



7<sup>th</sup> Multilateral Initiative on Malaria (MIM)  
Pan African Conference

"Two decades of progress, challenges and perspectives in  
ending Malaria"

Complete series



*MESA Correspondents bring you cutting-edge coverage  
from the 7th Multilateral Initiative on Malaria (MIM)  
Pan African Malaria Conference.*

*April 15 - 20, 2018  
Centre International de Conférence Abdou Diouf  
Dakar, Senegal*

*The MESA Alliance would like to thank Ingeborg van Schayk  
(Malaria World) for her mentoring and editorial support, and  
for sharing her knowledge during the production of these  
reports.*

*The MESA Alliance would also like to acknowledge the MESA  
Correspondents for their crucial role in the reporting of the  
sessions.*



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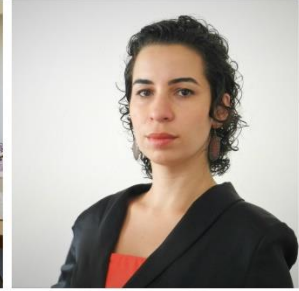
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## Background

There are a growing number of conferences being held globally where emerging evidence is shared in the field of malaria and related topics like entomology, parasitology, and health systems. These meetings offer the opportunity to hear cutting edge science and lessons learned from peers and mentors, in both broad and niche disciplines. As calendars and budgets are limited, those who could benefit from participating are often unable to attend. On the other hand, those who do participate, sometimes miss pertinent talks due to parallel scheduling of scientific sessions and side meetings.

With the overarching objective of sharing key findings with a global audience and also providing opportunities to emerging researchers, MESA identifies relevant conferences for the malaria community and reviews the scientific program to curate lists of talks to be covered by the *MESA Correspondents program*. Summaries of the highlights and technical content of the presentations are produced and shared through MESA's communication channels and those of strategic communications partners.

## Meet the MESA Correspondents



**Shehu Shagari Awandu** (Radboud UMC)

**Manuela Runge** (Swiss TPH)

**Helena Martí Soler** (ISGlobal)

**Camila Damasceno** (Independent Consultant)

## Opening Ceremony

### Dakar II, Two Decades of Progress, Challenges and Perspectives in Ending Malaria

On the 15th of April at 4.15 pm the 7th MIM conference started at the Centre International de Conférences Abdou Diouf (CICAD) in Dakar, Senegal. Local musicians entertained the conference participants and created a pleasant atmosphere.

Representatives of the MIM organising committee opened the event and invited nine leaders of national and international partner institutions on stage. The government of Senegal was well represented and the President was invited to launch the event.

The very first MIM conference was organised in 1997 in Dakar. Now, 6 MIM conferences and two decades later, the conference is back in Dakar. MIM aims to support the exchange of quality research, training and capacity building across malaria-endemic countries in Africa. The conference has grown to become the largest malaria conference on the continent and this year supported 200 African students with Travel Awards to enable them to attend the event.

**Mrs. Rose Leke**, Emeritus professor at the University of Yaoundé – Cameroon, presented a brief overview of the history of MIM. **Prof Harold Varmus**, who received the Nobel Prize Physiology or Medicine in 1989, is one of the founding members of MIM. He gave a presentation about the “spirit of Dakar”. Even though he is not a malaria scientist himself, he was convinced of the urge to create an African alliance to combat malaria. And now 20 years later he is looking forward to hearing all about the achievements of the past two decades.

Finally, **Joy Phumaphi**, the Executive Secretary of the African Leadership Malaria Alliance (ALMA), honoured Senegal with the 2018 Award of Excellence in Malaria Control. She presented the award to the President of Senegal with the words “*zero malaria starts with each of us*” therewith referring to the Senegal campaign “*zero malaria starts with me*”.

*This blog was written by Camila Damasceno (Independent Consultant), Manuela Runge (Swiss TPH), Shehu Shagari Awandu (Radboud UMC) and Helena Martí Soler (ISGlobal) as part of the MESA Correspondent program, and is cross-posted on the MESA website and Malaria World.*

## Day 1: Monday, April 16<sup>th</sup>

Prof. Oumar Gaye, member of the MIM organizing committee, and Prof. Rose Leke, from the University of Yaoundé, co-chaired today's plenary session and introduced keynote speakers Dr. Pedro Alonso and Prof. Fred Binka.

### **Presentation: "Current status of Malaria Control and Elimination" - Dr. Pedro Alonso, Director of WHO Global Malaria Programme**

*"To know where we are, we need to know where we are coming from"*. That's how **Dr. Alonso** started his overview of the stage of malaria. This year is the 70th anniversary of WHO. When WHO was first launched there was general consensus that *"we had the tools, we knew how to do it, and we just had to go out and do it"*. Today, 70 years later, we are still facing big challenges to globally eradicate malaria. Looking at the achievements over the past fifteen years, 2000-2015, there has been tremendous progress mainly because of scaled-up vector control, improved diagnosis and availability of new first line treatment. This resulted in 50% reduction of malaria mortality. WHO 2016 figures of global malaria cases showed that a decrease has come to a halt and even showed early signs of reversal.

Dr. Alonso expressed his concern that a significant number of countries are going backwards and funding has plateaued over the past few years. The 'malaria' world seems to be divided into two distinct groups: 1. a group of countries approaching malaria elimination, and 2. a group of countries a group of countries that seem to have increased malaria disease burden over the years. Dr. Alonso expects that the elimination goals will be achieved by 2030, but is concerned about reaching the morbidity and mortality goals and stated: *"We hope through collaborative effort to move forward. Malaria can be diagnosed and treated. No one should be dying of malaria."*

### **Presentation: "Challenges and perspectives ending malaria: the role and contributions of health systems" - Prof. Fred Binka, University of Health and Allied Sciences, Ho, Ghana**

**Prof. Binka** presented the importance of integrating national health systems into the Global Technical Strategy framework. The tools for malaria elimination are available, but we need a vehicle to eradicate malaria. The national health systems need to be adapted to the local malaria transmission. Stratification and identification of different transmission levels within each country ask for an area approach within the national program: *"No more one strategy fits all"*. Furthermore, improved health systems require more trained community health workers who can move beyond national health systems. In order to achieve malaria eradication, it is essential to share data across countries and develop a malaria elimination database that is required to clear transmission across different countries. *"A strong but flexible health system is the vehicle to get us to zero."*

*Reported by Camila Damasceno*

### **Symposium: "Benefitting from the diversity of field parasites in Africa to better guide the discovery and development of next generation of antimalarials"**

Interrogation of the parasite lifecycle using both laboratory and field strains of parasites, is key in the development of next generation of antimalarials before human trials, according to Medicines for Malaria Venture's (MMV) **Didier Leroy**. African artemisinin treatment failure to date is distinct from South East Asian parasite strains.

**Colin Sutherland** from the London School of Hygiene and Tropical Medicine explored the evidence for intra and inter-species differences in antimalarial susceptibility and their relevance for drug discovery. An analysis of African and Asian parasite strains showed that whilst *PfKelch13* and *pfpl4k* mutations were responsible for Artemisinin resistance in Asia, in contrast to Africa, other mutations like *Pfap2mu*, *pfubp1* and *Pfcoronin* could be driving the resistance.

**Patrick Tumwebaze** from Infectious Diseases Research Collaboration (IDRC) in Uganda, presented data from Tororo, where they have established a robust system that evaluated 8 commonly used antimalarials and 32 MMV isolates that gave excellent profiles. Fresh Ugandan parasites demonstrated moderate variability for a number of compounds that needs further exploration.

In an in vivo susceptibility testing of clinical *P. falciparum* isolates from Ivory Coast, **Kigbafori Silue**, Centre Suisse de Recherches Scientifiques en Cote d'Ivoire (CSRV) observed that Chloroquine resistance is still present in their field site. Through collaborative efforts between MMV and CSRV a laboratory was established that has successfully screened a panel of 24 MMV compounds with different efficacy profiles.

**Issa Nebie Ouedraogo**, from the Centre National de Recherche et de Formation sur le Paludisme (CNRFP) in Burkina Faso highlighted the challenges faced by scientists in resource limited settings in collecting field isolates for drug discovery. Technical challenges, consumables procurement as well as unavailability of quality reagents and ethical issues are common obstacles. He concluded that whilst challenges abound, training of core African Scientists would mitigate some of these issues.

**Salim Abdulla**, former head of Ifakara Health Institute, Tanzania, closed the session by calling for a structured protocol to collect field isolates.

*Reported by Shehu Shagari Awandu*

### **Symposium: "Digital approaches for improved malaria case management, surveillance and response"**

In the era of technology and innovation, malaria can't stay behind. Four experts shared with us their experience using digital surveillance platforms in Mozambique.

**Arnaud Le Menach** from the Clinton Health Access Initiative (CHAI) talked about the importance of a comprehensive malaria surveillance system that offers optimal flow of information for strategic and operational decision-making. He provided an example from Mozambique, where mHealth tools are relied upon to support both health information repositories and decision-making.

A second example was from the Malaria Consortium, where **Karin Källander** and **Arantxa Roca** discussed lessons from implementing and institutionalising digital health platforms for community service delivery in Mozambique. The system in Mozambique is already being successfully used to generate routine passive case detection data to support malaria elimination efforts. An interesting component of Karin's presentation was the illustration of how routine data submitted through the systems is visualized on DHIS2 dashboards, and linked with other systems. In Dr Arantxa Roca's presentation, there was an additional emphasis on how the digital approaches are being used to enhance malaria surveillance and control in the country.

**Pedro Aide** (on behalf of Francisco Saúde), researcher at Centro de Investigaçao em Saúde de Manhiça (CISM), pointed out how to set the way for elimination in low endemic areas of Mozambique strengthening the malaria surveillance system. This presentation focused on CISM's experience in expanding the DHIS2 surveillance platform to all Health facilities and community workers of 8 districts



in Maputo and Gaza provinces in Southern Mozambique. He also described the reactive case detection and response systems established in the pre-elimination district of Magude.

### **Symposium: “Detection of sub-microscopic malaria infections using new point-of-care diagnostic tests”**

**Xavier Ding**, the team Leader of Malaria and Fever Program at FIND introduced the symposium by highlighting the need of diagnostic tools that can effectively identify low density infections and close the gap between RDTs and PCR, thereby overcoming limitations associated with diagnosis in elimination settings.

**Dr Kigbafori D. Silue** from the Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRV) gave the first presentation, which focused on the performance of LAMP for detection of *Plasmodium* infections in asymptomatic carriers. Results were presented from a study carried out in one district in Côte d'Ivoire, where blood samples were collected from 390 households for evaluation of LAMP. The proportion of asymptomatic carriers was high, and LAMP was positively received by the local authorities. However, the researchers also noted that performance of LAMP is expected to further improve and that there are on-going PCR tests to validate this. At the end of his talk, Dr. Silue emphasized the urgent need to adapt sensitive tools in order to target asymptomatic malaria infections in Côte d'Ivoire.

**Beatriz Galatas** from ISGlobal presented results of a 2017 cross-sectional study conducted in two sites in Mozambique, where four diagnostic tools were compared. The diagnostic tools included ultra-sensitive rapid diagnostic tests (uRDTs) and regular RDTs. The team found that although uRDTs could detect lower parasite densities, these diagnostic tests had only marginal benefits compared to RDTs, due to relatively high numbers of false positives and few additional detected infections. Finally, she discussed whether uRDTs should be recommendable for clinical use, and the potential use for test and treat campaigns and for prevalence monitoring at the community level.

The final talk in this symposium was given by **Prof Babacar Faye** from the Department of Parasitology, Faculty of Medicine, Cheikah Anta Diop University of Dakar, and also a co-organiser of the MIM conference. Dr Faye also presented on the use of LAMP for detection of *Plasmodium falciparum* infections in asymptomatic carriers, this time in Kaolack region of Senegal. He re-emphasized that in order to reach elimination, the asymptomatic carriers need to be identified and treated and that tools such as LAMP could have potential to overcome the limits of RDT and microscopy. The study was conducted in 2015 and involved 1250 samples. Prof. Faye's group found that a large number of samples were pan positive and pf negative, with a higher sensitivity for non-*falciparum* infections. LAMP could help in mass screening and treatment (MSAT) strategies and could fill the gap for needed sensitive tools at points of care. The results were shared with the national malaria control program in Senegal (PNLP) and interest exists for feasibility studies of using LAMP in MSAT programs in order to tackle asymptomatic malaria reservoirs.

*Reported by Manuela Runge*

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## Day 2: Tuesday, April 17<sup>th</sup>

**"Engaging communities in the last push towards malaria elimination" - Dr. Halima Mwenesi, Department of Global Health, Population and Nutrition; Academy for Educational Department (AED), Washington, DC.**

Dr Mwenesi's presentation focused on the engagement of communities in malaria control in order to enhance people's responsibility to take care of their own health. She stressed that this behavioural change is needed to build on the successes that have been achieved in combating malaria in the past. She said that community engagement improves equity, inclusivity, coverage, access and quality of health care. An important highlight of her presentation was the concept that in order to engage communities, information alone is not enough, and that sensitisation, mobilisation and involvement are required to empower the community. Looking forward, she pointed to three implications of this community engagement: first, the need for better ways to engage communities, second, the potential to use models to predict human behaviour and to measure impact of behaviour change and lastly, the utilisation of IT advances to expand the possibilities around implementation and delivery strategies.

**"Eradication of malaria and eradication of poverty: A 2030 SDG nexus?" - Prof Jean-Paul Moatti, CEO of IRD and member of UN Expert panel for GSDR 2019.**

Prof. Moatti's lecture focused on the idea that even though extreme poverty has significantly reduced over the past years, the benefits of the increase in wealth have not been equally distributed. In order to achieve malaria eradication, we shouldn't just focus on malaria itself, but address it in relation to the Sustainable Malaria Goals (SDG's) in general and the SDG 3 "*Good health and well-being*" in particular. Universal health coverage with a guaranteed package of basic health services could contribute to preventing illness and reducing poverty. Understanding the interaction between malaria and other SDGs will create positive synergies that contribute to eradication of malaria. Prof Moatti ended his talk with the final mobilizing message "*Let's impose solutions to the poverty – malaria – inequalities – nexus in the 2030 SDGs agenda*".

The plenary was chaired by **Prof Wilfred Mbacham**, from the University of Yaounde.

*Reported by Manuela Runge*

**Symposium: "How to confirm absence of transmission in the last step towards elimination?"**

This session revolved around the critical need for local evidence confirming transmission or no transmission in areas targeted for malaria elimination.

**Prof. Chris Drakeley**, from the London School of Hygiene and Tropical Medicine (LSHTM), talked about essential measures necessary to document malaria elimination and the role that serology could play in the context of heterogeneous transmission. To obtain these metrics, we need to employ either cross sectional surveys using sentinel populations or transmission assessment surveys. Prof. Drakeley highlighted various metrics that could be used, but also stated that since these different metrics have limitations, combinations of them should be used to provide a more complete picture. He also stated that serological assays can provide an additional approach to show absence of exposure, but robust health systems and passive surveillance detection are key to confirmation of elimination.

After the introduction by Prof. Drakeley, three researchers from the Malaria Control Elimination Partnership on Africa (MACEPA), presented methods and results from surveys to assess malaria parasitemia and serological prevalence in near-zero transmission settings in Senegal, Ethiopia and Zambia.

**Dr. Yakou Dieye**, senior technical officer from PATH-MACEPA Senegal, pointed out that data from an easy-access survey in children provided similar conclusions to the community-based survey, as they are operationally easier and might be a good alternative to the more expensive community surveys. Besides, serological-surveys might be an appropriate complement to clinical surveillance data to validate surveillance results.

In the same framework, **Dr. Asefaw Getachew**, senior technical advisor from PATH-MACEPA Ethiopia, stressed that, even though there were zero reported passively detected local cases in the two last years, seroprevalence showed that there was still some residual transmission. Importation could play a role in this residual transmission.

Lastly, from PATH-MACEPA Zambia, **Dr. Mulenga Mwenda**, laboratory scientist, focused on the molecular surveillance in areas approaching malaria elimination in Southern Zambia, a region with much higher prevalence than Senegal and Ethiopia. She raised the interesting question, “*Is zero really zero?*” and discussed how we could be sure that no reporting meant zero malaria cases. The overall conclusion was that serological markers could be more sensitive than RDTs or PCR to be used in the final steps towards elimination.

Closing this symposium, **Dr. Gillian Stresman**, research fellow of immunology & infection at the LSHTM, focused on Freedom from infection (FFI), a term used to describe the probability of having an infected animal if there is one in the herd/flock/population in situations where surveillance activities have detected no infections. The FFI tools provide a potential standardized approach for informing decision-making that is being explored for use in malaria. However, questions on the applicability of these tools on malaria and other human diseases still remain.

### **Symposium: "Malaria Surveillance and Elimination: Country-driven and country-owned"**

This session examined the need for countries to set and own the agenda for local malaria elimination, while also integrating within the global health agenda as outlined in the WHO Global Technical Strategy of 2015. The WHO Global Malaria Programme was represented by **Dr Kim Lindblade** and **Dr Abdisalan Noor**. Dr Lindblade presented the updated 2017 framework for malaria elimination. This provided guidance on the tools, activities, and strategies required to achieve malaria elimination and prevent re-establishment of transmission in countries. She clarified that a set of interventions containing four components are recommended, including: a) enhancing and optimizing vector control and case management; b) increasing the sensitivity and specificity of surveillance tools; c) accelerating transmission reduction, and d) investigating and clearing individual cases. She emphasized that political and financial commitment are important conditions to prevent re-establishment of malaria transmission. The framework presented by Dr. Lindblade is intended to inform national malaria elimination strategic plans and should be adapted to local contexts. Following this talk, Dr Noor provided an overview of the “Malaria surveillance, monitoring & evaluation: a reference manual”, of the WHO Global Malaria Programme.

To provide a perspective from endemic countries, participants in the symposium could hear insights from Zambia and Senegal, mostly focusing on the current efforts and recent successes from these two countries. **Dr Elizabeth Chizema Kawesha**, Director of the Zambia National Malaria Elimination Centre, presented their National Malaria Elimination Strategy, which was launched in 2017. She explained that the rationale for the strategic plan was the drastic decrease of malaria cases between 2001-2017. The Zambia elimination strategy targets specific high-priority areas with a package of interventions, selected based on transmission levels. Here, districts with 50 or more malaria cases per 1,000 people focus on reducing the disease burden and strengthening health systems. On the other hand, districts

with fewer than 50 cases per 1,000 people mainly focus on surveillance as one of the key interventions. With this strategy, Zambia aims to achieve malaria elimination by 2021.

**Dr. Médoune Diop**, from the Ministry of Health of the Republic of Senegal, provided an overview of the strategies that were implemented in Senegal between 2001-2017, with a particular focus on surveillance and elimination issues, process, progress and challenges. He showed how Senegal has adjusted their monitoring system over time, resulting in a decrease of malaria morbidity and mortality between 2013-2017. He finally stressed the need to adapt surveillance, monitoring, and evaluation according to the progress made towards malaria elimination.

*Reported by Camila Damasceno*

### **Symposium: "Gene drive for malaria control"**

Scientific advancements, regulatory affairs and stakeholder engagements are all critical pillars in the development and acceptance of any new technologies for malaria control. According to **Dr. Jonathan Kayondo** of the Uganda Virus Research Institute (UVRI), the need to consider all these components is even greater for genetic modification approaches, particularly the potential use of gene drives to reduce *Anopheles* mosquito populations in Africa. Dr. Kayondo was speaking at a special symposium organized by Target Malaria, a non-for-profit research consortium, championing a multi-layered strategy for evaluating the use of genetically modified mosquitoes, particularly the use of gene drives for malaria control and elimination. In gene drive systems, new traits deliberately introduced in *Anopheles* mosquitoes can rapidly spread through interbreeding populations of malaria mosquitoes from very low initial introductions, and can persist in those mosquitoes indefinitely or until the target mosquito population is locally eliminated. Dr. Kayondo described various steps that his team is taking, with examples of work in Uganda and other African countries and explained why multisectoral championship is desirable to ensure eventual success of such approaches. It is expected that if successful, the gene drive approaches would become very high impact interventions for large-scale and rapid control of malaria transmission, either by transforming the mosquitoes to be refractory to malaria parasites or by causing their populations to dwindle so much that they can no longer sustain transmission.

**Ace North**, from the Oxford University, delivered a talk on a model simulation of gene drives control of malaria vectors in Burkina Faso. Key objective was understanding the dry season survival of mosquitoes, and how these may impact the gene drive technology application in Africa. Dr. North clarified that this is still work in progress, but that the models show great promise of this technology in the African context.

**Tibebu Habtewold**, from the Imperial College, gave a talk on mosquito population replacement strategies driven by CRISPR/CAS technology targeting the ookinete-oocyst developmental stage. The aim is to stop populations of *Anopheles gambiae* from transmitting malaria in wide geographical areas using gene drive. He emphasized that their approach, which uses high safety standards with Mobile Insectary Laboratory (MIL) modules, will overcome some of the challenges of setting up gene drive technology research, by enhancing tests and evaluations of transgenic mosquitoes in disease endemic countries.

An increasing number of African scientists expected to play leading roles in implementation of gene drive technologies in Africa, have been trained by the Pan African Mosquito Control Association (PAMCA) and Target Malaria. This was the message by **Prof. Antonio-Nkodjo Christophe** (Board Member PAMCA). The training included focus group discussions on public health benefits of gene drive and how to facilitate a smooth introduction in Africa. PAMCA is playing a critical role in meeting

the challenges facing gene drive implementation in Africa by assisting in changes to Biosafety regulation and securing political endorsement by the African Union assembly.

**Peter Winskill**, from the Imperial College spoke on challenges faced by current vector control tools of insufficient insecticide treated bed nets coverage, outdoor biting mosquitoes, insecticide resistance and resurgence of cases. While the existing tools have been effective, they may not be enough and gene drive technology would possibly cover the gaps. A model of the effects of the addition of genetically modified mosquitoes to the global technical strategy toolkit showed promising results. Gene drive technology may play a key role in future efforts towards elimination.

Lastly, **Prof. Lizette Koekemoer**, from the University of Witwatersrand in South Africa and chair of the Symposium guided the active participants in a Q&A session exploring various issues on gene drive technology.

*Reported by Shehu Shagari Awandu*

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## Day 3: Wednesday, April 18<sup>th</sup>

### **Plenary session: “Insecticide resistance in African malaria vectors: how worried should we be?” – Prof Hillary Ranson, Liverpool School of Tropical Medicine**

Prof Hillary Ranson, Head of the Department of Vector Biology at the Liverpool School of Tropical Medicine, is a world-renowned vector biologist. She also acts as a technical advisor to the Innovative Vector Control Consortium (IVCC) and is member of the WHO Vector Control Advisory Committee. Prof Ranson studies the impact of insecticide resistance on malaria control and evaluates alternative products and strategies to overcome resistance. Long-lasting insecticide treated nets (LLINs) are one of the two core and broadly recommended measures for malaria vector control by the WHO. Resistance to pyrethroids, the only class of insecticides available for use on LLINs, is now widespread in the major malaria vectors but recent studies show that, despite the spread of resistance, LLINs are still a useful tool for personal protection.

She discussed how the community protection provided to non-net users would be reduced by insecticide resistance before any impact was seen on personal protection. Hence studies focusing solely on malaria in net users may be substantially underestimating the future impact of resistance. In addition, she highlighted that understanding how insecticide exposure affects vectorial capacity is critical to predicting the expected impact of pyrethroid resistance on the effect of LLINs. In conclusion, she stressed that the global community cannot afford to be complacent about the increase in insecticide resistance despite the lack of evidence of wide scale impact on the personal protection provided by nets.

### **“New medicines for the control and elimination of malaria” – Dr Timothy Wells, Medicines for Malaria Ventures (MMV)**

Dr Timothy N.C Wells is the Chief Scientific Officer of Medicines for Malaria Venture (MMV), a product development partnership (PDP) in the field of antimalarial drug research and development. MMV works with academia, industry, the private and public sectors, scientists, and medical practitioners to catalyse the discovery, development and delivery of new, child-friendly medicines.

Dr Wells reported that over the past two decades, MMV has been involved in the development of seven new medicines. He also emphasized the need to keep focusing on new treatments and protective measures against malaria. He explained that even though we currently have artemisinin-based combination therapies (ACTs), which are still working, we must be ready by having a new generation of drugs when ACT-untreatable malaria hits. MMV is, therefore, working on the development of new therapies and aims to have developed new non-artemisinin combinations treatments for severe malaria by 2024.

Finally, Dr Wells stated that it is imperative to ensure the optimal use of the current tools if we are to drive down both the incidence and transmission of malaria.

*Reported by Camila Damasceno*

### **Symposium: “Approaching elimination in Africa using population-wide interventions: lessons from the field”**

**Elizabeth Chizema**, from the Zambian National Malaria Elimination Center and the symposium chair, outlined the session talks focusing on recent results and lessons in the field from the implementation of population-wide interventions for malaria elimination, especially Mass Drug Administration (MDA)

campaigns in Sub-Saharan Africa. Ways to optimize these interventions for future impact were also considered.

**Mame Birame Diouf**, from the President's Malaria Initiative/USAID, talked about the "Scale Up For Impact (SUFI) impact assessment: optimizing implementation" in Senegal, where successful scale up of core interventions has resulted in a malaria burden reduction from 24% in 2006 to 4.3% in 2017. In transitioning from control to elimination in Senegal, where SUFI implementation has been deployed and appropriate approaches adopted, the Ministry of Health has introduced new strategies like free care for children less than 5 years old and providing health insurance to the others. The final phase in SUFI implementation would involve re-orientation of the system to develop a more responsive and proactive system.

**Duncan Earle**, from MACEPA, shared the Zambian experience in his talk "Population based interventions for elimination: information and evidence driving decisions". Using data from 10 years of malaria indicator surveys, he showed how the programme had witnessed a progressive reduction of malaria in the whole country, especially in Southern Province, where more aggressive interventions have been used, such an MDA trial conducted in 2014-16. Before that, reactive case detection was implemented and the number of community health workers was increased to improve access to treatment. In the MDA trial, prevalence of infection was significantly reduced to very low levels, after which MDA was implemented in programmatic mode targeting the highest transmission health post catchment areas in a larger area. The malaria incidence trend in the last years has been heterogeneous, with some areas reaching very low levels of transmission, others going up and down, and a few where transmission has remained relatively high. Future questions include understanding the factor explaining this heterogeneity: scope of MDA coverage, optimal timing and number of rounds, and understanding of persistent burden in certain localities as well as reassessment of index case management.

**Beatriz Galatas**, from ISGlobal and CISM, spoke about the Magude Project, which aims to investigate whether malaria transmission can be interrupted locally in a rural African setting with moderate transmission (10% prevalence) after an annual round of IRS plus two MDA rounds with dihydroartemisinin-piperaquine (DHAP) in the Magude District of Mozambique. The baseline malaria prevalence by microscopy was 7%, 9% by RDT and 12% by PCR. Two years after the implementation of the interventions, the districts experienced an 89%, 71% and 61% reduction by microscopy, RDT and PCR respectively. Additionally, the intervention resulted in a 60.6% reduction of the expected passively detected cases between 2015 and 2018, but transmission was not interrupted.

**Adoke Yeka**, from Pilgrim Africa, presented on the "Impact of population based Indoor Residual Spraying (IRS) in combination with mass drug administration (MDA) on key malaria indicators in a high transmission setting in north eastern Uganda". Preliminary results demonstrated achievement of high coverage, significantly greater reduction in prevalence of infection in the arm with combined IRS and MDA compared to the other two arms (IRS+LLINs and LLINs only), and reduction in *Anopheles* numbers with good acceptability by the community.

**Hannah Slater** from Imperial College gave the final talk by showing predictions from mathematical models. The models predicted that MDA could reduce transmission, prevalence and incidence rapidly, but is unlikely to sustain gains without other measures in place, especially in the context of high importation. She concluded her talk by calling for need of further understanding of how to maintain the gains in MDA taking into consideration the local epidemiology, and that it is easier in low transmission settings.

*Reported by Shehu Shagari Awandu*

**Symposium: “Empowering African institutions and future malaria research leaders through capacity development and partnerships”**

This symposium was organised by the European & Developing Countries Clinical Trials Partnership (EDCTP) and was chaired by **Prof. Godfrey Tangwa**. The objective of the symposium was to raise awareness of opportunities and challenges of capacity development and networking in key areas of clinical research in Africa. Apart from sharing experiences, participants discussed solutions that can be adopted to address issues arising in their respective fields.

**Michelle Nderu**, project officer at the EDCTP, gave an introduction of the EDCTP activities and funding opportunities. She talked about the North-South collaborative programme, clinical research activities and regional networks of excellence. **Prof Abdoulaye Djimde**, from the University of Science, Techniques and Technologies of Bamako, Mali, received grants from EDCTP. He shared his project experience and highlighted several challenges that he had to overcome.

**Prof. Kamija Phiri**, from the College of Medicine, University of Malawi, talked about getting research into policy through the formulation of an Evidence-informed Decision-making Network (EviDeNt) and **Prof. Margaret Gyapong**, Director of the Centre for Health Policy and Implementation Research of the University of Health and Allied Sciences in Ghana, addressed the opportunities and challenges in linking research with policy. She pointed out that policy makers will likely not be able to use research results if they don't speak the same language as researchers. She also suggested that researchers need to translate their work in lay-man's language and explain the relevance of their work for society at large.

**Prof Ayola Akim Adegnika**, from the University of Tübingen, presented the challenges they are facing with the Malaria Drug Surveillance activities in CANTAM2 (Central Africa Network on Tuberculosis, HIV/AIDS and Malaria 2), a network of five established and two developing institutions in Central Africa. He highlighted the importance of data sharing and the importance of collaboration between community, stakeholders, researchers and health workers. He finished his talk by stressing that sharing information with the population is crucial.

Finally, **Dr Christiane Druml**, UNESCO Chair on Bioethics at the Medical University of Vienna, talked about empowering African institutions and future malaria research leaders through capacity development and partnerships. She highlighted the following UNESCO recommendations: building partnerships between scientific communities of developed and developing countries; bilateral and multilateral agreements that enable developing countries to build capacity; and the sharing of scientific knowledge.

*Reported by Helena Martí Soler*

**Symposium: “*Plasmodium vivax* in sub-Saharan Africa”**

In recent years *Plasmodium vivax* has been shown to be a problem in many parts of Africa. So far, there is no vaccine against any malaria parasite, but the *P. vivax* vaccine development looks promising. In this symposium, leading and young scientists shared their stories about *P. vivax* in Senegal, Mali, Botswana, Cameroon, Namibia, Ethiopia, Sudan, and Madagascar.

**Chetan Chitnis**, a specialist in vaccine development against *P. vivax*, presented on the development of a vaccine against the blood stage of *P. vivax*. In their study, participants with *P. vivax* Erythrocyte-



Binding Protein (PvEBP) antibodies showed lower risk of infection compared to control participants and control *Plasmodium falciparum* infections.

**Didier Menard**, from the Institute Pasteur, found an expansion of certain genes that may be selected by *P. vivax* to make infection possible. The study was conducted in Madagascar and aimed to define invasion pathways of *P. vivax*, study polymorphisms and look at immune responses.

*P. vivax* was also described as a problem in Mali. **Ogobara Doumbo**, from the University of Bamako, discussed his findings on *P. vivax* in a Duffy negative area and the potential association to anaemia in children. In that setting, *P. vivax* infections were only found with a low parasite density of less than 200 parasites per  $\mu\text{L}$ . Further studies are on-going to ascertain the findings.

**Makhtar Niang**, from the Institute Pasteur Dakar, talked about a two-year follow up study with schoolchildren to assess Duffy status, serological and molecular prevalence and origin of infections, after having found *P. vivax* infections in febrile illnesses in south-eastern Senegal. The follow up study revealed unexpected high circulation of *P. vivax* and high proportion of chronic *P. vivax* infections in asymptomatic Duffy negative children.

**Eugenia Lo**, from the University of California – Irvine, addressed the *P. vivax* infection in Duffy negative individuals in Ethiopia and Sudan, by conducting genome sequencing and gene duplication analysis. The main findings were high *Plasmodium vivax* Duffy Binding Protein (PvDBP) copies of *P. vivax* in Duffy negative individuals and multiplication several times independently.

The question whether *P. vivax* infections in Duffy negative populations were previously missed or whether *P. vivax* had adapted to infect Duffy negative individuals was raised by **Giacomo Paganotti**, from the Botswana-University of Pennsylvania Partnership (BUP), after presenting findings of a study in Cameroon. After the finding of substantial *P. vivax* infections in Cameroon, next steps include looking at genotyping to identify circulating strains and exploring how *vivax* may circulate in Duffy negative populations.

The importance of actively looking out for infections for all species and in the appropriate populations within the host and epidemiological areas was emphasised by **Isaac Quaye**, from the University of Namibia.

During the session, multiple speakers highlighted the need to include *vivax* in their agenda to achieve the goal of malaria elimination.

*Reported by Manuela Runge*

### Gala dinner

The day finished off by gathering old and new friends around the table to share experiences and discuss the answers (and also questions) that have been raised throughout the three days of the conference. White round tables facing a colourful stage were the perfect starting point for the night. Food was served and traditional music, fire-breathing and dancing engaged the audience making it hard to stay seated. The MIM organizing committee honoured key members of the malaria community, and a local singer energized the audience and moved them to the dancefloor. Youssou N'Dour then closed the night with a memorable performance which ended with several participants on the stage.

*This blog was written by Camila Damasceno (Independent Consultant), Manuela Runge (Swiss TPH), Shehu Shagari Awandu (Radboud UMC) and Helena Martí Soler (ISGlobal) as part of the MESA Correspondent program, and is cross-posted on the MESA website and Malaria World.*

## Day 4: Thursday, April 19<sup>th</sup>

### Plenary Session:

The plenary session was chaired by **Prof. Ogabara Doumbo** of MRTC, Mali who introduced the speakers.

#### **“From parasite biology to T cells to African infants to genome editing and back: toward licensure of the first and future generations of live parasite *Plasmodium falciparum* sporozoite (PfSPZ) vaccines”**

A fully compliant vaccine product with clinical safety, tolerability and efficacy is needed for licensure according to **Dr. Stephen L. Hoffman** of Sanaria. The *Plasmodium falciparum* sporozoite (PfSPZ) vaccine is aiming to be the first human infectious disease vaccine. Delivering the first plenary talk focusing on the protection offered by the PfSPZ vaccine across multiple clinical trial sites, Dr. Hoffman reflected on the journey of the vaccine development while offering insights from the past and future plans. The aseptic, purified, vialled cryopreserved PfSPZ Vaccine protects through T cell responses that recognize both homologous and the heterologous strains of *P. falciparum*. The PfSPZ vaccines are distributed internationally in liquid nitrogen vapor phase and administered by direct venous inoculation, which have key advantages over traditional cold chains and methods of administration. More than 1,800 subjects have received >5,000 injections of PfSPZ-based products in >30 clinical trials in the U.S, Europe and Africa, with a trial in Indonesia planned for 2018. Dr. Hoffman highlighted that from these clinical trials, promising results and protection have been observed with the goal of demonstrating that the PfSPZ Vaccine can be used to eliminate malaria in geographically defined areas where transmission has been reduced by other control measures.

Highlighting the roles played by MIM on the developmental journey of the promising PfSPZ Vaccine, Dr. Hoffman remarked that the vaccine was a product of the first MIM conference with several African scientists now playing key roles in the vaccine trial advisory board. In addition, African governments namely those of Equatorial Guinea and Tanzania, have provided funds for some of the vaccine initiatives.

Further, with the recognition that improved next generation PfSPZ-based vaccines could be more efficacious than the current versions, innovations for second and third generation vaccines are ongoing. These include genetically attenuated PfSPZ, in vitro produced PfSPZ which negate the need for mosquitoes, as well as mosquitoes genetically altered to incubate higher numbers of PfSPZ. Clinical trials are currently ongoing in the Netherlands with first injectable genetically attenuated (GA) PfSPZ vaccine. He finished his talk by observing that fighting the malaria parasite was a huge challenge and plenty more needed to be done.

*Reported by Shehu Shagari Awandu*

#### **“Progress with malaria chemoprevention in endemic countries since 1997”**

**Sir Brian Greenwood**, of LSHTM, presented lessons learnt from the use of antimalarial drugs in areas where malaria is endemic. He also discussed future challenges and opportunities for malaria control in Africa. He began by stating that back in 1997, when the first MIM meeting was launched; antimalarial medicines were hardly used because there was a general concern about impairment of immunity, drug resistance, lack of a delivery system, and costs. Since then, intermittent preventive treatment of malaria in pregnant women (IPTp), in infants (IPTi), and in children (IPTc), have been developed and tried in different settings. The concept of chemoprevention as used today combines the features of chemoprophylaxis, mass drug administration and intermittent preventive treatment.

The first chemopreventive strategy to be recommended by WHO in 1998 was IPTp with sulphadoxine pyrimethamine (SP). Since then it has been used widely and has contributed significantly to reductions in maternal anaemia, low birth weight and neonatal deaths.

IPTi had a much smaller uptake than IPTp, resulting in only moderate impact on the overall malaria incidence. The lower uptake was partly because of restrictive WHO recommendations, lack of the forward push from within Africa, and the age shift of malaria in children from under-fives to older ages. The application of seasonal chemoprevention (SMC) however addressed these age shifts, by targeting older children, and showed substantial reductions in malaria prevalence when deployed through national malaria control programs.

According to Sir Greenwood, there are however still major challenges ahead of us, such as achieving high coverage, sustaining financial support and finding a replacement for the current drug of choice, i.e. sulphadoxine pyrimethamine (SP). Additionally, he stressed the need for the inclusion of older children in SMC and of pregnant women in MDA.

He concluded his presentation by emphasizing that chemoprevention tools could have significant potential, but also stressed the need to combine chemoprevention with other health interventions, based on scientific evidence. The development of long-acting drugs for chemoprevention would provide new opportunities to protect people against malaria.

*Reported by Manuela Runge*

#### **Symposium: “Monitoring Plasmodium diversity for malaria elimination in Africa: Progress and updates from the Plasmodium Diversity Network Africa”**

Four experts presented progress and updates on the activities and programmes that are implemented by the *Plasmodium* Diversity Network Africa (PDNA).

**Prof Abdoulaye Djimde**, of the University of Science, Techniques and Technologies of Bamako, Mali was the chair of this symposium and introduced the PDNA: A Pan-African network of researchers from 15 institutions. The aim of PDNA is to build the capacity of African researchers in genomics and bioinformatics for handling big-data, which is currently generated through on-going genomic studies. This network also generates new knowledge that, in close collaboration with the National Malaria Control Programme, will contribute to strategies for malaria elimination and eradication.

**Prof Marielle Bouyou**, from the Université des Sciences de La Santé, Gabon, highlighted the strength of the PDNA network to determine the diversity of malaria parasites in sub-Saharan Africa, and to use this data to inform malaria control policy makers.

**Dr Milijaona Randrianarivojosia**, from the Pasteur Institute of Madagascar, talked about the status of Artemisinin (ART) resistance in Africa. He concluded that ART resistance in Africa may involve additional mutations than the K13 mutations. He also provided evidence that the delayed parasite clearance seen in some African countries is not associated with the pfK13 mutations, the molecular marker for ART resistance.

**Dr Alfred Amambua Ngwa**, from The MRC Unit, the Gambia, and the LSHTM, presented ideas for exploring and developing new approaches to mine data from PDNA affiliated sites. In particular, he highlighted the potential use of optimised clustering by machine learning, the detection of ancestry and parasite flow, and the detection of markers of adaptation to interventions. He also raised some questions such as why some individuals are more susceptible to malaria than others, or why and how drug resistance develops. He further raised the need to improve methods for tracking the spread of

drug resistance across sub-Saharan Africa. At the end of his talk, he emphasized the need to continue to engage African scientists in these efforts to monitor the diversity of malaria parasites in Africa.

*Reported by Helena Martí Soler and Camila Damasceno*

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## Day 5: Friday, April 20<sup>th</sup>

### Plenary session:

The plenary speakers were introduced by **Professor Oumar Gaye** from the University Cheikh Anta Diop, Senegal, and President of the MIM Organising Committee.

#### **“When will we have a Licenced malaria vaccine?”**

**Prof Adrian Hill**, Director of the Jenner Institute at Oxford University, UK, explained that a deployable multistage-subunit vaccine that combines sporozoite stages, liver stages, and mosquito stages is currently in development.

Such a multistage vaccine approach would provide higher efficacy, protect the vaccine against parasite escape mutations and would allow for host heterogeneity in immune responses. Besides, the vaccine would also be advantageous for both disease prevention and transmission reduction. While the most advanced malaria vaccine to date, the RTS,S vaccine, had demonstrated up to 36% efficacy over 3-4 years in children 5-17 months of age, the immunity waned rapidly and would need a booster dose. He stressed that the next phase of the RTS,S would need to consider the safety issues, such as the increased all cause female mortality in vaccinees, before the new target licensure in endemic areas by 2024. He opined that while the quest for whole sporozoite vaccine had shown promising results and could even be licensed before the RTS,S vaccine, several challenges still remain, notably the high costs of manufacture, the need for cold chain storage, and the modest efficacy in African adults.

Prof Hill showed the results of a subunit vaccine, the R21. The R21 has shown 100% efficacy in mice and is highly immunogenic for only circumsporozoite (CSP) repeat region, in contrast to RTS,S, which is highly immunogenic for both CSP repeat and hepatitis B surface antigens. Phase I/II trials of the R21/Matrix-M have shown good safety profile in >1,500 subjects, and the vaccine is less costly to manufacture and has better potential in younger infants. The R21 clinical development plan that includes trials in endemic African populations are under design with target licensure in 2023. Prof. Hill further shared results of *P. falciparum* RH5 and its improvement RH5.2, which has shown the first blood stage efficacy as assessed by controlled human malaria infections (CHMI). The goal for RH5.2 vaccine development program involves improving its immunogenicity, the quality of vaccine-induced IgGs and identifying additive or ideally synergistic antigen combinations. On transmission blocking vaccines, he outlined some of the leading parasite candidates expressed both in the vector and in the host.

He concluded his talk by focussing on prime target vaccination that requires priming intramuscular immunisation followed by an intravenous boost to target the liver. The approach induces high levels of resident memory T cells in the liver, with a markedly increased preclinical malaria vaccine efficacy.

#### **“Challenges and Perspective in Ending Malaria - Drug Resistance”**

Despite the serious emerging and real threat of drug resistant parasites, the malaria community does not need to panic, according to **Prof Christopher Plowe**, the Director of Duke Global Health Institute, Duke University, USA. It is not gloom and doom as the artemisinin-based combination therapies (ACTs) still remain efficacious in most of the Greater Mekong Sub-Region, the epicentre of reported artemisinin resistance. In addition, in Africa artemisinin resistance has not taken hold yet and the genetic background of ACT resistant “strains” is vulnerable to recombination after spreading to higher transmission zones.

In the past 20 years, drug resistance research has included identifying the genetic determinants of resistance to chloroquine, antifolates, artemisinins, and several ACT partner drugs. The time from initial appearance of resistance to identifying resistance markers has shortened from decades for chloroquine to a few years for artemisinins, to having candidate markers in hand for new drugs before they are even deployed. This progress is attributable in part to technological advances in genome sequencing, as well as genetic and in vitro manipulation of malaria parasites. Better and earlier integration of these basic sciences with field epidemiology has also accelerated the identification and validation of resistance markers.

Genomic epidemiological evidence that a “tsunami” of artemisinin resistance was both spreading transnationally out of Cambodia and emerging independently in multiple locations contributed to the decision to launch an aggressive malaria elimination campaign in the Greater Mekong Sub-Region. Mathematical modelling of resistance and of interventions aiming to mitigate resistance has also influenced malaria drug treatment and prevention policies.

While questions remain on how to monitor resistance when malaria becomes rare, Prof Plowe shared details of a novel ultrasensitive method that uses small volumes of blood and is amenable for large scale molecular surveillance monitoring of drug resistance, especially in eliminating countries. He emphasized that for maximum impact, drug resistance research must continue to cross barriers between basic and applied sciences and between the cultures of research and of program implementation and policymaking. An “all hands-on deck” approach that calls for interdisciplinary research that integrates not just genomics and epidemiology but vector biology, health economics, social, environmental, and political sciences, and healthcare inequalities and health systems research is necessary.

*Reported by Shehu Shagari Awandu and Helena Martí Soler*

### **Symposium: “Environmental Compliance Concerns and Solutions that Arise from Malaria Control via Indoor Residual Spraying (IRS)”**

Indoor residual spraying is a widely used intervention for malaria control. The safe handling, deployment and adequate disposal of insecticides require local solutions according to international recommendations.

**Dr Yemane Yihdago**, of AIRS Ghana, Abt Associates, presented their experience with the recycling of organophosphate insecticide bottles used during indoor residual (IRS) campaigns. The project aimed to free storage space for the following campaign-season and to avoid risks to humans, animals, and environmental contamination. As a result, final products such as garbage bins and pavement blocks confirmed as non-hazardous, are being produced in at least 12 countries where IRS is conducted. This project managed to achieve savings on transport and incineration and showed a positive impact on the environment.

**Dr Peter Chandonait**, Director of Environmental Compliance and Safety of the PMI AIRS project showed how secondary package cardboard cartons of insecticides from IRS campaigns in Rwanda are recycled into greeting cards. The boxes are not insecticide contaminated and are donated to Cards from Africa, a fair-trade and socially committed company in Rwanda.

**Tahina Masihelison**, Environmental Compliance Officer from Abt Associates, presented a mobile Soak Pit for environmental compliance during IRS campaigns. He stated that the building and maintenance of facilities for IRS equipment cleaning in remote areas is difficult, thus innovative technologies are needed. Mobile Soak Pits were designed as a transportable, easy to install and effective replacement

for fixed pits, ideal for travelling teams. This approach enhances the safety for IRS operators with minimum environmental impact.

The last presentation illustrated how countries can deal with large quantities of unused insecticides. Ethiopia had previously had to deal with tons of obsolete DDT, years after identifying mosquito resistance to DDT back in 2010. The management of large amounts of DDT in Ethiopia was presented by **Yohannes Ameha**, Senior Environmental Health Expert from the Ethiopian Ministry of Environment. Due to risks and costs of other disposal options, Ethiopia opted for transboundary transportation to a licensed incinerator. The project resulted in the safe disposal of 119 tons of DDT and contaminated waste.

*Reported by Camila Damasceno*

### **Symposium: “Progress in Malaria Transmission Blocking Vaccine Development”**

The progress of candidate transmission blocking vaccines (TBV) development with the focus on *Plasmodium falciparum* antigens Pfs230, Pfs25 and Pfs48/45, was discussed. Results from recent clinical trials as well as approaches to measuring TBV activity in mosquitoes were presented in the perspective of bringing TBVs into use in Africa.

**Dr Ashley Birkett**, from the PATH’s Malaria Vaccine Initiative, set the stage for the rest of the talks and also gave the final presentation, highlighting past progress and current challenges. Remarkable progress has been made in overcoming challenges, such as scalability of manufacturing and formulation of priority antigens, pre-clinical antibodies and their predictive value, and the generation of human proof of concept data. However, more needs to be done to bridge "lab" and "field" transmission measures. Humanized monoclonal antibodies may be a promising approach for bridging that gap when addressing field efficacy in the perspective of heterologous protection, and durability of protection for at least two years.

**Dr Mamadou Coulibaly** from MRTC/USTTB, presented novel approaches to measure the activity of transmission blocking vaccines in the field. Lab evaluation methods of TBV activity include standard membrane feeding-assays (SMFA) and direct membrane feeding assay (DMFA) with direct skin feeding (DSF) being tested as a new approach in the field. In Mali, already 9,000 DSFs have been conducted since 2011. Community consent and safety precautions in mosquito rearing were identified as critical aspects of the studies. DSF was found to be safe and well tolerated but with low infectivity. Work is on-going to optimise the approach. In order to do so, experimental huts in near natural settings are used as well as community malaria transmission studies.

**Prof Robert Sauerwein**, from the Radboud University Medical Center, talked about preclinical development of Pfs48/45 vaccine candidates. The development of R0-6C looks promising, with established upstream production of research cell banks and downstream purification. Work is on-going for the optimization of immunogenicity. In the coming years, a cell bank for manufacturing according to good manufacturing practice as well as potency and toxicity studies will be established, and clinical trials will start in healthy volunteers.

**Dr Patrick Duffy** from the Laboratory of Malaria Immunology and Vaccinology, NIAID/NIH presented results on US trials of Pfs25 and Pfs230 vaccine candidates. They compared functional antibody activities of Pfs25 and Pfs230 alone as well as in combination. The results have shown no difference on the activity of Pfs25 and Pfs230 conjugates in mice but differences in non-human primates (NHP). Moreover, Pfs230D1 was found to be superior to Pfs25 for inducing functional activity and the

combination with Pfs25 may not enhance the activity. Overall, the clinical trials are addressing key translational goals and are contributing to bridging the gap between the lab and the field.

**Prof Issaka Sagara** from the Malaria Research and Training Center (MRTC); USTTB Bamako, has investigated Pfs25 and Pfs230 and their combination in field trials in Mali since 2013. Immunogenicity and activity were assessed using SMFA, while DSF was used to explore activity further. Results showed that Pfs25 and Pfs230 were both well tolerated with antibody responses in almost all subjects (Pfs230 greater responses than Pfs25).

TBVs will require mass administrations to achieve herd immunity in order to reduce the incidence of infections in a community at high levels. According to the experts, in combination with other tools, they could potentially play an essential role in malaria elimination and eventually eradication.

*Reported by Manuela Runge*

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