to rest after blood meal. The other suggestion was, for a study to be considered as a survey it must be conducted for at least one and half years but the current study took six months and should be called a study rather than a survey.

V: Malaria Entomology: Vector Behavior

The fifth session is also about malaria entomology but with emphasis on the vector behavior this time. In this session three papers were presented and the studies focused on Impact of housing condition, seasonal pattern and conditions of anophline mosquito and entomological indices among resettled communities. The session was moderated by Dr.Mekonnen Yohannes from Mekelle University. The titles of the papers and their presenters are: *Impact of housing condition on indoor-biting and indoor-resting Anopheles arabiensis density in a highland area, central Ethiopia* by Abebe Animut from Aklilu Lema Institute of Pathobiology; *Seasonal pattern and behavioral study of Anopheles gambiae s.l. in Oromia region – Ethiopia* by Alemayehu Getachew from Abt. Associate and *Malaria Incidence and Assessment of Entomological Indices among Resettled Communities in Ethiopia: A Longitudinal Study* by Endalew Zemene from Jima University

Session Discussion

Here also constructive comments related to methodology and data collection and suggestion were given for the presenters from the senior researchers. A point of clarification on the relationship of the household size and malaria transmission were raised; The presenter tries to explain the relationship by giving example of LLIN utilization, which is one modality of malaria prevention and indicated that as the family size increases the LLIN utilization rate decreases as the number of LLIN provided may not be adequate to be used by all members of the household.

The other concern raised is about the comparison of the villages if the villages are not similar or if they are not very far apart more than the mosquito flying range. The presenter and the co-authors of the paper responded by informing the audience that the villages compared have similar physical feature, altitude and socio-economic status and are very comparable and they also stated that the villages are far apart out of the range of mosquito flying.

Session VI: Vector Control

This session focused on Situational Analysis, Repellent efficacy of DEET and Evaluation of the Efficacy of DDT containing IRS and LLINs. Four papers were presented during the session and their title and presenters were: *Situational Analysis on the People Experience with Insecticide Treated in Kolla Shelle, South West Ethiopia* by Ephrem Damene from Arba Minch University, *Repellent efficacy of DEET, Mygga, neem (Azadirachta indica) oil and chinaberry (Melia azedarach) oil against Anopheles arabiensis, the principal malaria vector in Ethiopia* by Ephrem Abiy from RTI international, *Evaluation of the Efficacy of DDT Indoor Residual Spraying and Long-Lasting Insecticidal Nets against Insecticide Resistant Populations of Anopheles Arabiensis Patton (Diptera: Culicidae) From Ethiopia Using Experimental Huts* by Abebe Asale from Jima University and *The in Vivo Anti-malarial Activity of Solvent Fractions of The Leaf of Vernonia Amygdalina Against Plasmodium Berghei in Mice* by Temesgen Bihonegn from Kombolcha college of agriculture, Wollo University. The session was moderated by Dr. Meshesha Balkew from Addis Ababa University, Aklilu Lema institute of pathobiology

Session Discussion

In this session some of the issues brought for discussion were the accessibility of repellants and availability of studies on repellants extracted from plants. The presenter responded that repellants especially locally produced repellants are accessible and are easy to use. The presenter admitted that to his knowledge the study is the first in the country, which tries to show the utilization of plant extracted oils for the prevention of malaria.

Hot discussion on the paper about Vernonia Amigdalina. Clarification was sought regarding place of sample collection and effect of geographical location on the constituent of the plant. Temesgen explained that it is recommended to collect the leaves or samples from places where people around there use the leaves for the treatment of malaria. He also stated that the leaves of *Vernonia Amigdalina* contain a phytoconstituent and the metabolite of this phytoconstituent is affected by soil, temperature, way of collection and extraction technique.

Participants asked why water and methanol are used instead of other solvents. The presenter replied that methanol, ethanol and water are standard solvents for extraction procedures from the chloroform, butanol and aqueous fractions. The chloroform fractions have proven to have a

good antimalarial activity as it is shown to suppress parasitemia in the mice. Alkaloids, tannin and terbinoids are responsible for the anti-malarial activity of the extract.

Clarification regarding plant authentication was also asked. Temesgen replied that the genome Vernon have thousands of species and among which *Vernona Amigdalina* is commonly used in the traditional community for the treatment of malaria and it is authenticated in the national herbal medicinal directory.

Session VII: The way forward on the Malaria Research Network future direction

This was the final session of the symposium, which focused on the network's future direction. Dr Ayele Zewde from Addis Continental Institute of Public Health (ACIPH) presented the amendments made on the Network's bylaw, on the January 18, 2016 members meeting. This session was moderated by Dr. Adugna Woyessa from EPHI

Dr. Adugna expressed his feeling of seeing the strong malaria research network in the country. He appreciated the commitment of donors like PMI and urged the malaria community to seize this opportunity in strengthening the network, which he envisioned will have more audience, more paper and an ideal platform for malaria researchers and program people to meet to share and transfer knowledge.

Overview of the Amended by-law was then presented by Dr. Ayele Zewde who gave the highlight of the January 18, 2016 network members meeting.

Dr Ayele started his presentation by stating that, if the network is strengthened, it will be a forum where researches are conducted, disseminated and used by the malaria community for program improvement, which should be the core purpose of any research activity. He mentioned that on January 18, 2016 there was a meeting at ACIPH where 25 network members from MoH, NGOs and RHBs attended. After some presentations on experience of other countries' malaria research network, the participants of the meeting were organized into different groups, and each group is assigned to look into a couple of articles from the by-law and come up with amendments which could be either addition or omission. Comments were accommodated and final by-law document was prepared. The name of the network was agreed to be: "**Malaria Research Network of Ethiopia**" and its principal office was agreed to be at EPHI and Universities will have focal

person in the network. It was agreed that membership could be individual or institutional, for the time being, it was agreed that the participants of the meeting were members and any individual or institute as long as engaged in malaria research can be a member of the network.

The coordination committee contains 12 members who were selected at the 6th malaria research symposium at Arba Minch. The participants have agreed and it was stated in the by-law that the chair will always be EPHI and the co-chair and secretary AAU-SPH and ACIPH which will be replaced every two years. It was also agreed that the project coordinator shall be hired and housed at EPHI.

Meetings

- Regular coordinating committee meetings – Monthly; could be virtual
- Regular general assembly meeting – Annually
- Extraordinary meetings can be called through the chair

Obligation and penalties

- Three unexcused absence from meeting by CC member – dropped from the membership
- No membership fee but donation by institute and individuals shall be welcomed
- Notification of representative by institute shall be by formal letter
- Contracts and fund administration shall be responsibilities of EPHI

Report should be prepared by project coordinator and reviewed by coordinating committee and disseminated to all members. Fiscal year is July 1 to June 30 – EPHI's fiscal year. Amendment can be made by the affirmative vote of two thirds of the members which is considered a quorum. Following Dr Ayele's presentation, the chair person, Dr. Adugna invited the participants for open discussion, questions and comments about the by-law. Several concerns and questions were forwarded by participants. Among the questions raised were year of change for chair and the co-chair, resource mobilization, meeting interval, scope of the network and business activities undertaken to support the network. Based on the comments and questions the following points are suggested as a way forward:

Dr. Wakgari, institutionalizing in EPHI is good as it will help to sustain the network. Change every 2 year might be a problem as it's a new developing network, change of the co-chair and secretary in 3 year will be good as it is institutional type of network and will take time to consolidate and internalize the network. He also mentioned resource mobilization to be

considered to sustain the network either from internal or external source to be considered, for the time being the network is funded by PMI and it is good to think of phasing out of the donor.

Dr.Gune suggested to sustain the network ways of getting resources should be planned and developed by a mechanism to get donation at least partially. It is better to identify by designation or delegating a relevant and responsible person for the network. He also suggested during the network meetings, it will be good to discuss between members, the roles, responsibilities and scope of the network and also activities that will be undertaken by the network other than hosting symposiums. He suggested the network meeting to be bi-annual rather than having more frequent virtual meetings.

Dr.Delnesaw, suggested that the network need to have strategic plan. The plan then will be a guideline for all the activities to be undertaken by the network. He also mentioned having voice for this network like a journal should be considered in the long ran.

Professor Ahmed, stressed the importance of extending the involvement of other stakeholders and he suggested to engage higher institutions like ministry of education, ministry of science and technology, these will help to broaden the network and also government support. He also added to include regional health bureau representatives as network members to create link between the research and the program.

Dr.Mekonnen, suggested that activities and responsibilities be outlined and also the role of the chairman to be stated clearly. He strongly agreed that EPHI should take responsibility of leading the network. Role of universities and how universities will support the network need to be outlined clearly.

Dr.Adugna strongly affirm that EPHI will take the lead of the network and contact/focal persons will be assigned to strengthen the link between the network and the universities .Regarding legal issues he mentioned that EPHI has the mandate to coordinate health related researches, hence having a research network to strengthen the malaria research coordination is not by any means out of its mandate and doesn't think that it will raise any legal issue.

Dr.Ayele then tried to summarize the recommendations, which will be accepted as:

1. Resource mobilization is key in strengthening the network in a sustainable way. The idea of having a coordinator hired and housed at EPHI will push this one step forward and needs the support of all the members of the network.

2. Institutional membership shall be effected through formal letter from the institute/organization.
3. Change of coordinating committee members shall be every three years
4. The meeting of the coordinating committee shall remain to be every month for the time being until the network is strong enough. The members meeting will be annual during the organization of the symposium

He also reminded the participants the network has vision, mission and goal of the network and role of chair, co-chair, secretary and role of the coordinating committee are also clearly stated in the by-law and it will be circulated for members.

Finally it was agreed that the next symposium be held at EPHI on October 2016.

The closing remark was given by Mrs. Achamyelesh from FMOH, on behalf of national malaria prevention and control program. She in her speech acknowledged the organizers Jimma University, ACIPH, and EPHI for the preparations and coordination of the current research symposiums, PMI for funding the symposium in addition to playing a great role on malaria prevention and control program in the country and participants and presenters for their valuable contribution in sharing evidence based information, ideas and recommendations to address the program gaps. She mentioned, improving research for evidence based decisions is one of the main agenda in HSTP. She also acknowledge that the symposium was very fruitful, informative and valuable for the program. Thus, this kind of symposium and discussions with high technical experts and decision with stakeholders is very important to achieve the intended plan as well as to reduce the disease burden because malaria is still one of the main public health problems until it is eliminated from the country and also from the continent. Finally Mrs. Achamyelesh officially closed the symposium stating that everybody is responsible to end this specific public health problem.

Annex

Annex 1: List of participants

1.	Name	Organization/ Institute
2.	Abdissa B.	JU
3.	Abebaw Tiruneh	JU
4.	Abebe Animut	AAU/ALIPB
5.	Abebe Asale	JU/TIDRC
6.	Achamyelesh Sisay	FMOH/NMC
7.	Adugna Woyessa	EPHI
8.	Agajie Likie	EPHI
9.	Ahmed Ali	AAU/SPH
10.	Alemayehu Afework	JU
11.	Alemayehu Dagne	JU/TIDRC
12.	Alemayehu Getachew	Abt Associates
13.	Alemayehu Worku	ACIPH/SMMES
14.	Arega Tsefaye	JU
15.	Behailu Taye	Gambella University
16.	Beka Raya	JU/TIDRC
17.	Belay Erchato	JU
18.	Berhan G/Krsfos	JU
19.	Berhanu Belay	JU
20.	Birhan Tafe	JU
21.	Bisrat Fikadu	JU
22.	Daniel Emana	JU
23.	Dawit Hawaria	YHMC
24.	Dawit Siraw	Axum university
25.	Desalegn Dabaro	Jimma Hospital
26.	Delnesaw Yehuala	JU/TIDRC
27.	Eden Bekele	JU
28.	Endalew Zemene	JU/TIDRC
29.	Ephrem Abiy	RTI International
30.	EphremDamene	AMU
31.	Estifanos Kebede	JU/TIDRC
32.	Eyasu Ejeta	JU
33.	Gashahun Adugna	Dedo Malaria Project
34.	Gashu Fentie	FMOH/NMCP
35.	Gedeon Yohannes	ABT Associates
36.	Gemechu Etana	JU
37.	Getinet Bayih	FMOH
38.	Girmay Belete	JU
39.	Gune Dissanayake	PMI/USAID

40.	Hassen Mamo	AAU
41.	Kassahun Eba	JU
42.	Kidene Lelisa	Dilla University
43.	kidus Yitbarek	JU
44.	Kora Tushene	JU
45.	Matt Murphy	PMI/CDC
46.	Mebrahtom Haile	FMOH/NMCP
47.	Mekonnen Yohannes	MU
48.	Melaku Teshome	Sekoru Malaria Project
49.	Meseret Asefa	EPHI/MC
50.	Meshesha Balkew	AAU/ALIPB
51.	Morankan Sodhakar	JU
52.	Nasir Abdo	Jimma Zone Health Department
53.	Nigus Chekole	JU
54.	Nuhamin Zena	JU
55.	Nuredin Abduselam	JU
56.	Reta Mosissa	Jimma Metrology
57.	Ruth Yesigeta	JU
58.	Samuel Girma	ICAP/Columbia University
59.	Samuel Sahile	JU
60.	Sisay Tadesse	JU
61.	Solomon Gedfie	JU
62.	Sossina Abel	JU
63.	Takele Kefyalew	MC
64.	Tariku Tadese	JU
65.	Temam Tbrahim	JU
66.	Temesgen Bekele	JU
67.	Temesgen Bekele	JU
68.	Temesgen Bihonegn	Kombolcah College of Agriculture
69.	Tibeso Gemechu	JU
70.	Tilahun Gemmda	JU
71.	Tolera Mamo	JU
72.	Wakgari Deressa	AAU/SPH
73.	Waktola Cheneke	JU
74.	Wolde Teklehaymanot Kassahun	JU
75.	Wosenu Lanecha	JU
76.	Yalew Muche	JU
77.	Yibeltal Siraneh	JU
78.	Yinebeb Tariku	JU
79.	Zenawork Sahito	JU
80.	Zewdie Birhanu	JU/TIDRC

Annex 2: Schedule

Malaria Research Network Symposium, March 8 – 9, 2016. Jima University

Schedule		
Time	Topics	Presenters
Day 1		
08:30- 09:00	Registration	Jimma University/ACIPH
Session I: Moderator and Master of Ceremony – Dr. Delenesaw Yewhalaw		
09:00- 09:10	Welcome	Dr. Delenesaw Yewhalew
09:10 -09:20	Key note address	Dr. Gunawardena Dissanayake – PMI
09:20- 09:30	Key note address	Dr. Adugna Woyessa – EPHI
09:30- 09:40	Opening speech	Ato Kora , President JU
09:40-10:00	Overview of the malaria prevention, control and elimination program in Jimma Zone	Jimma Zone Malaria focal Person
10:00-10:30	Tea Break	Organizers
Session II: Current malaria affair / Moderator – Prof. Abraham Haileamlak		
10:30-11:10	Implications of climate variability on malaria epidemiology in Ethiopia	Dr. Adugna Woyessa
11:10 -11:30	Ethiopia, from sustaining malaria control to elimination: mapping existing challenges	Dr. Delnesaw Yewhalaw
11:30-12:30	Discussion	Participants
12:30- 01:30	Lunch	Organizers
Session III: Malaria Epidemiology and others/ Moderator: Prof. Ahmed Ali		
01:30 -01:45	Ethiopian Malaria Indicator Survey (MIS-2015): A Work in Progress	Meseret Yenehun
01:45 -02:00	Malaria Related Perceptions, Seeking Care After Onset of Fever And Anti-Malarial Drug Use in Malaria Endemic Settings Of South West Ethiopia	Zewdie Birhanu
02:30-03:00	Discussion	Participants
03:00-03:30	Tea break	Organizers
Session IV: Poster Session		
03:30- 04:30	Poster presentation	Presenters and participants
Day 2		
Session V: Malaria Entomology: vector behavior/ Moderator: Dr Berhanu Belay		
09:00- 09:15	Anopheline Mosquito Species Composition, Density, Longevity and Malaria Prevalence around Gilgel-Gibe Area, Southwest Ethiopia	Alemayehu Dagne

09:15- 09:30	Assessment of Current Malaria Status in Light of the Ongoing Control Interventions, Socio-Demographic and Environmental Variables in Jiga Area, Northwest Ethiopia	Hussen Mamo
09:30- 09:45	Vector Behavior and Density Monitoring in Southwestern Ethiopia in Relation to Pre- and Post-Indoor Residual Spray Operation: Implications for Malaria Control	Kidane Lelisa
09:45-10:00	Seasonal dynamics, biting activity and longevity of Anopheles mosquitoes in Southwestern Ethiopia	Behailu Taye
10:00 -10:30	Discussion	Participants
10:30 -11:00	Tea Break	Organizers
Session VI: / Malaria Entomology: vector behavior/ Moderator: Dr. Mekonen Yohanes		
11:00-11:15	Impact of housing condition on indoor-biting and indoor-resting Anopheles arabiensis density in a highland area, central Ethiopia	Abebe Animut
11:15-11:30	Seasonal pattern and behavioral study of Anopheles gambiae s.l. in Oromia region – Ethiopia	Alemayehu Getachew
11:30-12:00	Malaria Incidence and Assessment of Entomological Indices among Resettled Communities In Ethiopia: A Longitudinal Study	Teshome Degefa
12:00-12:30	Discussion	Participants
12:30-01:30	Lunch	Organizers
Session VII:Vector control / Moderator: Dr. Meshesha Balkew		
01:30- 01:45	Situational Analysis on The People Experience with Insecticide Treated Net in Kolla Shelle, South West Ethiopia	Epherem Damene
01:45-02:00	Repellent efficacy of DEET, MyggA, neem (<i>Azadirachta indica</i>) oil and chinaberry (<i>Melia azedarach</i>) oil against <i>Anopheles arabiensis</i> , the principal malaria vector in Ethiopia	Ephrem Abiy
02:00-02:15	Evaluation of The Efficacy of DDT Indoor Residual Spraying and Long-Lasting Insecticidal Nets Against Insecticide Resistant Populations of Anopheles Arabiensis Patton (Diptera: Culicidae) From Ethiopia Using Experimental Huts	Abebe Asale
02:15-02:30	Study on The in Vivo Anti-malarial Activity of Solvent Fractions of The Leaf of Vernonia Amygdalina Against Plasmodium Berghei in Mice	Temesgen Bihonegn
02:30- 03:00	Discussion	Participants
03:00-03:30	Tea break	Organizers
03:30 -04:30	Discussion on Malaria research network TOR and future direction	Dr. Adugna Woyessa
04:30-04:45	Closing remarks	Representative of FMOH NMC program

Abstracts selected for poster presentation

1	Patients' perception and satisfaction on quality of laboratory malaria diagnostic service in Amhara Regional State, North West Ethiopia	Agajie Likie
3	Effect of Health Education Focusing on School Communities and religious Leaders on community's malaria prevention behaviors, Jimma Zone: result from Lots Quality Assurance Survey	Zewdie Birhanu
5	Assesment of ownership and factors affecting utilization of insecticide treated Bed Nets in Dembecha Woreda, West Gojam Zone, Ethiopia, 2014	Dawit Siraw

Annex 3: Abstracts

Abstract 1: Ethiopian Malaria Indicator Survey (MIS-2015): A Work in Progress

Background: Malaria is among the major health problems in Ethiopia. Two large scale household malaria indicators surveys (MISs) were conducted in 2007 and 2011, to measure the coverage and utilization of key malaria interventions. MISs complements the HMIS and the routine malaria control monitoring and evaluation systems. These surveys indicated that the implementation of malaria prevention and control interventions improved significantly in recent years. A follow up survey, MIS 2015 is being conducted to measure attainment of goals set in the 2011-2015 national malaria strategic plans.

Methods: Malaria Indicator Survey (2015) is a nationally representative, population based cross-sectional survey. Two stage cluster probability sampling technique was used to select 555 enumeration areas (EAs) and 13,875 households from all malaria endemic and epidemic prone areas of Ethiopia. The survey used two questionnaires (household and women's questionnaires) as data collection tool. These questionnaires were uploaded in to smart phones using Open Data Kit (ODK) platform. 326 data collectors organized in to 36 teams who were selected from regional health bureaus were trained on objectives and rationale of MIS, questionnaires, biological sample collection, GPS recording and navigation and interview techniques. Data collected from 555 EAs were actively sent to the central server from the field. Data downloaded from the server in to XL spread sheet are under cleaning and analysis.

Results: Data were downloaded in six modules from the EPHI central server. The data were checked for completeness and consistency. 100,159 households were mapped in all 555 EAs, on average 180 households were mapped per EA. 13,875 HHs were selected for interview. Of these, 13,374 HHs were interviewed, with a non-response rate of 3.6%. 15,941 blood samples were collected to diagnose malaria using blood slide and dried blood spot (DBS) and 7,325 hemoglobin measurements were taken for children under five.

12,404 women were included in the survey with a response rate of 92.87%. Data cleaning and first round slide reading are completed. The unweighted malaria prevalence by RDT and microscopy is 2.4% and 1.1% in all surveyed areas, respectively. The data analysis will be conducted starting from February 29, 2016.

Conclusion & the way forward: The MIS 2015 planning and data collection were completed successfully with the concerted effort of all partners. Local capacity is built for the planning and management of MISs. The crude results show that malaria prevalence was reduced in 2015 compared to 2011. Further data summarization and analysis is expected to reveal programmatically important evidences. MIS-2015 results will be made available by end of March 2016 and results will be disseminated in June 2016.

Abstract 2: Malaria Related Perceptions, Seeking Care after Onset of Fever and Anti-Malarial Drug Use in Malaria Endemic Settings of South West Ethiopia

Zewdie Birhanu¹, Lakew Abebe¹, Morankar Sudhakar¹, Gunawardena Dissanayake², Yemane Yebiyo Yihdego³, Guda Alemayehu², Delenasaw Yewhalaw¹

¹Jimma University, ²United States Agency for International Development, ³Abt Associates, Africa Indoor Residual Spraying

Background: Prompt care seeking and appropriate use of anti-malarial drugs are critical components of malaria prevention and control. This study assessed malaria related perceptions, care seeking behavior and anti-malarial drug use in malaria endemic settings of Ethiopia.

Methods: Data were generated from a community based cross sectional study conducted among 798 households during January 2014 in three districts of Jimma zone, Ethiopia. Quantitative and qualitative data were collected and analyzed by SPSS 17.0 and STATA 12.0.

Results: 76.1% of the respondents associated malaria to mosquito bite and incorrect beliefs and perceptions were noted. Despite low level of comprehensive knowledge (mean =58.1%, SD=17.1%), attitude towards malaria prevention was high (Mean =92.2%, SD=7.0%). Among study participants with fever, 86 (74.1%) sought care where all of them consulted formal health care system. However, only 17 (19.8%) of them sought the care within 24 hours after onset of fever. The frequency of seeking care was higher (77.8%) and quicker (28.6%) for children although statistically significant difference did not exist ($p > 0.05$). However, higher median time of seeking first care was observed for people who are affiliated with Muslim religion and among people who did not attend school ($p <$

0.05). Inappropriate use of anti-malarial drugs such as saving and sharing was reported. Irregular availability of anti-malarial drugs and frontline health workers; misconceptions contributed to delayed care seeking and irrational use of anti-malarial drugs.

Conclusions: Although care seeking behavior for febrile illness was common in this community, the habit of prompt seeking care was very limited and influenced by individual perceptions and system related factors.

Recommendations: Malaria prevention and control programs need to take into account local misconceptions and wrong perceptions, and health system factors to achieve optimal health seeking behavior in such malaria endemic settings.

Key words: Malaria, Seeking Care, Malaria Related Perceptions

Abstract 3: Anopheline Mosquito Species Composition, Density, Longevity and Malaria Prevalence around Gilgel-Gibe Area, Southwest Ethiopia

Alemayehu Dagne¹, Abebe Asale¹, Behailu Taye², Abdissa Gurmessa³, Delenasaw Yewhalaw¹

¹Jimma University ²Gambells University ³Jimma University

Background: Construction of dams and irrigated farm lands may contribute for breeding of anopheline mosquitoes. In this paper, we investigated the effects of a mega hydropower dam on *Anopheles* mosquito species composition, density, longevity and malaria prevalence.

Methods: Longitudinal entomological study was conducted from June to December 2013 in two *kebeles* in Tiro Afeta district in Jimma zone, Southwest Ethiopia. Adult anopheline mosquitoes were collected using Centers for Disease Control light traps and pyrethrum spray catches in the two *kebeles* (Koticha Gibe, located near Gilgel-Gibe hydroelectric dam and Decha Nadi, located away from the dam). Moreover, record of malaria cases in the health facilities was reviewed.

Results: Overall, 1521 adult anopheline mosquitoes belonging to two species were collected. *An. gambiae* s.l. was the predominant species (72.9%) followed by *An. coustani* (27.1%). The mean monthly *An. gambiae* s.l. density, collected by light trap catches and pyrethrum spray catches was 5.6 per trap/night and 3.51 per house, respectively. The density of *An. gambiae* s.l. in Koticha Gibe was higher (8.5 per trap/night and 5.6 per house/day) than that of Decha Nadi (2.71 per trap/night and 1.95 per house/day), respectively. There was significant difference in mean monthly *An. gambiae* s.l. density between the two *kebeles* ($P = 0.04$). However, there was no significant difference between

mean indoor and outdoor density of *An. coustani* in the two *kebeles* ($P > 0.05$). Post intervention (IRS operation and LLITNs distribution), degree of exophily increased from 1.61 to 1.28 and 1.35 to 1.23 in Koticha Gibe and Decha Nadi *kebeles*, respectively. Overall probability of daily survival of *An. gambiae* s.l. decreased from 0.70 to 0.56 post intervention. Prevalence of malaria in the study setting was 10.71%, with no significance difference between the two *kebeles* ($P = 0.052$).

Conclusion: The findings of the study show that the dam creates favorable breeding site for mosquito population as compared to farther areas.

Key words: Mosquito density, malaria prevalence, Gilgel-Gibe dam, Ethiopia

Abstract 4: Assessment of Current Malaria Status in Light of the Ongoing Control Interventions, Socio-Demographic and Environmental Variables in Jiga Area, Northwest Ethiopia

Seble Ayalew¹, Hassen Mamo^{1*}, Abebe Animut², Berhanu Erko²

¹Department of Microbial, Cellular and Molecular Biology, College of Natural Sciences, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia, ²Aklilu Lemma Institute of Patho biology, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia

Following substantial decline in malaria burden in Ethiopia, the country is planning to eliminate malaria in certain low transmission settings by 2020. To evaluate the attainability of this goal in-depth examination of malaria parasite carriage at community level is necessary. This study was, therefore, aimed at assessing the current situation of malaria in relation to ongoing control interventions in Jiga area, JabiTehnan District in northwest Ethiopia.

Methods: A cross-sectional household (HH) survey was conducted in November-December 2013. Out of 2,574 HHs (11,815 people) in the entire Jabi Tehnan District, 392 (accommodating 1911 people) were randomly selected from three purposely selected villages. One randomly selected member from each selected HH was tested for malaria using rapid diagnostic test (mRDT).

Result: All participants tested for malaria ($n = 392$) were afebrile (axillary temperature $<37.5^{\circ}\text{C}$). Eleven individuals (2.8%, 95% confidence interval (CI):1.2–4.4%) were found to be mRDT positive. Most HHs (95.9%, 95% CI: 93.5–97.5%) had at least 1 long-lasting insecticidal net (LLIN). Insecticide residual spraying (IRS) coverage the last six months was 85.5% (95% CI: 82.0–88.9%). Malaria prevalence remains unexpectedly high despite high HH coverage of control interventions.

Conclusion: Although LLIN and IRS coverage at HH level was encouragingly high in the study area, asymptomatic malaria infection is persistent among the study participants. Carefully-

coordinated regular surveillance and response systems must be in place to thoroughly address the impact of ongoing control interventions and associated risk factors in the locality. The findings are believed to contribute towards improving malaria control efforts in Jiga and its surroundings

Abstract 5: Vector Behavior and Density Monitoring in Southwestern Ethiopia in Relation to Pre- and Post-Indoor Residual Spray Operation: Implications for Malaria Control

Kidane Lelisa¹, Behailu Taye², Daniel Eman³, Abebe Asale³, Delenasaw Yewhalaw^{3*}

Affiliation: ¹Dilla University, ²Gambella University, ³Jimma University. *Corresponding Author

Background: This study was conducted to assess entomological parameters of anopheline mosquitoes in Kersa district, Jimma zone, southwestern Ethiopia from June, 2012 to December 2012.

Purposes/Aims:-To assess anopheline mosquito species composition, behavior longevity and infectivity rates pre and post indoor residual spray operation.

Methods:- Mosquito collection was carried out from each selected households in each of the 9 selected study villages using Center for Diseases Control(CDC) light traps and pyrethrum spray catches (PSCs) for 7 months (June to December 2012). Vector; parity rates, gonotrophic cycle, Degree of exophily and Parasites sporogonic cycle were compared pre and post indoor residual spray. While Fed, gravid and unfed head thorax of *Anopheles gambiae sensu lato*'s sub-sample specimen collected by Light Trap Catches and Pyrethrum spray catches was used for circumsporozoite protein detection using Enzyme-linked immunosorbent assays (ELISA). Mosquito count data were log transformed before analysis and the data were analyzed using Statistical Package for Social sciences (SPSS) software package version 16.0.

Results:-Overall, 1,559 adult female Anopheline mosquitoes representing at least 3 species were collected from June to December 2012, from the nine study villages. *Anopheles gambiae sensu lato* (71.8%) was the most abundant species, followed by *Anopheles coustani sensu lato* (22%) and *Anopheles pharoensis* (6.2%). The mean monthly density of Anopheline mosquito species was highly significant ($p < 0.001$). Significantly ($p < 0.05$). The fed to gravid ratio of *Anopheles gambiae sensu lato* pre and post Indoor Residual Spray operation was 1.5:1 and 6:1, respectively. The longevity of *Anopheles gambiae sensu lato* Pre and post Indoor Residual Spray operation were 7.32 and 2.94 days respectively. Two *Anopheles gambiae sensu lato* specimens were found positive for *plasmodium vivax* 210 polymorphs and the overall infectivity rates was estimated to be 1.04 %.

Conclusion: We conclude that the malaria vector has developed mechanisms of deterring indoor residual spray though the operation has significant impact on their life expectancy and preventing to reach infectivity rates.

Recommendation: We recommend the study community, the national malaria control authority and other stockholders to use the finding of this study that could contribute to the understanding of anopheline mosquitoes: composition, dynamics, distribution, life expectancy, behavior and infectivity rates of principal vector in Kersa district; hence could be used for evidence based malaria vector control program.

Key word(s); Vector Behavior, Parity rate pre and post Indoor residual spray operation, infectivity

Abstract 6: Seasonal dynamics, biting activity and longevity of Anopheles mosquitoes in Southwestern Ethiopia

Behailu Taye³, Kidane Lelisa², Daniel Emana¹, Abebe Asale¹, Delenasaw Yewhalaw^{1*}

¹ Jimma University, ²Dilla University ³Gambella University

Introduction: Continuous monitoring of vector species composition, abundance, dynamics, feeding pattern, and host finding strategy is the base to determine when, what, and how control should be implemented. Thus, this study was aimed to assess entomological parameters of anopheline mosquitoes in nine villages in Seka district, southwestern Ethiopia.

Methods: Mosquito collection was carried out from selected households in each of the nine study villages using light trap catches from June to December 2012. Differences in mean mosquito density, parity rates before, and after indoor residual spraying (IRS) operation were compared.

Results: In total, 1,136 adult female anopheline mosquitoes were collected during the study period. All anopheline mosquitoes collected belong to three species. *Anopheles gambiae* sensu lato Giles was the most predominant (69.7%) followed by *Anopheles coustani* sensu lato Laveran (22.7%) and *Anopheles pharoensis* Theobald (7.6%). There was significant variation in mean mosquito density among *An. gambiae* sensu lato, *An. coustani* sensu lato, and *An. pharoensis*. Parity rate of *An. gambiae* s.l. before spray operation was significantly higher than after spray operation. The highest peak biting activity of *An. gambiae* s.l. was between 1800 and 2100 hours. The longevity of *An. gambiae* sensu lato ranged from 3.4 to 12.5 d. The highest vector abundance and parity rate were recorded in July and August.

Conclusion: In conclusion, the behavioral plasticity and early biting activity of *An. gambiae* sensu lato could affect current vector control tools (IRS and long lasting insecticidal nets).

Recommendation: Hence, it is imperative to explore intervention tools for outdoor malaria vector control in addition to the existing IRS and long-lasting insecticidal nets.

Key words: mosquito longevity, parity rate, infectivity rate

Abstract 7: Impact of housing condition on indoor-biting and indoor-resting *Anopheles arabiensis* density in a highland area, central Ethiopia

Abebe Animut, Meshesha Balkew and Bernt Lindtjørn

Background: Exposure of individuals to malaria infection may depend on their housing conditions as houses serve as biting and resting places of vectors. This study describes the association of housing conditions with densities of indoor-biting and indoor-resting *Anopheles arabiensis* in Hobe, Dirama and Wurib villages of a highland area in central Ethiopia.

Methods: Data on housing conditions, including presence of house apertures, number of occupants and number and the type of domestic animal tethered inside, were collected. Indoor-biting mosquitoes were sampled using Centers for Disease Control (CDC) light traps and indoor-resting mosquitoes sampled with pyrethrum spray catches (PSCs) monthly for two years (July 2008 to June 2010). Female anophelines were identified to species and processed. Univariate and general linear estimating equation allowing for repeated measures were used to assess the contribution of housing conditions for indoor-biting and indoor-resting *An. arabiensis*.

Results: About 96% (4,597/4,788) of anophelines were caught inside residential houses. Nine anopheline species were identified, among which *An. arabiensis* was most prevalent (2,489; 52%). Vectors entering houses were higher in those situated at low ($\beta = 4.475$; 95% CI = 3.475-5.476; $p < 0.001$; β = strength of the association) and medium ($\beta = 2.850$; 95% CI = 1.975-3.724; $p < 0.001$) altitudes compared to high altitude, and where houses have no windows ($\beta = -0.570$; 95% CI = -1.047-0.094; $p = 0.019$) compared with those that have. Numbers of indoor-resting vectors were higher in those situated at low ($\beta = 6.100$; 95% CI = 4.571-7.629; $p < 0.001$) and medium ($\beta = 4.411$; 95% CI = 2.284-6.537; $p < 0.001$) altitudes compared to high altitudes, and where houses had open eaves ($\beta = 1.201$; 95% CI = 0.704-1.698; $p < 0.001$) compared with those that had closed eaves.

Conclusion: Housing conditions such as presence of open eaves, absence of window, location at low and mid altitudes, were strong predictors of indoor exposure to *An. arabiensis* bite in a highland area of south-central Ethiopia.

Abstract 8: Seasonal pattern and behavioral study of *Anopheles gambiae* s.l. in Oromia region - Ethiopia

Alemayehu Getachew Tesfaye ¹, Gedeon Yohannes Anshebo ¹, Josephat Shililu¹, Dereje Dengela ², Lena Kolyada ², Christen Fornadel ³, Kristen George ³, Gunawardena Dissanayake ⁴ and Sheleme Chibsa ⁴

Background: The 2015 entomological monitoring activities included year-round collection of data on vector density and species composition to help understand the abundance, seasonal patterns, biting behavior, parity of anopheline mosquitoes and assess the impact of IRS on entomological indicators. During the reporting period (March –February 2016), monthly pyrethrum spray catches (PSC), human landing catches (HLC), CDC light traps and window exit traps were carried out in two intervention (sprayed) sites and one control (not sprayed) site.

Methods: The intervention sites were in Gobu Sayo and Seka Chekorsa Districts. One site from Ilugelan District, Ijaji Town, was selected as an unsprayed control site. HLC was used in two households in each sentinel site for two nights per month. PSC was used to sample indoor resting mosquitoes in 20 houses in each of the study sites every month. CDC light traps were installed in two houses adjacent to houses selected for HLC in each of the three sentinel sites, and window exit traps were installed in four selected houses in each site. A total of 7,459 female anopheline mosquitoes comprising six species were collected.

Result: The most abundant species were *An. gambiae* s.l. (32.9%), *An. coustani* (35.3%) and *An. pharoensis* (31.2%). Overall, the main vector of malaria in Ethiopia, *An. gambiae* s.l., started proliferation in the month of April and reached its peak at variable times between June and September, with densities dropping from October onwards. In the control site peak density was achieved in September. *An. gambiae* s.l. was most abundant during the peak rainy period (June – August) in all sites though peak density was achieved at variable times. *An. coustani* was the dominant anopheline species collected from August onwards. Indoor resting density and human biting rates as measured by PSC and human landing catches, respectively, dropped after IRS in both

intervention sites but increased and peaked in September in the control site. The resting habits of *An. gambiae* s.l. were variable by site. *An. gambiae* s.l. tended to exhibit endophilic tendencies in both intervention sites while it was more exophilic in the control site when we compared fed versus half gravid and gravid in PSC collections. The number of *An. gambiae* s.l. resting indoors reduced drastically after IRS in the intervention sites compared to the control site. *An. gambiae* s.l. tended to feed more outdoors than indoors showing exophagic tendency in the two intervention sites (59.4% Gobu Sayo; 64.0% Seka Chokorsa) but tended to show endophagic tendencies in the control site (53.1% Ijaji). However, the difference in feeding tendencies within sites was not significant. *An. gambiae* s.l. engaged in biting throughout the night but peak biting was variable between sites, with Gobu Sayo and Ijaji recording post-midnight biting activity (01.00 – 03.00 hours). In Seka Chokorsa a higher proportion of host-seeking *An. gambiae* s.l. was collected before midnight (19.00 – 23.00 hours). Monthly parous rates for *An. gambiae* s.l. were variable between sites throughout the period of study with generally higher rates recorded between April and August in the intervention sites (Gobu Sayo: 76.8 – 100; Seka Chokorsa: 33.3 – 67). Parous rate greatly reduced in both intervention sites after IRS but remained the same in the control site. In the Ijaji control site parous rates remained high during the whole period of study (93.3 – 100). The present study characterizes the bionomics of *An. gambiae* s.l. and provides relevant information to be considered in planning and implementation of vector interventions. The longitudinal vector density monitoring studies conducted indicated that the main malaria vector *An. gambiae* s.l. started proliferation in April, reaching a peak in September based on results from the control site.

Conclusion: Based on these results, conducting IRS in the month of May/June with long-lasting insecticides would most probably provide sufficient protection. In the use of insecticides with short residual life, implementation of IRS in early August would be recommended. Indoor resting densities as well as mean human biting rates considerably declined after IRS in both intervention sites, most likely due to the effect of insecticide sprayed. These results provide a basis for improved targeting of IRS for enhanced impact on malaria transmission.

Keywords: DEET, MyggA, Chinaberry oil, Neem, *Anopheles arabiensis*, Vector, Repellent, Niger seed/noog/

Conclusion: Housing conditions such as presence of open eaves, absence of window, location at low and mid altitudes, were strong predictors of indoor exposure to *An. arabiensis* bite in a highland area of south-central Ethiopia.

Abstract 9: Malaria Incidence and Assessment of Entomological Indices among Resettled Communities in Ethiopia: A Longitudinal Study

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Background: Population resettlement has been considered among factors that may increase risk of malaria transmission. This study reports, the impact of resettlement on malaria incidence and entomological indices among communities resettled in suburbs of Jimma town, southwestern Ethiopia.

Methods: A cohort of 604 study participants (302 resettles and 302 non-resettles) was monthly followed-up from September to November 2013 using active case detection. Moreover, longitudinal entomological study was conducted from June to November 2013. Anopheline mosquitoes were collected using Centers for Disease Control light traps and pyrethrum spray catches. Sporozoite enzyme-linked immunosorbent assay was performed to determine *Plasmodium* infection rates.

Results: Overall, 112 malaria cases were recorded during the three-month follow-up, of which 74.1% of the cases were from resettlement villages. *Plasmodium falciparum* incidence from resettlement and non-resettlement villages was 52.5 and 14.5/1,000 person-months at risk, respectively. Resettlement villages were three times at higher risk of *Plasmodium* infection (OR = 2.8, 95% CI: 1.22-6.48). *Anopheles gambiae* s.l. was the predominant (86.6%) of all the collected anopheline mosquito species. *Plasmodium* sporozoite rate in the resettlement and non-resettlement villages was 2.1 and 0.72%, respectively. *Plasmodium falciparum* entomological inoculation rate for *An. gambiae* s.l. in the resettlement and non-resettlement villages was 13.1 and 0 infective bites/person/night, respectively. Both sporozoite and entomological inoculation rates were significantly higher in the resettlement villages ($p < 0.05$).

Conclusion: Resettled communities were at higher risk of malaria infection as compared to non-resettled communities. Special attention should be given to malaria control interventions during resettlement programs.

Keywords: Malaria, Incidence, Anopheles, Entomological indices, Resettlement, Ethiopia

Abstract 10: Situational analysis on the people experience with insecticide treated net in Kolla Shelle, South West Ethiopia

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Background: The widespread implementation of insecticide-treated nets is a major intervention strategy likely to significantly reduce morbidity and mortality from malaria across Africa when used correctly. This study evaluates the coverage, use and condition of insecticide-treated nets owned by house hold in study area.

Methods: This cross sectional study was conducted in Kolla Shele kebele, Gamo Gofa Zone, South West Ethiopia. The study participants were randomly selected from study area and were interviewed about ownership and utilization of bed net using structured questionnaire. A physical inspection of all bed nets in household was done and their condition recorded.

Result: Of 200 surveyed households 85% were owned at least insecticide treated net. Of the total 366 bed net only 43.98% were in use and 56.02% misused. 83.5% of misused nets had not been opened and hanged. 19.89% of people residing in the survey households slept last night under a insecticide treated net before the survey.

Conclusion: Although the study household had awareness of insecticide treated net, there were a wide gap between possession and utilization of nets. Therefore, mass distribution of bed net should be accompanied with regular follow up on utilization at community level.

Keywords: Insecticide-treated net, Malaria, Coverage, Utilization, Misuse

Abstract 11: Repellent efficacy of DEET, MyggA, neem (*Azadirachta indica*) oil and chinaberry (*Melia azedarach*) oil against *Anopheles arabiensis* , the principal malaria vector in Ethiopia

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Background: In Ethiopia, *Anopheles arabiensis* is the main vector responsible for the transmission of malaria in the country and its control mainly involves application of indoor residual spraying (IRS) and use of insecticide-treated bed nets (ITNs).

Objective: Although the role of repellents for reducing man-vector contact is documented in the literature, the response of *An. arabiensis* to repellents was not previously evaluated under field conditions in Ethiopia.

Method: The trial was conducted in Sodere village assessing the repellent activities of four repellents, of which, two of them were commercially available DEET (N, N-diethyl-1,3-methylbenzamide) and MyggA (p-methane diol) and the other two were laboratory-produced, 20% neem oil and 20% chinaberry oil. A 6 by 6 Latin square design was employed by involving six volunteers who received rotated treatments of repellents and the Ethiopian Niger seed, noog abyssinia (*Guizotia abyssinia*), and locally called as noog oil (diluent to the two plant oils). Each volunteer also served as control. Volunteers were positioned at a distance of 20–40 m from each other and each was treated with one of the repellents, Niger seed/noog/ oil or untreated. Landing mosquitoes were collected from dusk to dawn using test tubes. The tests were done in three replicates.

Results: Both DEET and MyggA provided more than 96% protection. The mean protection time for DEET was 8 hrs while the time for MyggA was 6 hrs. Protection obtained from neem oil and chinaberry oil was almost similar (more than 70%), however, the complete protection time for neem was 3 hrs, while that of chinaberry oil was one hour.

Conclusion: The commercial products and laboratory-produced repellents can be utilized by individuals to avoid contact with *An. arabiensis* in Ethiopia.

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Abstract 12: Evaluation of the Efficacy of DDT Indoor Residual Spraying and Long-Lasting Insecticidal Nets Against Insecticide Resistant Populations of Anopheles Arabiensis Patton (Diptera:Culicidae) From Ethiopia Using Experimental Huts

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Background: Indoor Residual Spraying (IRS) and Long-Lasting Insecticidal nets (LLINs) are major malaria vector control tools in Ethiopia. However, recent reports from different parts of

the country showed that populations of *Anopheles arabiensis*, the principal malaria vector, have developed resistance to most families of insecticides recommended for public health use which may compromise the efficacy of both of these key vector control interventions. Thus, this study evaluated the efficacy of DDT IRS and LLINs against resistant populations of *Anopheles arabiensis* using experimental huts in Asendabo area, south-western Ethiopia.

Methods: The susceptibility status of populations of *An. arabiensis* was assessed using WHO test kits to DDT, deltamethrin, malathion, lambda-cyhalothrin, fenitrothion and bendiocarb. The efficacy of LLIN (PermaNet® 2.0), was evaluated using the WHO cone bioassay. Moreover, the effects of the observed resistance against malaria vector control interventions (DDT, IRS and LLINs) were assessed using experimental huts.

Results: The findings of this study revealed that populations of *Anopheles arabiensis* were resistant to DDT, deltamethrin, lambda-cyhalothrin and malathion with mortality rates of 1.3%, 18.8%, 36.3% and 72.5%, respectively but susceptible to fenitrothion and bendiocarb with mortality rates of 98.81% and 97.5%, respectively. The bio-efficacy test of LLIN (PermaNet® 2.0) against *Anopheles arabiensis* revealed that the mosquito population showed moderate knockdown (64%) and mortality (78%). Moreover, mosquito mortalities in DDT sprayed huts and in huts with LLINs were not significantly different ($p > 0.05$) from their respective controls.

Conclusion and Recommendation: The evaluation of the efficacy of DDT IRS and LLINs using experimental huts showed that both vector control tools had only low to moderate efficacy against *An. arabiensis* populations from Ethiopia. Despite DDT being replaced by carbamates for IRS, the low efficacy of LLINs against the resistant population of *An. arabiensis* is still a problem. Thus, there is a need for alternative vector control tools and implementation of appropriate insecticide resistance management strategies as part of integrated vector management by the national malaria control program.

Keywords: *Anopheles arabiensis*, Insecticide resistance, Experimental huts, LLINs, Ethiopia

Abstract 13: Study on the *In Vivo* Antimalarial Activity of Solvent Fractions of the Leaf of *Vernonia Amygdalina* against *Plasmodium Berghei* in Mice

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Background Malaria is one of the leading causes of morbidity and mortality in Ethiopia. The most important problem associated with the management of malaria are resistant to the most widely available, affordable and safest first line treatments.

Objective: To evaluate the *in vivo* antimalarial activity of solvent fractions of the leaves of *V. amygdalina* against *Plasmodium berghei* infection in mice using four day suppressive.

Methods: A total of 900 grams of coarsely powdered leaves were extracted with cold maceration in 80% methanol. A total of 90 grams hydroalcoholic crude extract of *V. amygdalina* was subjected to chloroform, butanol and aqueous fractions. For evaluating antiplasmodial activity of *V. amygdalina* , four day suppressive test was employed.

Results: Acute oral toxicity test showed that both the aqueous and hydroalcoholic extracts and solvent fractions of the leaves of *V. amygdalina* revealed no mortality and signs of toxicities up to 2000mg/kg. All doses of crude extracts of *V. amygdalina* prolonged the survival time, shown prevention against weight loss and prevent PCV reduction in a dose dependent manner. The percentage suppression of chloroform fraction was 21.68%, 23.72% and 33.85 % at 100, 200 and 400mg/kg of the fraction, respectively. The 100 and 200 mg/kg of butanol fraction resulted in moderate anti-plasmodial activity (18.12%, and 21.03% %, respectively), followed by the 400 mg/kg (26.88%).

Conclusion: The results of the present study indicated that the *in vivo* administration of both extracts and solvent fractions of the leaf of *V. amygdalina* possess antimalarial activity and were capable of suppressing parasitemia.

Recommendations: There is a need to advance the current status of *V. amygdalina* to an antimalarial lead drug level through isolation and characterization active antiplasmodial components in the extracts and solvent fractions.

Key words: Antimalarial activity, Four day suppressive test, *V. amygdalina*.

Abstract 14: Patients' perception and satisfaction on quality of laboratory malaria diagnostic service in Amhara Regional State, North West Ethiopia

Agajie Likie Bogale

Background: The most effective strategies in the fight against malaria are to correctly diagnose and timely treat the illness. A diagnosis based on clinical symptoms alone is subjected to misuse of anti-malarial drugs, increased costs to the health services, patient dissatisfaction and also contributes to an increase in non-malaria morbidity and mortality. Among others,

inappropriate perception and inadequate satisfaction of patients are significant challenges reported to affect the quality of laboratory malaria diagnostic services.

Methods: A facility-based, cross-sectional study was conducted from November to December 2013 among 300 patients. Their level of satisfaction was measured using both pre-tested structured and open ended questionnaires. A 5-point Likert scales and their weighted average were used to categorize satisfaction level of the patients. Data were entered in Epi-Info version 3.5.3 and analyzed using SPSS version 20. Chi-square test was used to see the association between the outcome variable and independent and the strength of the association was identified using odds ratio in the binary logistic regression. In addition the open ended questionnaire findings were coded and analyzed thematically.

Results: Over half (52.6 %) of the patients were satisfied with the malaria diagnostic service with a 98.7 % response rate. The majority (89.3 %) of patients perceived they were well diagnosed in facing fever upon giving blood for laboratory malaria diagnosis within 30 min waiting time in most (62.5 %) of the patients. Ethnicity, residence, knowing malaria diagnosis after consulting clinician, and time period to receive malaria result were the independent predictors for patient satisfaction ($p < 0.05$). The open ended questionnaire responses also revealed providing precise laboratory result timely, availability of the right treatment, presence of health professionals performing the laboratory test upon request in the health facility were among the major enabling factors for patients' satisfaction.

Conclusion: The observed level of satisfaction in the current study though encouraging when compared with some previous studies conducted in eastern Ethiopia on general laboratory services, still it requires scale-up in the enhancement of malaria laboratory diagnostic service in the fight against malaria.

Abstract 15: Assessment of Ownership and Factors Affecting Utilization of Insecticide Treated Bed Nets in Dembecha Woreda, West Gojjam Zone, Ethiopia, 2014

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Background: Malaria is a preventable and treatable mosquito-borne disease. Approximately 52 million people (68%) live in malaria risk areas in Ethiopia. Dembecha Woreda annual report shows that malaria is the top leading cause of morbidity and mortality Assessment of factors related with bed net Ownership and utilization is not well understood. Observation and rumors of not using nets in a correct manner deserve close examination. The main objective of this study is to assess the

ownership and factors affecting utilization of Insecticide Treated bed nets in Dembecha Woreda, west Gojam zone, Ethiopia.

Methods: A Cross sectional study was used and interview was conducted using structured questionnaire to assess the ownership and factors affecting utilization of Insecticide Treated bed nets in Dembecha woreda 2014. Two kebeles from highly malarious stratum and two kebeles from medium malarious stratum based on burden of the disease were randomly selected for the study and totally 4 kebeles were used. A total of 380 households were systematically selected from the study kebeles by using their respective household head name list which was obtained from kebele administration from four kebeles. The data was entered, cleaned, edited and analyzed using EPI info version 3.5.1 and SPSS version 16.

Results/Findings: Malaria was recognized as a major problem. Possession of at least one net was reported by 79.2% of the households but ever sleep under a net was (40.5%). Factors associated with net use were: being knowledgeable, getting health information about malaria and ITNs and education status. The odds of being knowledgeable was 3.0 higher (AOR= 3.04; 95% CI:(1.69-5.43), the odds of getting health information pertaining to malaria was 3.3 higher, (AOR= 3.33; 95%CI: (1.05-10.59), the odds of getting health information pertaining to bed net was 11 times higher, (AOR= 11.24; 95%CI: (5.107-24.75) and the odds of education status(grade 1-4) of the head was 2.82 times higher,(AOR= 2.82; 95%CI: (1.459-5.452) Nets however, were not always used for the intended purpose.

Conclusion and Recommendations: Selection of control measures, should take into consideration local situation. Once chosen as methods of prevention, mosquito net distribution should have proper guideline and local capacities for doing so should be strengthened.

Key words; Utilization, Insecticide treated bed net, Malaria

Abstract 16: Effect Of Health Education Focusing On School Communities and Religious Leaders on Community's Malaria Prevention Behaviors, Jimma Zone: A Result from Lots Quality Assurance Survey

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Background: Promoting community's appropriate behavioral practices is a critical component of malaria prevention and control activities. This study assessed effect of malaria education through school communities and religious leaders on communities' malaria prevention and control behaviors in Jimma zone.

Methods: The data were obtained from a study conducted to promote communities behavioral practices on malaria prevention and control in five districts of Jimma Zone. The project was started in Jan 2014 and run for three years. As part of preparatory activities, baseline data were collected in Jan 2014. The interventions included health education activities through school communities and religious leaders. To monitor progress on key indicators, Lots Quality Assurance survey was conducted in June 2015. In this report, we compared baseline indicators to results obtained from LQAS. The data were analyzed by SPSS 17.0 and STATA 12.0

Results: The study indicated that 64.2% of the target population had exposed to school based malaria education activities. On the other hand, nearly of the populations (54.7%) also received malaria related information through religious based health education. The interventions resulted in large improvements in community's knowledge, attitude and malaria prevention behaviors. Accordingly, mean knowledge and attitude score was increased by 6.8 and 7.1 respectively. Likewise, long lasting insecticide treated net use was increased from 38.0% to 62.0% (among households members); from 66.3% to 73.7 % (under five children); from 42.9% to 76.8% (pregnant women), and ratio of LLIN use to access was increased from 70.2% to 82.0% leading to narrowed behavioral failure gap in net use. On the other hand, seeking care within 24 hours after onset of fever was increased by 14.9% (from 19.8% to 34.7%). However, the result did not show improvement in rational use of anti-malaria drugs.

Conclusions and recommendations: Health education focusing on school communities and religious leaders improves community perceptions and behaviors on malaria preventive behaviors. However, the intervention did not show effect on proper use of anti-malaria drug use calling for attention and further investigations.

Keywords: Malaria, Seeking Care, LLIN, Behaviors, health education