



6th PAMCA Annual Conference & Exhibition

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from the 6th PAMCA Annual Conference & Exhibition.*

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Hilton Hotel, Yaoundé, Cameroon

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reporting of the sessions.*



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Day 1: 23rd September 2019

Opening Ceremony

Dr Antonio-Nkondjio Christophe (Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale, OCEAC) chair of the local organizing committee, opened the stage of this 6th Pan-African Mosquito Control Association (PAMCA) Annual Conference organized for the first time in Yaoundé, city of 7 mountains, Cameroon, Central Africa. Dr Christophe emphasized the need to break down the deadly cycles of the vector-borne diseases (VBDs) as one of the prerequisites to achieve economic prosperity in Africa. This conference provides a platform to enable the exchange of knowledge, capacities, and actions and face the challenges to foster the elimination of VBDs in Africa.

PAMCA president **Prof Charles Mbogo** (Kenya Medical Research Institute, KEMRI, and University of Nairobi, Kenya) expressed a very warm welcome to all conference participants and took the opportunity to recapture the PAMCA vision of an "Africa free of vector-borne diseases." With about 350 participating delegates, this 3-day event follows two pre-conference workshops: The Gene Drive Technology Training Course and the Women in Vector Control Workshop. These workshops served to equip young African scientists, especially women, with effective tools to enable them to play their rightful role in the control of VBDs in Africa. Prof Mbogo concluded that "one of the key drivers of PAMCA is to comprehensively develop vector surveillance in one voice, in one action to combat vector-borne diseases - we do not want to continue working in isolation, but in unison."

James Newell spoke on behalf of Dr Prosper Chaki, PAMCA Executive Director, and reminded the audience of the necessity to build entomological capacities, robust systems and to use appropriate management systems that can enable the African continent to respond effectively to VBDs.

Dr Phanuel Habimana (WHO Cameroon Representative) emphasized the tremendous burden imposed by VBDs in Africa with malaria-causing the highest burden.

Finally, **Dr Manuel-Nso Obiang** (OCEAC Executive Director) presented OCEAC's facilities and its technical platform. These assist central African countries in their fight against infectious and vector-borne diseases through health policy development, research and training, and health emergency management and responses.

After being treated to a taste of the Cameroonian cultural dance by the University of Yaoundé musical group, **Prof Joseph Lebel Tamesse**, the representative of the Minister of State Higher Education, presided over an award ceremony to recognize 15 outstanding scientist/researchers. This was followed by a group photo, a stunning musical performance, and an official opening address by Prof Tamesse.



Keynote address

Prof Charles S. Wondji (Liverpool School of Tropical Medicine, UK and Centre for Research in Infectious Diseases, Cameroon, ED CRID and Wellcome Trust Senior Research Fellow in Biomedical Sciences) highlighted the current challenge of genomic evolution of insecticide resistance facing pyrethroid-based interventions of malaria vectors. He cited over-reliance on a single class of insecticides, the pyrethroids, as a major cause of resistance that necessitates the diversification of control tools and strategies. He further emphasized the need for molecular markers for the detection of insecticide resistance in the major malaria vectors in Africa (*An. gambiae* and *An. funestus*). Additionally, the operation of resistance management strategies early enough will help to manage the spread of insecticide resistance. New approaches are also needed beyond IRS and LLNs to reduce malaria transmission, for instance, genetic approaches such as CRISPR-cas9 and gene drives; and capacity development through training of the next generation of African researchers on mosquito-borne diseases control.

The opening session was also graced by the presence of **Rodger Milla**, the PAMCA goodwill ambassador. Mr. Milla is a former Cameroonian footballer, and his passion for malaria stems from his personal experience as a victim of the malaria scourge.

Plenary session 1

Prof Yeya Touré (Retired from WHO/TDR and Malaria Research & Training Centre (MRTC), Mali) mentioned the lack of progress in malaria control in recent years in general and the vector control challenges with respect to achieving malaria elimination, in particular: to achieve high ITN/LLINs and IRS coverage, and to address insecticide resistance that is spreading across Africa. Prof Touré explained that, in 2016, the WHO identified 21 countries with the potential to eliminate malaria by 2020, christened the E-2020 goal. Currently, 11 of these countries are on track to achieve elimination, but ten countries are off-track. The WHO adopted a new “high burden to high impact” approach that complements the E-2020 goal. In concluding, he highlighted the need to optimize current vector control strategies, strengthen integrated vector surveillance and enhance multi-sectoral collaboration to move closer towards malaria elimination.

Dr Didier Fontenille (Institut de recherche pour le développement, IRD, France) took the participants through mosquito biology, ecology, and control. Particularly, he focused on dengue fever viruses and the *Plasmodium* parasite; these pathogens are transmitted by vectors that have different genetic structure. As such, it is difficult to use one control strategy to target all the vectors. Effective mosquito vector control should, therefore, take into consideration different ecological settings, evolution and public health risk. He challenged participants to think globally and act locally.

Prof Hilary Ranson (Liverpool School of Tropical Medicine, UK) provided an overview of the current status of malaria burden in Burkina Faso. This country still bears a high malaria burden despite high coverage and use of bed nets. A longitudinal study in Burkina Faso revealed presence of pyrethroid resistance and poor health-seeking behaviour of adults. The highlight of the talk was the need for a multidisciplinary approach in malaria control.

Parallel session 1: Harnessing research capacity in Africa to empower national programs

Agapitus Kato (Ministry of Health Uganda, Uganda Virus Research Institute) demonstrated how the design of cost-effective and scalable implementation systems for larviciding policies could reduce malaria transmission in Uganda, especially in large populations. **Jessy Marlene Goupeyou-Youmsi** (University of Malawi and Institut Pasteur) talked about the susceptibility of *Anopheles* mosquitoes to *Plasmodium falciparum* and *Plasmodium vivax* infections in Madagascar. Her work demonstrated the need to monitor *P. vivax* infections in clinics and mentioned the potential for vector control to prevent both *P. falciparum* and *P. vivax* infections. **Elodie Vajda** (University of California San Francisco) discussed a novel Entomological Surveillance Planning Tool (ESPT) to improve vector-control decision-making. This tool provides national malaria programs with a decision framework for entomological surveillance planning, analysis of entomological data, and for measuring human behaviour associated with vector behaviour. **Mutale Chisanga** (Macha Research Trust, Zambia) showed how a reference laboratory that offers entomological services to other research institutes enabled Zambia to successfully support programmatic operations in the area of entomological surveillance. **Aurelie Prisca Yougang** (University of Yaoundé 1, Cameroon) presented a study about the susceptibility profile and mechanisms involved in insecticide resistance in populations of *Aedes albopictus* in Cameroon. **Efundem Agboraw** (Liverpool School of Tropical Medicine, UK) discussed a systematic review of the cost and cost-effectiveness of malaria control strategies and related health outcomes.



Parallel session 2: Mosquito genomics: progress and challenges

Nsa Dada (CDC, USA, KEMRI, Kenya) talked about microbiota-mediated insecticide resistance. Dada's study demonstrated significant differences in the bacterial composition and putative enzymes of resistant vs. susceptible mosquitoes. **Flore M. M. Kouamo** described a study outlining the role of GST genes in conferring resistance to pyrethroids/DDT, followed by **Tony Nolan** (Liverpool School of Tropical Medical, UK), who described a study detailing an improvement to the CRISPR-Cas 9 gene drive system, a mosquito genetic control that is being explored for mosquito population suppression and population replacement strategies.

Thabo Mashatola (National Institute for Communicable Diseases of the National Health Laboratory Service, South Africa) talked about a review of the progress of sex-separation techniques for sterile insect technique (STI) application against *Anopheles arabiensis*. **Alistair Miles'** (The *An. gambiae* 1000 genome consortium) presentation focused on the *An. gambiae* genome, specifically looking at single nucleotide polymorphisms (SNPs) and copy number variations (CNVs). Interestingly, Cytochrome P450 gene cluster is a CNV hot spot. Also, he explained how these genes can be exploited for surveillance/insecticide resistance management.

David Weetman (LSTM, UK) then talked about gene duplication and selection and how these processes can drive the spread of organophosphate resistance in African *An. gambiae*. **Keith R. Hayes** (The Commonwealth Scientific and Industrial Research Organisation, CSIRO, Australia) provided insights on risk assessment (e.g. effect on target organism, spread, and persistence, horizontal gene transfer) with respect to genetic control methods for malaria vectors.

Symposium 1: Guidance on stakeholder engagement principles to inform the development of area-wide vector control methods

New vector control approaches have led to a renewed focus on stakeholder engagement and consent. Area-wide interventions require a community-based approach. **Delphine Thizy** (Imperial College London, UK) discussed the importance of responsible and thorough stakeholder engagement during the R&D process. **Lina Finda** (Ifakara Health Institute, Tanzania) and **Damaris Matoke-Muhia** (Research Scientist, KEMRI, Postdoctoral Fellow, ICIPE, Kenya) discussed the need for alternative and supplementary strategies. **Lea Pare Toé** (Institut de Recherches en Sciences de la Santé, IRSS-Burkina Faso) explained the seven years community engagement with a release project of sterile male mosquitoes in Burkina Faso through step-by-step engagement, inclusive engagement, and transparency in the research.

Parallel session 3: Vector biology and control

Caroline W. Kiuru (Max plank Institute for Infection Biology, Germany) talked about the role of bacteria in mosquito growth and development. Using different *E. coli* mutants, she highlighted two different pathways that influence mosquito larvae development. **Etienne Fondjo** (Abt Associates, Cameroon) described how he used different approaches to assess insecticide resistance intensity in *An. Gambiae*. His work focused on four sentinel sites in Cameroon and selection of these sites were based on malaria transmission levels. **Delenasaw Yewhalaw** (Jimma University, Ethiopia) focused on pyrethroid resistance in malaria vector populations in Ethiopia. From his findings, he suggests that Pyrethroid-PBO nets should be incorporated in areas with pyrethroid-resistant mosquito populations. **Kenyssony Valera** (Abt Associates, Mozambique) presented a study conducted in Mopeia, Mozambique evaluating the impact of a third-generation IRS. The use of this product resulted in a reduction of *An. funestus*, both outdoor and indoor. **Theresia Nkya** (ICIPE, Kenya) presented the

experimental design of a project that assessed the feasibility and impact of community-based winter larviciding on malaria transmission in Namibia, Botswana, and Swaziland.

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Day 2: 24th September 2019

Plenary session 2

Dr Pierre Carnevale (Director of Research Exceptional Class, CE II, France) described a long-term comprehensive vector control project evaluating mosquito control in Balombo area in Angola. The vector control programme evaluated and compared the efficacy of 4 methods: the classical Long-Lasting Insecticide-treated Nets (LLIN) PermaNet® 2, Indoor Residual Spraying (IRS) and two models of the recently developed insecticide-treated plastic sheeting (ITPS). The results suggested that ITPS could usefully replace IRS. It is easier to implement and as efficient as IRS. The data were used to directly inform the national malaria control programme.

To close the gap between communities and their rightful access to healthcare, **Brian Gitta** (ThinkIT Limited, Uganda) presented Matibabu, an innovative medically non-invasive, cost-effective device for malaria diagnosis that detects malaria in 2 minutes. Matibabu can also assist in disease surveillance management. The prototype has been developed based on users experience.

Dr Bonventure Savadogo (Swiss TPH) discussed the burden of neglected tropical diseases (NTDs) that affect sub-Saharan Africa and the control approaches used in central Africa. He described the achievements in NTD control/elimination so far and highlighted significant achievements made in the control of Human African trypanosomiasis (HAT) and soil-transmitted helminths. He mentioned the shortage of donor funding as a significant challenge towards control and elimination of these diseases. The Swiss TPH recently started a project in collaboration with the Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC) to promote in-country control/elimination of NTDs through capacity building whereby PhD students are trained by experts.

Symposium 2: Strengthening the role of women in the control of vector-borne diseases

The chair of this session, **Dr Damaris Matoke** (KEMRI, Kenya) started an open dialogue on gaps and barriers that limit the participation of women in the control of VBDs. **Dr Theresia Nkya** (*icipa*, Kenya) opened the floor and shared her personal experiences in the field of vector control research in Africa. She mentioned some of the nicknames she was assigned as a woman in vector control to illustrate the challenges that women face. Even though Dr Matoke indicated that the number of African women holding leadership positions in vector control remains very low, she stressed that women have strong skills and capabilities. Hence, "If you want to get the job done, get a woman to do it." Afterwards, the participants were treated to a "Fireside chat" between **Ms Emma Orefuwa** (PAMCA co-founder) and **Dr Silas Majambere** (Director of Scientific Operations, PAMCA secretariat). As the only woman in the PAMCA board for the ten past years, Emma took us on her challenging PAMCA journey. **Dr Damaris Matoke** (KEMRI, Kenya) gave an overview of the dynamic pre-conference workshop on Women in Vector Control (WIVC). She emphasized how mentorship is the "key" to breaking barriers for women in vector control. This symposium ended with a panel discussion about the role of men in supporting women in research. This discussion was spearheaded by **Dr Neil Lobo** (University of Notre-dame, France) and **Ms Emma Orefuwa**.



Symposium 3: Target Malaria insectary and field entomology preparedness towards the 1st releases of genetically-modified malaria mosquito *Anopheles gambiae s.l*

The Target Malaria’s insectary and field entomology preparedness in Burkina Faso, Mali, and Uganda were the focus of this symposium. **Prof Frederic Tripet** (Keele University, UK) introduced the symposium by briefly describing the Target malaria project, its objectives and the stakeholders involved.

Dr Jonathan Kayondo (Target Malaria, Uganda Virus Research Unit (UVRI)) discussed the construction of a new arthropod containment level 2 (ACL-2) facility. The technology and development processes associated with genetically modified (GM) mosquito research need to take place in appropriate contained laboratories. The work in Uganda is still in its early stages, and there is a need to establish good practices. The new insectary incorporates a series of barriers that prevent mosquitoes from escaping. Appropriate cages, double closing doors, access restrictions, sealed windows, modified sinks and drains to prevent the escape of eggs; and the monitoring of escaping insects are all requirements of an ACL-2 facility.

Mr Moussa Namountougou (Target Malaria, Institut de Recherche des Sciences de la Santé, Burkina Faso) talked about the development of optimized rearing protocols for the maintenance of colour variants and genetically-modified *An. gambiae s.l.* strains in Burkina Faso. Major facility renovations, development of Standard Operating Procedures for risk management, staff training, and audits took place in preparation for a field release of GM mosquitoes. Mr Namountougou indicated that colour-variant backcrossing is the most critical activity in rearing genetically-modified mosquitoes. Rigorous planning and preparation of the insectary ultimately facilitated the authorization from Burkina Faso authorities for sterile male shipment, and ultimately a permit to allow the field release.

Prof Tripet described Target malaria’s stepwise approach to improve the release of genetically modified male mosquitoes. He highlighted the value of mark-release recaptures as a method to estimate the impact and improve the design and processes of future field releases.

Dr Florian Noulin (Keele University, UK) gave a presentation about the development of medium-throughput assays for post-release monitoring of GM mosquitoes. Individual and manual techniques can take a lot of time, and a more efficient technique is needed. Dr Noulin discussed several methods to speed up the analysis, such as pooling mosquitoes, novel mosquito grinding methods and loop-mediated isothermal amplification (LAMP).

Parallel session 4: Innovations in vector surveillance and control

Carmène S. Ngadjeu (OCEAC, University of Yaoundé 1, Cameroon) assessed how improved houses could limit the human-mosquito contact and help to reduce disease transmission. She suggested that the promotion of improved housing needs to be integrated into the malaria control strategy of the city of Yaoundé. **Piameu Michael** (OCEAC, Cameroon) delivered a talk on the LabDisk diagnostic tool – an automated, cost-effective diagnostic platform for improving vector surveillance. Validation of the tool is currently on-going in four African countries: Cameroon, Ethiopia, Zambia, and Ivory-coast.

John Lucas (Sumitomo Chemical Company) encouraged the use of Sumishield 50WG, prequalified by WHO in 2017, as a new insecticide for IRS. Sumishield is currently being used extensively throughout Africa, and studies indicate widespread field susceptibility against *Anopheles* mosquitoes. **Michael Coleman** (Liverpool School of Tropical Medicine, UK) gave a presentation on the development of a handheld device for quality assurance of IRS. This tool is yet to undergo a final field validation.

Yacouba Poumachu (OCEAC, Cameroon) described how a genetic sexing strain (GSS) has helped the mass production of *An. arabiensis*. Cytogenetics investigation of this strain is needed before the implementation of large-scale sterile insect technique (IST) programmes. The presentation by **Elijah Juma** (University of Illinois, US) focused on the impact of pesticides on the gut microbiota of mosquitoes (*Culex pipiens* L.). He discussed promising results showing that mosquito bacterial community composition is influenced by mosquito life stages and the immediate environment, but not by pesticide treatments.

Elias Miyituma (Rwanda Biomedical Center, Rwanda) explained that in the project study sites in Rwanda, *An. arabiensis* was the dominant species in the IRS sites because of its preference to feed on cattle rather than on humans. On the other hand, *An. gambiae* was found to be the primary vector in sites where IRS was not deployed. In areas where *An. arabiensis* is becoming the dominant malaria vector, regular treatment of cattle with insecticides could provide additional protection against malaria.

Parallel session 5: Adopting the One Health approach – breaking down silos

Ellie Sherrard-Smith (Imperial College, UK) presented about the benefits of larval source management for pyrethroid resistance. She also described the role of community engagement programmes that encourage environmental management to reduce mosquito populations. She further gave an account of how this method was successful in eliminating malaria in large parts of the world in the past. **Tovi Lehmann** (National Institutes of Health, NIH, USA) gave a presentation about the potential role of long-distance windborne vector migration in the spread of arboviruses. He reported a study where insects flying between 40 and 290m above ground level were sampled using sticky traps attached to helium balloons. The results suggested mean nightly migrations of up to 300km for 9-hour flight durations. The findings of this study have important implications for control and sampling methods.

Miss Fatou Fofana (RHD-LRR, The Gambia) talked about schistosomiasis, an acute and chronic disease. Common control methods include mass drug administration, health education, and environmental sanitation. Fofana summarised the prevalence of schistosomiasis in Minna community, Jarra central

district in the Gambia before and after a health education campaign in 2014. **Rousseau Djouaka** (University of Abomey, Benin) described a study about the link between agriculture and malaria transmission. His results show that λ -Cyhalothrin, a widely used insecticide by farmers in Benin, degrades in the environment and does not play a significant role in resistance selection in *An. coluzzii* populations. Additionally, copper residues present in breeding sites may be correlated with insecticide resistance evolution of malaria vectors.

Richard Oxborough (Abt Associates, USA) presented on behalf of Francis Wat'senga (Institut National de Recherche Biomédicale, DR Congo). He presented results from a nationwide study about pyrethroid resistance in mosquito populations at 11 study sites in DRC. Moderate and high-intensity resistance was recorded in several provinces using the WHO tube tests and CDC bottle assays. A widespread pyrethroid resistance to all the three pyrethroids (deltamethrin, alpha-cypermethrin, and permethrin) that are used on LLINs in DRC was reported. He recommended the use of next-generation nets (PBO or bi-treated nets) in DRC as an alternative to the pyrethroid insecticides.



Symposium 4: Vector control innovations to drive progress in malaria and other mosquito-borne disease control

This symposium focused on innovation in vector control tools and approaches for both *Anopheles* and *Aedes* control. Early findings of the scaling-up of new tools and the respective decision-making processes for malaria programs were also discussed.

Derric Nimmo (Innovative Vector Control Consortium, IVCC, UK) kicked off the symposium by explaining the role of IVCC as a product development partnership that helps companies and other innovators to deliver and develop novel insecticides and tools for vector control. He discussed several novel vector control tools, expressing a particular interest in attractive targeted sugar baits (ATSB) with reference to a multi-country trial currently taking place in sub-Saharan Africa. **Ingrid Etoke** (IVCC, UK) presented the New Nets Project, a partnership that aims to accelerate access to next-generation nets that use novel active ingredients. Access to these new resistance-breaking LLINs can be restricted by insufficient evidence to support policy recommendations and a lack of evidence on cost-effectiveness. Derric Nimmo described 2 cluster-randomized trials in Tanzania and Benin assessing three novel LLINs, with hut trials taking place alongside to establish entomological surrogates. Datasets from these trials will feed into a broader analysis of the cost-effectiveness of dual LLINs.

Andrew Saibu (IVCC, UK) presented the early results of the PMI VectorLink rollout of 3rd generation IRS (3GIRS) insecticides, Fludora Fusion, and SumiShield, as part of the NgenIRS project. NgenIRS is a 4-year Unitaid funded project that aims to increase the use of 3GIRS products in insecticide resistance management programmes. **Richard Oxborough** (Abt Associates, USA) later described new neonicotinoid-based IRS formulations that resulted in high mortalities in malaria vectors in Burkina Faso, Ghana, Madagascar, Mali, Mozambique, and Zambia.

Silas Majambere (PAMCA) described a spatial intelligence system for precision larviciding using drones and google earth engine. This system addresses some challenges associated with applying larviciding. The technology was trialled in Zanzibar in hotspots identified using routine malaria surveillance data. Phone-based weekly reporting was used to identify, access and monitor water bodies.

Eric Ochomo (Kenya Medical Research Institute, KEMRI, Kenya) discussed the results of a randomised controlled trial investigating high-dose ivermectin for malaria elimination (IVERMAL). The results suggested that ivermectin is a promising novel tool for malaria control that effectively kills mosquitoes that recently fed on human blood that contains ivermectin.

Lina Finda (Ifakara Health Institute, Tanzania) discussed the potential of eave ribbons as a complementary vector control intervention for low-income households. There are many cases in which IRS and LLINs are not sufficient for elimination. Ribbons are soaked in transfluthrin and placed in the eave spaces. Finda presented the results of an enclosed semi-field system study that indicated the potential for eave ribbons to protect against both indoor and outdoor malaria vectors.

Symposium 5: Enhancing entomological capacity in Africa for effective vector-borne disease control: prospects, challenges, and opportunities

In Africa lack of capacity to respond timely and effectively to increased VBD transmission is a major factor that aggravates the threat posed by these diseases.

Kevin O. Opondo (Medical Research Council Unit, London School of Hygiene and Tropical Medicine, The Gambia) gave a talk (on behalf of Fredros Okumu, IHI Tanzania) on ten barriers and ten practices for creating a productive ecosystem to support early-career health researchers in Africa. "Research leaders and administrators have the duty to create an enabling environment for early-career scientists so that they can effectively address priority health needs on a sustainable basis". **Abdoulaye Diabate** (IRSS, Burkina Faso) spoke about how to enhance entomological research capacity in sub-Saharan Africa. He also provided an overview of the future prospects of the ITECH-MTV Center of Excellence (ACE) in Burkina Faso. The final presentation was by **Chadwick H. Sikaala** and **Lesley-Anne van Wyk** (SADC Malaria Elimination & Secretariat). The duo gave an overview of the E8 Entomology Fellowship, a 5-steps program meant to equip young scientists from the southern African region with the dexterity to effectively support malaria control programs. Two of the E8 fellows also shared their personal experience on the dividends of participating in the fellowship.

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Day 3: 25th September 2019

PAMCA Symposium

Dr Silas Majambere (Director of Scientific Operations, PAMCA) spoke on behalf of PAMCA Executive Director Dr Prosper Chaki and provided an update about "PAMCA - Who we are and where we are." Silas elaborated on PAMCA's mission and vision; highlighted the eight registered country chapters with more than 250 active members, and presented data from a PAMCA study in 2017 on the entomological and institutional capacity in Africa. He also highlighted ongoing programmes currently being implemented by PAMCA including gene drive training, the women in vector control workshop, technical support to National Malaria Control Programmes (NMCPs) and the organization of annual meetings. The current PAMCA meeting had an attendance of 400 participants from 34 countries. Additionally, he outlined the PAMCA's plans for the next 3-5 years, such as the strengthening of the entomology capacity in Africa, vector surveillance, strategic collaborations with both local and international bodies, development of a support system for early-career entomologists, and a renewed focus on non-malaria vectors.



Industry update

Angus Spiers (Director of Innovation to Impact, i2i) gave an update of i2i, an initiative that promotes innovation, efficiency, and quality in vector control product development. In collaboration with all the stakeholders involved in developing and bringing new vector control tools to market, i2i identifies the shared obstacles and catalyses solutions. **John Lucas** (Sumitomo Chemicals) presented a new award, the Innovation in Africa Award, that aims to encourage young scientists to think creatively about vector control and foster stronger relationships between industry and researchers. **Justin McBeath** (Bayer) discussed market-dependent factors that affect the effectiveness of indoor residual spraying (IRS). He referred to trials that examine a novel product, Fludora Fusion. **Robert Vink** (Syngenta) presented a video that summarized the potential impact of a novel IRS chemical, Actellic 300CS, highlighting the perspectives of community members, researchers, and industry. **Justin McBeath** (RBM Partnership to End Malaria) gave an update of the Vector Control Working Group (VCWG); a platform that works to improve information sharing across countries and research groups.

Symposium 6: Introduction to the PIIVeC: Partnership for increasing the impact of vector control

Prof Charles Wondji (Liverpool School of Tropical Medicine, LSTM, UK and ED CRID, Cameroon) kicked off this symposium by introducing the PIIVeC as an international collaboration platform that brings together leading African research institutes and national disease control programmes to develop evidence-based solutions for integrated vector control in countries with a high burden of vector-borne diseases.

Prof Hilary Ranson (LSTM, UK) further explained the PIIVeC strategy that focuses on increasing the autonomy of institutions and facilitates knowledge translation to policy-makers. Thereafter, **Prof Philip J. McCall** (LSTM, UK), co-organizer of the symposium, gave the floor to the first cohort of PIIVeC African Research Career Development fellows for brief presentations about their research projects, preliminary results and the impact of PIIVeC on their careers.

Elisabeth Bandason (University of Malawi) provided projections on how disengagement influences the efficacy of vector control interventions in Malawi by studying mosquito physiology and behaviour. She also talked about her involvement in mentoring young scientists in Malawi.

Huguette Simo (CRID, Cameroon) presented the study design of a project that assesses the epidemiological risk of Chikungunya, Dengue, and Zika virus outbreaks in Cameroon. The study aims to unravel the incidence and prevalence of these diseases with the ultimate goal of supporting the national vector control programmes.

Hyacinthe Toé (National Institute of Public Health, INSP, Burkina Faso) gave a presentation about epidemiological surveillance of *Aedes* sp. in rural, urban and peri-urban areas of Burkina Faso. This study will benefit the country's vector control program on surveillance and control of *Aedes* transmitted diseases.

Evelyn Olanga (University of Malawi) presented the experimental design and the preliminary findings of a study that estimates indoor and outdoor malaria transmission in two districts in Southern Malawi.

Moving away from diseases transmitted by mosquitoes, **Lassane Koala** (Institut de Recherche en Sciences de la Santé, IRSS, Burkina Faso) presented a study that aims to develop efficient traps and targets for the xenomonitoring of the population of *Simulium damnosum* s.l. in the southwest region of Burkina Faso. This project aims to provide information about effective surveillance of black flies that cause river blindness disease.

On the same line, **Tito T. Melachio** (CRID, Cameroon) talked about the microgeographic structure, vector control and population dynamics of *Glossina palpalis palpalis* and its impact on human and animal trypanosomiasis in southern Cameroon. The study involves monitoring and surveillance of tsetse flies and assesses insecticide resistance development. The study will contribute to the elimination of sleeping sickness in Cameroon.

Jessica Amegee (LSTM, UK) gave a presentation about the contribution that PIIVeC makes in strengthening institutional capacity to conduct vector control research. She highlighted some of the common challenges that partner institutions face and the priority actions that PIIVeC takes to strengthen these institutions.

Chikondi Mwendera (LSTM, UK) outlined the role of PIIVeC in the establishment of technical vector control advisory groups (TVCAGs). The mandate of these TVCAGs is to advise in-country programmes

on vector control. He also presented experiences and opportunities of the TVCAGs from pilot countries.



Parallel session 6: Innovation in vector surveillance and control

Givmore Munhenga (University of Witwatersrand, South Africa) discussed mosquito surveillance in South Africa over a 5-year period that took place in preparation for a pilot sterile insect technique (SIT) intervention. The data will be used to predict how sterile males may disperse in a SIT release, and to select the appropriate field site.

The talk by **Michelle Stanton** (Lancaster University, UK) focused on the use of drones to identify *Anopheles* mosquito breeding sites. Knowledge of mosquito breeding sites is essential for identifying malaria transmission hotspots for targeted control. The “Maladrone study” is being carried out in Malawi and involves the use of quadcopter and fixed-wing drones.

Emmanuel N’dille (Centre for Research in Infectious Diseases, CRID, Cameroon) presented results from a study that indicates that expression of D7 salivary gland genes facilitate bloodmeal intake by mosquitoes. His study showed that pyrethroid resistance can influence bloodmeal intake in *Anopheles funestus* s.s., but not *An. gambiae* through overexpression of D7. Future studies will attempt to establish the potential impact on vectorial capacity.

Francesco Baldini (University of Glasgow, UK) delivered a talk on the use of Mid-Infrared Spectroscopy (MIRS) to predict mosquito traits such as age and species. The technology is based on mosquito cuticle composition and has the potential to significantly improve vector surveillance programmes.

Antoine Sanou (Centre Nationale de Formation et Recherche sur le Paludisme, Burkina Faso and University of Glasgow, UK) talked about biting and resting behaviours of malaria vectors in rural Burkina Faso following the scale-up of long-lasting insecticidal nets (LLINs). Results showed a long-term reduction in abundance but no evidence of long-term changes in biting behaviour.

Parallel session 7: Vector biology and control

Badolo Athanase (Université Joseph Ki-Zerbo, Burkina Faso) gave a presentation about a study of the bionomic variations and genetic diversity of *Aedes aegypti* populations from Burkina Faso. He characterized genotypic traits associated with resistance and recorded high pyrethroid resistance. He suggested that further genome sequencing research is needed to provide a clear image of *Ae. aegypti* bionomic and genetic links.

Basile Kamgang (CRID, Cameroon) presented findings of a study that confirmed the potential of *Aedes albopictus* and *Aedes aegypti* to transmit yellow fever in urban areas of Central Africa. Kamgang recommended collective efforts in vector surveillance. He called upon the public health authorities to intensify their efforts to control the domestic vectors and extend vaccine coverage to prevent major yellow fever outbreaks in future.

Parallel session 8: Vector biology and control

Dr Jennifer Stevenson (Macha Research Trust, Zambia and John Hopkins Bloomberg School of Public Health, USA) described outdoor malaria vectors in low and high transmission settings in Zambia. She highlighted the importance of outdoor sampling for surveillance; sampling at the right time when humans are present; and the inclusion of all mosquitoes to establish species composition.

Edmond Kopya (OCEAC and University of Yaounde 1, Cameroon) provided a broad overview of *An. funestus* research followed by a detailed presentation of results showing the impact of glutathione S-transferase (GST) resistance on *An. funestus* vector competence.

Prof Josiane Etang (OCEAC and University of Douala, Cameroon) talked about the insecticide resistance status and the underlying mechanisms governing deltamethrin resistance in *Anopheles gambiae* in Northern Cameroon. She collected mosquito larvae from 24 sites between 2011 and 2015. Because her research confirmed increased resistance of deltamethrin in *An. gambiae*, improved vector surveillance and insecticide resistance management strategies are urgently needed in Cameroon.

Olukayode G. Odufuwa (Ifakara Health Institute, IHI, Tanzania) presented on behalf of Sarah Moore (IHI) and talked about insecticide-treated net (ITN) evaluation in experimental huts vs. the Ifakara Ambient Chamber Test (I-ACT). Results showed that the I-ACT assay can be used to measure small effect differences between new products.

Booster talk: My thesis in 3 minutes

The final session of the PAMCA 2019 conference was a series of booster talks chaired by **Prof Flobert Njiokou** (University of Yaoundé 1, Cameroon). During this session, six Ph.D. students took the challenge to present their research activities in 3 minutes. This exercise featured talks on push-pull control strategies against mosquitoes, insecticide resistance status, genes and fitness cost on males' mating competitiveness, *Anopheles* life traits and vector competence, and the entomological risk of arbovirus outbreaks. **Amelie Wamba** (University of Yaoundé 1 and CRID, Cameroon) emerged as the winning student and was awarded the prize of the "Best presenter" by a multi-country jury panel.

Closing Ceremony

The closing ceremony began with invigorating music and dance performance by students from the University of Yaoundé I. This was followed by a brief talk by Dr Antonio-Nkondjio (President of the Local Organizing Committee, Cameroon) who captured the synopsis of the pre-conference activities and the main conference. Overall the conference attracted over 400 participants and featured over 250 presentations in the form of keynote speeches, oral presentations, and poster presentations. He expressed his gratitude to keynote speaker, Prof Charles Wondji, the plenary speakers, and members of the secretariat. PAMCA president, Prof Charles Mbogo oversaw the presentation of awards to best booster presentations, best poster presentations, and gave the closing speech marking the end of the 3-day PAMCA conference in Yaoundé, Cameroon. The musicians and dancers yet again lit up the room and encouraged delegates to join them to mark the close of the conference.

Poster presentations

The poster presentations are covered in the [abstract book](#) pp. 128-336



This report is brought to you by the MESA Correspondents Nathalie Amvongo Adjia, Joanna Furnival-Adams, Teresia Njoroge and Trizah Koyi with mentoring and editorial support from Elijah Juma & Silas Majambere (PAMCA).

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