

Upcoming Event

**Lecture Series on
Infectious Diseases
24th May, 2022**



**Dr Manju Rahi,
ICMR, India**

Interviews



**Prof Philip Rosenthal,
UCSF, USA**



**Dr Vineeta Singh,
ICMR-NIMR, India**

**NEWS
&
VIEWS**

ISSUE 19, MAY 2022

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- Announcements

A Child's Perception of Malaria

Sketch by Hiranya Raina,
Age: 6 years



Editorial

Dear Readers,

MERA-India team brings you the nineteenth issue of our newsletter.

These days, Northern India is in the throes of record-shattering extreme heat conditions affecting millions of people, attributed to drastic changes in the climate. Climate change, along with human-induced disturbances in nature, is the hardest to cope with, as it affects the physical well-being of people and is also a menace to mental health. The indicators of change in climate patterns are apparent, such as rising sea levels, scorching heat waves, increased rainfall, droughts, and intense storms. Expeditious use of natural resources and large-scale deforestation are dominant reasons leading to climate forcing the temperature and major anthropogenic changes in the atmospheric environment.

Climate change is a massive crisis in the present scenario, disturbing the entire world. The government's environmental policies and firm, decisive laws should be implemented to avoid the worst circumstances. More than emphasizing policies, it is an individual's responsibility to make wise choices of their activities to minimize the damage to the environment and thus to the planet.

Malaria is one of the deadliest mosquito-borne infectious diseases in the world. The change in climate conditions like high temperature, increased humidity and excessive rainfall may have profound effects on the breeding patterns and survival of mosquitoes and hence lead to an increase in transmission rates of the disease. There are chances that climate change will expand the geographical dissemination of the disease which may have a horrendous effect on the burden of malaria in the endemic areas. We at MERA-India, believe in promoting innovative ideas to seek solutions to such massive issues.

On 25th April 2022, MERA-India and ICMR-NIMR celebrated World Malaria day by hosting many scientific activities. The one-day event featured a stimulating lecture by Professor Sumit Malhotra, Additional professor at AIIMS, Delhi, on the role of implementation research in malaria elimination. The details of student-centric activities at this event and highlights of the lecture are summarized in the current issue.

It was a delight hearing the inspiring lecture by Dr Saman Habib, Chief Scientist at the CSIR-Central Drug Research Institute, India. Her lecture gave insights into possible therapeutic antimalarial interventions targeting essential proteins present in parasite organelles. A summary of the lecture is provided in this issue.

This issue of MERA-India newsletter brings to you engaging, inspirational interviews by eminent scientists, Professor Philip Rosenthal (UCSF, USA) and Dr Vineeta Singh (ICMR-NIMR, Delhi) in the 'Malaria Scientists to Watch' section. Read about the latest findings in the new therapeutic interventions and diagnostics for malaria prevention and management in the 'Research in Spotlight' section.

Further, under the stimulating “Resource for Malaria Researchers” section, we have highlighted the MMVSola, an online mathematical modelling platform for early prediction of clinical pharmacokinetics and antimalarial drug dose based on preclinical studies. In our “A Child’s Perception of Malaria” section, we are showing thoughts of a young child in the form of a beautiful sketch demonstrating her understanding of malaria disease.

We are excited to have Dr Manju Rahi, Scientist F, ICMR as our next speaker in the “Lecture Series on Infectious Diseases”, to be held on 24th May 2022. We cordially invite all our readers to attend this lecture.

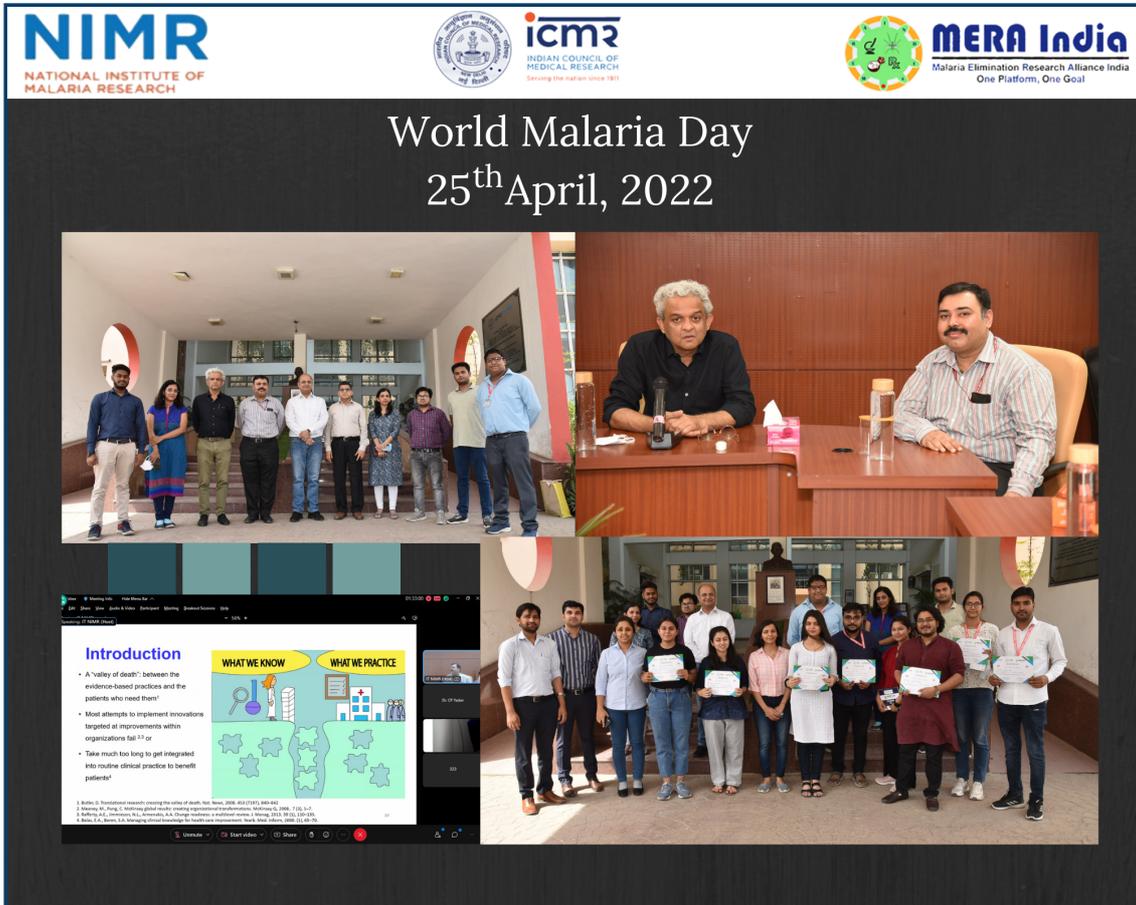
In the “Announcements” section, we have highlighted the currently open call for ISID/ESCMID fellowship applications and the upcoming 20th International Congress for Tropical Medicine and Malaria.

We hope that you will find this issue more engaging and enjoyable. Please write to us for any feedback or suggestions regarding the content of the newsletter at meranewsletter@gmail.com.

With best wishes
MERA-India team

ICMR-NIMR & MERA-India Activities

World Malaria Day 2022



To mark World Malaria Day 2022, an event was organized by ICMR-NIMR and MERA-India at NIMR, Delhi. On this occasion, Dr Amit Sharma, Director of NIMR, highlighted the current challenges worldwide for the malaria control and elimination efforts and stressed upon the need for investing in resources and support malaria research for a malaria-free future. A special lecture was also delivered by Professor Sumit Malhotra from the Centre for Community Medicine at AIIMS, Delhi. He talked about the principles, role & challenges of implementation research, with examples from malaria & vector control interventions. Dr Sachin Sharma, Chief Consultant MERA-India, also briefly described the journey and activities of MERA-India over the last three years. The recording of this lecture is available on the MERA-India website (https://www.meraindia.org.in/video_gallery).

World Malaria Day 25th April, 2022



A poster competition was also organized on this occasion, in which the NIMR PhD students showcased their work focusing on various aspects of malaria research.

World Malaria Day 2022 Poster competition at ICMR-NIMR



Based on the evaluation by judges, the following students were adjudged as the winners of the poster competition:

First Prize: Ms Ritu Goswami - "Structural and biochemical investigation of anopheles Prolyl-tRNA synthetase with a quinazolinone-based inhibitor"

Second Prize: Ms Aakansha Singh - "Significance of PCR in detection of low-density infection detection"

Third Prize: Mr Rahul Pasupureddy - "Interactions of the endogenous macromolecular inhibitor of cysteine proteases (ICPs)- falstatin, with the *P. falciparum* hemoglobinase falcipain-2 (FP2)"

All the participating students were awarded prizes and certificates of participation.

Lecture Series on Infectious Diseases Lecture 11 by Dr Saman Habib

The screenshot shows a Webex meeting interface with four participants in a grid. The main content is a slide titled "Can this become a liability?". The slide features a phylogenetic tree on the left with the following organisms and their characteristics:

- Chromera**: Photosynthesis, Fatty acid, Isoprenoid*, Haem*
- Toxoplasma**: Fatty acid, Isoprenoid, Haem
- Plasmodium**: [Fe-S] by *SUF*
- Theileria**: Isoprenoid
- Cryptosporidium**: no plastid

On the right, a diagram shows a **human RBC** with **HMBPP** being converted into **CO₂, aldehydes, monoterpenes**. A text box states: "A key malaria metabolite modulates mosquito blood seeking, feeding, and susceptibility to infection - Emami et al. Science (2017)". Below the diagram, it says: "Apicomplexa retained the plastid because of their profound **metabolic dependence** on the endosymbiont." The slide concludes with the question: "Can this become a liability?". The source is cited as "From Annu Rev Microbiol, 2013".

Dr Saman Habib was the eleventh speaker in the ICMR-NIMR & MERA-India "Lecture Series on Infectious Diseases". Dr Habib is Chief Scientist at the CSIR-Central Drug Research Institute, India. She delivered the lecture on the topic entitled "Can intervention strategies turn the reduced but essential organelles of the malaria parasite into liabilities". Dr Sachin Sharma, Chief Consultant MERA-India, welcomed everyone and introduced Dr Habib.

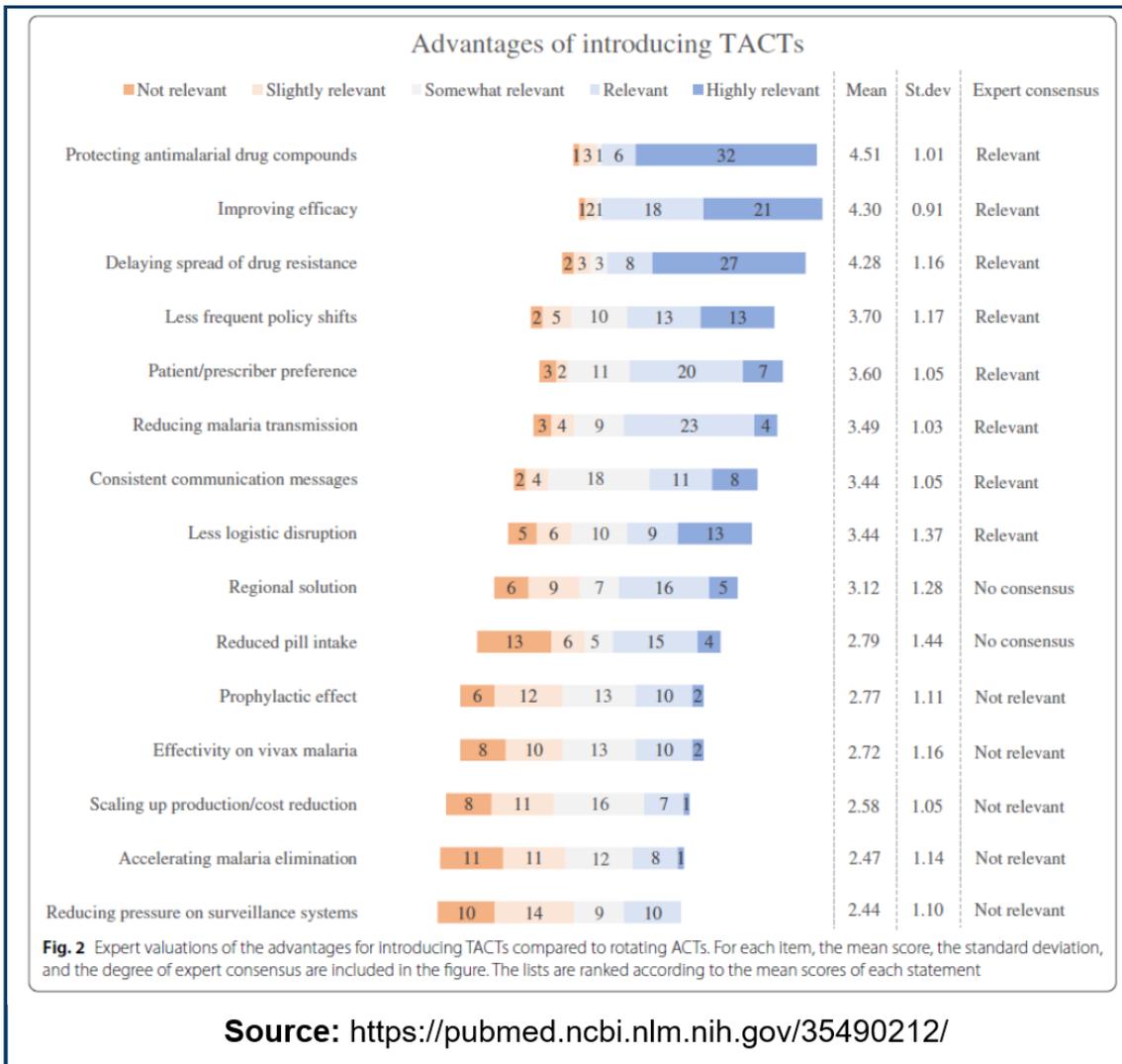
In the lecture, Dr Habib talked about the possibilities and issues regarding therapeutic strategies targeting parasite organellar proteins. She showed the intracellular targets of the current antimalarial drugs and highlighted how the emerging resistance to the available drugs presses the need to identify new drug targets. She narrated how the apicoplast in *Plasmodium* was identified and the evolutionary theory behind its existence in

apicomplexans. She further described the apicoplast and mitochondrial genomes and the essential parasite pathways, such as the apicoplast SUF pathway and the mitochondrial ISC pathway, which are critical for the parasite survival. She also highlighted the leading drug targets in the apicoplast and mitochondrial genomes owing to their unique and essential roles in the parasite and the current antimalarial drugs under development.

The lecture was followed by answers to the questions from attendees and ended with a note of thanks from Dr Sachin Sharma. The recording of this lecture is available on the MERA-India website (<https://www.meraindia.org.in/lecture-series>).

Research in Spotlight

de Haan F *et al.*, *BMC Public Health*, 2022: Expert perspectives on the introduction of Triple Artemisinin-based Combination Therapies (TACTs) in Southeast Asia: a Delphi study



With the onset of drug resistance to ACTs in Southeast Asia, there is a pressing need to identify solutions to prevent the antimalarial resistance spread to other regions and deploy efficacious drugs for malaria treatment. The present [study](#) summarizes the outlook of malaria experts for the introduction of Triple Artemisinin-based Combination Therapies (TACTs) as first-line treatment for uncomplicated malaria in Southeast Asia. The authors conducted a Delphi study with malaria experts where they were asked questions regarding the benefits, disadvantages, and implementation challenges of introducing TACTs in this region. With the two rounds of the Delphi study, the experts' consensus was reached on thirteen advantages. Eight were viewed as relevant; five were not relevant, twelve disadvantages (ten relevant, two not relevant), and thirteen were relevant to implementation challenges. Major disadvantages that came up with the rounds of discussions were

associated majorly with the side effects of TACTs, an increase in the cost of medication, and the possibility of non-availability of fixed doses of TACTs. Besides the clinical and epidemiological advantages of introducing TACTs, there are bounteous challenges related to the regime's implementation, including regulatory approvals and global policy support. However, the authors conclude that this type of study is encouraging as it provided essential findings that could be beneficial in designing strategies and prioritizing resources in the fight against malaria.

Galindo MS *et al.*, *BMC Public Health*, 2022: Implementation of a novel malaria management strategy based on self-testing and self-treatment in remote areas in the Amazon (Malakit): confronting a-priori assumptions with reality

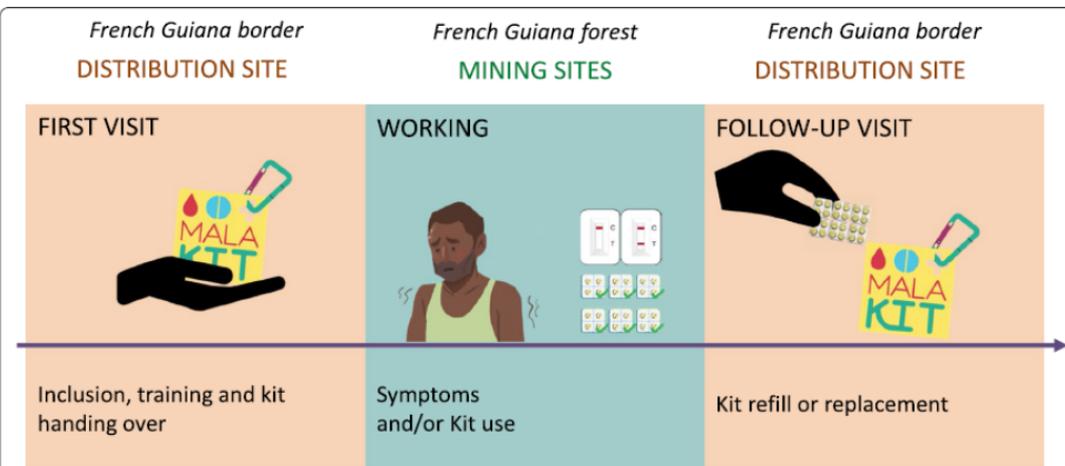


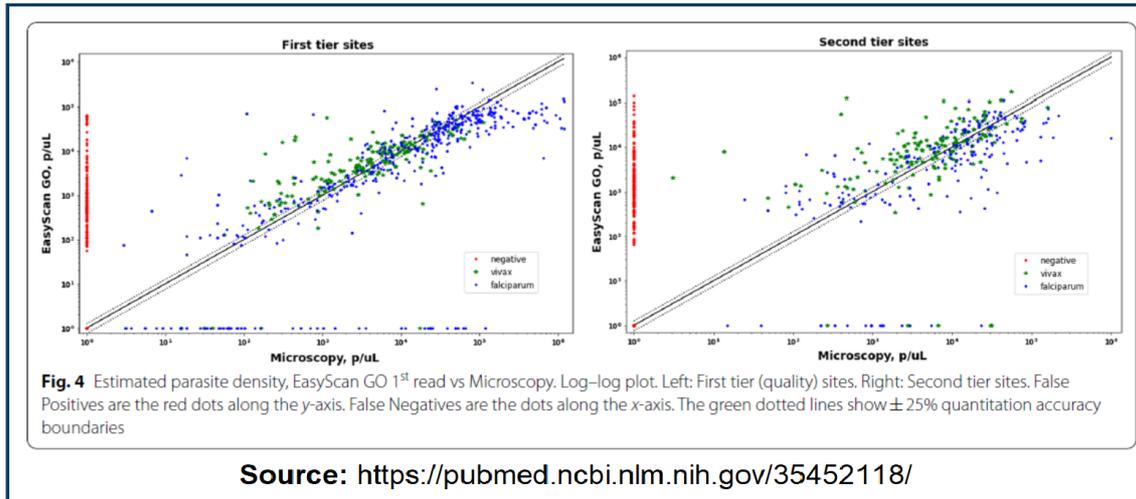
Fig. 2 Principle of the Malakit intervention in Suriname and Brazil (April 2018-March 2020). Source: created by the authors

Source: <https://pubmed.ncbi.nlm.nih.gov/35428230/>

A novel intervention strategy, Malakit, was introduced to tackle malaria in the hard-to-reach, mobile community of gold miners working in the remote sites in the French Guiana forest in the Amazon region. The gold miners were provided with malaria self-management kits (including RDT for malaria detection and anti-malarial drugs for treatment) after training them and providing them with information on when and how to use it. The primary purpose of this intervention was to enable the gold miners to undertake self-diagnosis tests immediately upon the onset of the malaria symptoms and to take proper anti-malarial medication upon positive diagnosis. This strategy is of much significance to this population as they often do not have access to consultation by the health care provider. This [article](#) by Galindo *et al.*, looks into the process of the implementation process and the outcomes of this intervention using the data collected during the intervention, post-intervention surveys, self-recorded videos from the training facilitators, visit reports from supervisors, and feedback from the project implementers. The authors describe the challenges in the field during the implementation of the Malakit project and the solutions derived to tackle them at the local level, and modifications in the approach to implementing the intervention objectives based on the challenges which led to an effective and impactful outcome. The authors highlight that the easy and prompt access to the kit led to increased participant

responsiveness and further strengthened the intervention. The details, experience and insights from this study will help design and apply similar interventions to other settings to tackle malaria and other diseases in the remote areas and populations.

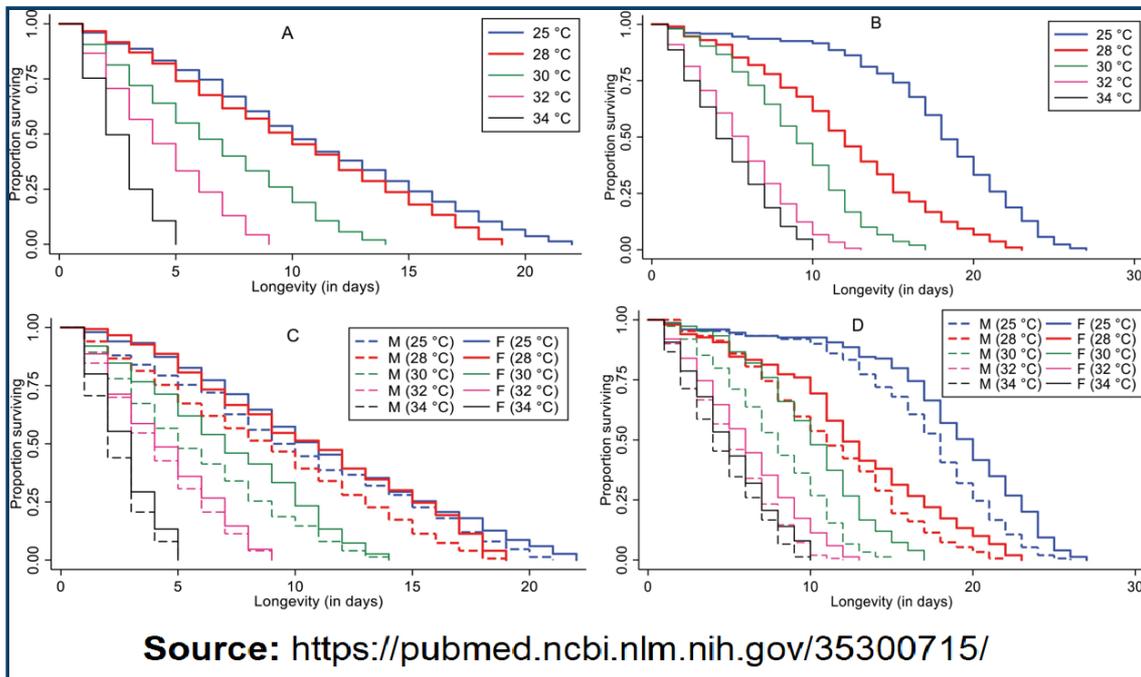
Das D et al., *Malar. J.*, 2022: Field evaluation of the diagnostic performance of EasyScan GO: a digital malaria microscopy device based on machine-learning



In this [study](#), the authors provide substantial optimism to machine-learning-based automated malaria microscopy platforms for parasite detection and estimation of parasite density. Here, the authors assessed the diagnostic performance of the production prototype device built by Motic, The EasyScan GO plus the thick film algorithm, with respect to microscopy, which is used as the gold standard for clinical diagnosis of the disease. CNNs (convolutional neural networks) were applied to the algorithm to succeed in the image-related task.

A multi-centric study was done at eleven sites in eleven countries to access the specificity and sensitivity of EasyScan Go through examination of blood film. The algorithm analyzes the image stacks to detect and quantify the parasite. Bland-Altman graph was plotted to define the parasite density estimation between EasyScan Go and microscopy. The study concluded that this machine-learning-based algorithm could reduce the dependence on trained technicians in malaria quality assurance programmes. This device can stimulate the cross-checking of blood slides. To increase the sensitivity at low parasitaemia and parasite estimation, further software improvement is needed.

Agyekum TP *et al.*, *J. Med. Entomol.*, 2022: Effects of Elevated Temperatures on the Growth and Development of Adult *Anopheles gambiae* (s.l.) (Diptera: Culicidae) Mosquitoes



In this [study](#), the authors have looked into the effects of exposure to increased temperature on the various physical and physiological features as well as the life span of the malaria vector *Anopheles gambiae*. The authors exposed the eggs of the mosquitoes to different temperatures ranging from 25 to 40°C. The eggs exposed to 40°C did not hatch while the eggs that hatched at 38°C died before pupation, and the adults from the eggs exposed to 36°C died within the first day. Further, the adults from eggs exposed to 32°C or 34°C failed to lay eggs. The adults were fed on sugar solution as well as blood meal. The authors observed that the female mosquitoes survived longer than the male mosquitoes; while the mosquitoes that were fed only on sugar meal had increased longevity as compared to the mosquitoes fed on sugar meal and the blood meal. No significant difference was observed in the gonotrophic cycle length or the biting rate with increasing temperature exposure; however, a significant decrease in fecundity was observed in the mosquitoes exposed at 30°C as compared to 25°C. A decrease in body size, weight and proboscis length was also observed with an increase in temperature. Thus, this study reports reduced longevity and changes in the mosquitoes when exposed to increasing temperatures. It is yet to be determined how these changes affect the parasite dynamics in the vectors.

Malaria Scientists to Watch

An interview with Professor Philip J. Rosenthal



[Professor Philip J. Rosenthal](#)

**Department of Medicine,
University of California, San Francisco**

1. What motivated you to work in the field of malaria research?

I must admit that I fell into malaria research somewhat by accident. As a trainee, I was interested in international issues in general and infectious diseases in particular. These interests led me to seek out research projects in parasitology when I entered the research component of my fellowship in infectious diseases at UCSF. At that time, I met Jim Leech, who became my primary mentor, and he helped me to focus my interest on a specific project on the biochemistry of malaria parasites. Later, my interests broadened, partly based on my decision to merge my experience as a clinician with my research, with major attention to translational research on malaria in Africa.

2. What has been your most surprising and unexpected discovery in malaria so far?

I must say that most of our research advances have not taken the form of surprising discoveries (aha moments are uncommon), but rather steady advances as we gradually figured out solutions to scientific questions, e.g. sorting out the roles of the falcipain family of cysteine proteases in parasite biology (of note, most of these advances were made by Indian scientists in my lab). In recent years, my biggest surprise may be the remarkably plastic nature of malaria in Africa. In Uganda, over just the last few years we have seen malaria incidence vary markedly in regions with variations in control activities (e.g. incidence and prevalence increased tremendously within months after discontinuation of insecticide spraying), clinical consequences of malaria vary greatly in populations with different histories (with a greater likelihood of symptomatic and severe malaria in populations with previously low transmission intensity), changing risks for different age groups (with an increased burden in older children), and rapid emergence of parasite mutations linked to drug resistance. This highly changeable nature of malaria makes the disease incredibly interesting to study, but also highlights the challenges inherent in attempting to better control and eventually eliminate malaria in the highest-burden countries of the world.

3. If you have to pick one intervention that has played the biggest role in our fight against malaria, which one would that be?

I will take the liberty of picking two. First, highly effective drugs have had an enormous impact, both in saving the lives of those treated for malaria and in helping to control the problem in endemic areas. Second, highly effective insecticides, included in bed-nets or sprayed on the walls of houses, have had a huge impact on malaria transmission. With both drugs and insecticides, we must continually adapt our approaches as parasites and mosquitoes develop resistance to available compounds, and, although newer approaches such as vaccines and mosquito engineering may have great promise for the future, it remains a high priority right now to develop the next generation of drugs and insecticides to fight malaria.

4. What do you see as the biggest challenge for India in achieving the malaria elimination goal by the year 2030?

In recent years we have learned that malaria elimination can be feasible even in large countries with large burdens, e.g. China, but also that progress can be very challenging in highly endemic countries, e.g. most of sub-Saharan Africa and parts of India. Challenges for India remain great. First, although there has been great progress, some parts of the country still have high-level transmission of falciparum malaria, and so there is a long way to go. Elimination of vivax malaria maybe even more challenging; 8 years may be unrealistic. Second, we have seen in other parts of the world that even after great progress, the last steps to full elimination can be very challenging. This is due to biological factors (a parasite reservoir can persist even in a population with minimal clinical malaria), meteorology (climate change, both continued warming and year-to-year fluctuations, can facilitate re-emergence and epidemics), social factors (it is hard to mobilize populations against a problem that appears to have been solved), politics (it is similarly hard to maintain government interest), and other factors. Elimination in India will require a concerted, consistent, and protracted push, utilizing many tools, and enthusiasm must not wane as progress is achieved, but before elimination is complete.

5. What significance do you see for MERA-India in achieving India's malaria elimination target?

Malaria elimination will be a highly significant accomplishment for MERA-India and the country. It is hard to think of a more profound advance in healthcare than the elimination of this previously overwhelming problem.

An interview with Dr Vineeta Singh



[Dr Vineeta Singh](#)

Scientist E,

ICMR - National Institute of Malaria Research, Delhi

1. What motivated you to work in the field of malaria research?

Since my early graduation days, the emerging field of Biotechnology interested me, and thereby I went on to complete my MVSc from IVRI and later PhD from BITS, Pilani in Biotechnology. In the initial stages of my career, I was working on infectious diseases and their disease pathogenesis mostly, with hardly any focus on malaria. My career in malaria research started with my joining the ICMR-NIMR whereupon the huge potential of malaria research dawned upon me.

My lab is in the malaria parasite bank where I do my research work along with the routine activities of the parasite bank. When I joined the parasite bank there was no ongoing molecular work in the lab. I set up the molecular lab with some technical difficulties initially and then started to study the field isolates of *Plasmodium falciparum* and *P. vivax* at the molecular level. Slowly my lab grew with extramural funding from DBT, ICMR and DST, and with more students, we started looking into other aspects of parasite biology like drug resistance genes, *in vitro* culture, virulence genes, green synthesis nanoparticles, the characterization, antimalarial activities and several other related areas. We are currently engaged in whole-genome sequencing of a few *Plasmodium* field isolates. From beginning here to now; my job profile is currently diverse ranging from research in the field of parasite biology to mentoring PhD/PDF students coupled with other additional activities. My professional goals also include training young researchers and capacity building.

2. What has been your most surprising and unexpected discovery in malaria so far?

Initially around a decade before when I was trying to collect patient samples in hospitals for my study, I started to notice severe clinical manifestations trends' in *P. vivax* cases. Later more and more reports came out that echoed my findings too - that vivax malaria once considered benign species, is recently also causing severe malaria in patients, similar to *P. falciparum*.

After getting some promising results in my earlier research proposals, I am studying this significant shift in the paradigm of *P. vivax* disease pathogenesis.

3. What do you see as the biggest challenge for India in achieving the malaria elimination goal by the year 2030?

The presence of persistent asymptomatic with very low-density malaria parasite infections is perceived as a major threat to the national malaria elimination programme and must be addressed by devising a multi-approach policy for surveillance and treatment of asymptomatic low-density *Plasmodium* carriers to deplete and eliminate asymptomatic reservoirs.

4. What is the best piece of career advice that you have ever received?

The journey of any researcher can be very challenging and to sail through this, the best advice I ever received was to be a lifelong learner, no matter at what stage of career you are and I consciously follow it. Also, working in collaboration with the team helps to reach the research goals more efficiently and effectively.

5. What significance do you see for MERA-India in achieving India's malaria elimination target?

MERA- India plays a very significant role as it gives a common platform to identify and prioritize targeted research aimed at malaria elimination from India by 2030. MERA-India's major goal is to address gaps and challenges in malaria research and give a common platform to all stakeholders with the national program, for successful implementation of the malaria elimination program.

Resource for Malaria Researchers: MMVSola

MMV
Medicines for Malaria Venture

Developing antimalarials to save lives

Research & Development Access Partnering Our impact About us Malaria & medicines Newsroom MMV Open

Home > MMV Open > MMVSola > About MMVSola

Malaria Libre > About MMVSola

MMVSola

About MMVSola

Pandemic Response Box >

COVID Box >

Archived projects >

MMV Open Team

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About MMVSola

An open tool for early prediction of pharmacokinetics and antimalarial dose

Sharing technology can spark innovation and accelerate the development of lifesaving medicines. This is why MMV has developed and made available a free tool for early prediction of (i) clinical pharmacokinetics (PK) (in malaria as well as other diseases) and (ii) the dose required to clear all parasites from an adult malaria patient weighing 50 kilograms. The tool aims to help teams optimize compound series and advance the selection of the best possible candidate drugs.

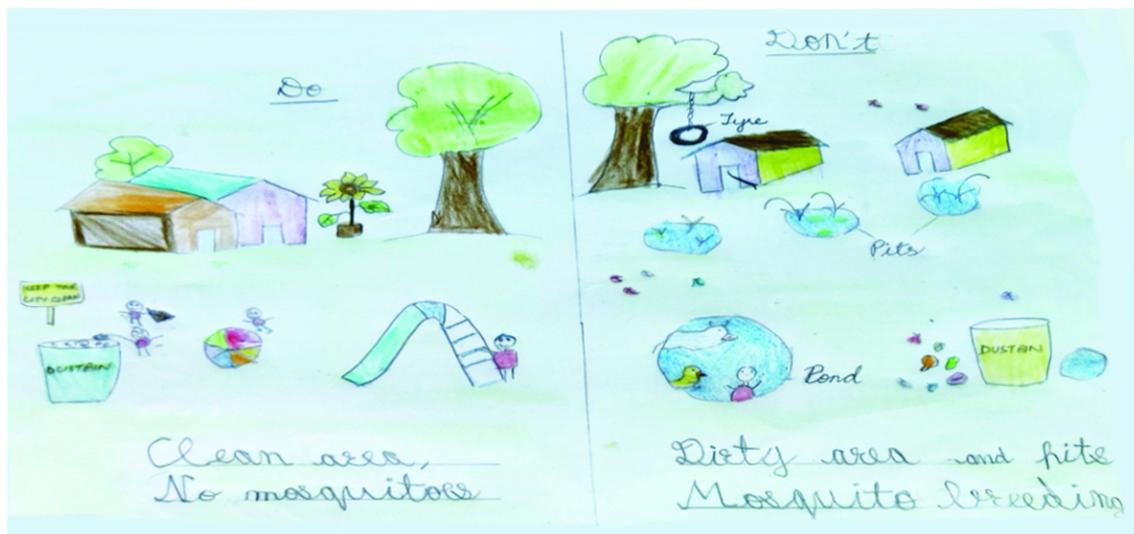
Source: <https://www.mmv.org/mmv-open/mmv-sola/about-mmv-sola>

MMVSola is a free tool launched by Medicines for Malaria Venture (MMV) in 2021. Using this tool, the researchers can predict clinical pharmacokinetics and the drug dose required to clear malaria infection from an adult patient. These predictions are generated based on preclinical experiments using mathematical algorithms. The tool can make clinical predictions during the early discovery phase of the drugs (for use in malaria as well as other diseases) before the experimental testing of the drug. The tool thus fastens the development and supports the researchers by saving resources, reducing the requirement for animal models, and helping in designing informed clinical trials.

To know and explore more about MMVSola, visit <https://mmvsola.org/>

A Child's Perception of Malaria

In this issue, we showcase the sketch of Miss Hiranya, aged six years old. Through the drawing, Miss Hiranya has highlighted the importance of keeping the surroundings clean and filling up the water pits to prevent mosquito breeding and thus protection from mosquito-borne diseases like malaria.



Sketch by: Miss Hiranya Raina (daughter of Ms Ankita Sindhania, ICMR-NIMR Delhi);

Age: 06 years; **Class:** First

Upcoming Event

Lecture Series on Infectious Diseases: Lecture 12 by Dr Manju Rahi



NIMR & MERA-India present
Lecture Series on Infectious Diseases

Lecture: 12



Dr Manju Rahi
Scientist F,
Indian Council of Medical Research,
New Delhi, India

“Strategies/tools to maintain the momentum of malaria elimination in India”

Lecture link: <https://bit.ly/Lecture12May>
Tuesday, 24th May, 1500 IST



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Dr Manju Rahi will be the speaker for the closing lecture of the “Lecture Series on Infectious Diseases”. Dr Rahi is Scientist 'F' at the Division of Epidemiology and Communicable Diseases, ICMR Headquarters, Delhi. She is the focal point at ICMR for implementing research schemes on vector-borne diseases and One Health with deep interest in diseases in the elimination phase.

Dr Rahi will be delivering the lecture entitled "Strategies/tools to maintain the momentum of malaria elimination in India", on 24th May 2022 at 1500 IST.

To join this lecture, please click on this link: <https://bit.ly/Lecture12May>.

Announcements

The International Society for Infectious Diseases (ISID) & the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) Fellowship



**INTERNATIONAL
SOCIETY
FOR INFECTIOUS
DISEASES**



ESCMID

MANAGING INFECTIONS
PROMOTING SCIENCE

ISID/ESCMID Fellowship Application

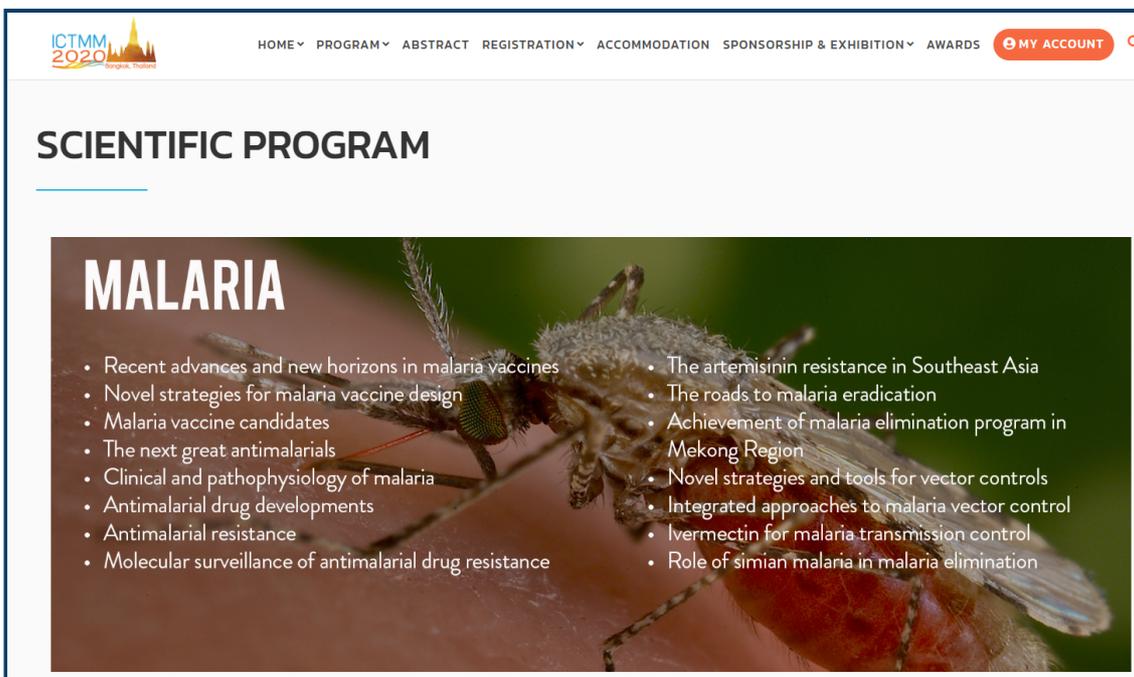
The call for ISID/ESCMID fellowship program is open. Applications are invited from early-career investigators (less than forty years of age) from low and lower-middle-income countries outside Europe. The fellowship will support travel to Europe for multidisciplinary clinical and laboratory training. The application deadline is 31st May 2022.

For more details, visit <https://isid.org/research/isid-escmid-fellowships/>

The 20th International Congress for Tropical Medicine and Malaria (ICTMM2020)



The banner features a dark purple background with golden Thai temple architecture and a statue of a deity. The text reads: "The 20th International Congress for Tropical Medicine and Malaria 24-28 October 2022 Bangkok International Trade & Exhibition Centre (BITEC) THAILAND". Navigation buttons for "Registration Now" and "Abstract Submission" are visible.



The page is titled "SCIENTIFIC PROGRAM" and features a large image of a mosquito. The word "MALARIA" is prominently displayed. A list of topics is provided:

- Recent advances and new horizons in malaria vaccines
- Novel strategies for malaria vaccine design
- Malaria vaccine candidates
- The next great antimalarials
- Clinical and pathophysiology of malaria
- Antimalarial drug developments
- Antimalarial resistance
- Molecular surveillance of antimalarial drug resistance
- The artemisinin resistance in Southeast Asia
- The roads to malaria eradication
- Achievement of malaria elimination program in Mekong Region
- Novel strategies and tools for vector controls
- Integrated approaches to malaria vector control
- Ivermectin for malaria transmission control
- Role of simian malaria in malaria elimination

This conference organized by the Faculty of Tropical Medicine, Mahidol University, and The Parasitology and Tropical Medicine Association of Thailand (PTAT), will be held in Bangkok, Thailand, between 24th - 28th October 2022.

The Congress will cover topics on tropical medicine, including malaria, infectious diseases, parasitic infections, bacterial infections, viral diseases, neglected diseases and other issues of public health importance. The program will include international session speakers, oral presentations and exhibitions. The abstract submission deadline is 30th June 2022, while the early registration deadline is 31st July 2022.

For more details, visit <https://ictmm2020.org/>.

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