Ifakara MasterClasses: Lessons from leading experts on the battle against malaria

Ilinca I. Ciubotariu[1]*, April Monroe[2,3], Nana Aba Williams[4,5], Sheila B. Ogoma[6], Fredros Okumu[3]*

[1] Department of Biological Sciences, Purdue University, West Lafayette, USA
[2] Johns Hopkins Center for Communication Programs, Baltimore, USA
[3] Ifakara Health Institute, Ifakara, Tanzania
[4] MESA Alliance, Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain
[5] Barcelona Institute for Global Health (ISGlobal), Hospital Clínic-Universitat de Barcelona, Barcelona, Spain
[6] PMI VectorLink Abt Associates, Nairobi, Kenya
* Correspondence: iciubota@purdue.edu (I. I. Ciubotariu), fredros@ihi.or.tz (F. Okumu)

Authors' ORCID and Twitter information:
Ilinca I. Ciubotariu, ORCID: 0000-0002-6549-0771, Twitter: @iliciub1
April Monroe, ORCID: 0000-0002-8959-6837, Twitter: @AprilCMonroe
Nana Aba Williams, ORCID: 0000-0003-3520-7573, Twitter: @NanaAbaWill
Sheila B. Ogoma, ORCID: 0000-0002-4063-6762, Twitter: @Ogoma_S
Fredros Okumu, ORCID: 0000-0003-2731-5654, Twitter: @Fredros_Inc

Abstract

Bringing together the global community is vital for continued progress in the fight against malaria. The Ifakara MasterClasses consist of discussions with experts that allow for applied understanding of specific subjects related to malaria control. They enable researchers, post-graduate students, National Malaria Program officials, and malaria advocates to engage in the same virtual room to share best practices in malaria control. In this *TrendsTalk*, the organizers, hosts, and some participant researchers present a synthesis of five key MasterClasses held to emphasize their mission of promoting essential scientific discourse on malaria and its control by bringing together world-leading experts to discuss technical knowledge and experiences with a wide audience.

Overview of the Ifakara MasterClasses

The Ifakara MasterClasses in public health and medical entomology provide a platform for world-leading experts in malaria and its control to share their technical knowledge and experiences with researchers, post-graduate students, National Malaria Program (NMP) officials, and malaria advocates. These classes are conducted in the form of informational interviews and conversations. The web conferences occur typically twice per month on Wednesdays or Thursdays, with approximately 150-350 people joining live by Zoom and asking additional questions via the chat box. All classes, starting from edition 16, were streamed live on YouTube [i].

Advance reviews of the experts' research are carried out and related works are compiled, and illustrative slides to anchor the discussions are created by the organizer and host Dr. Fredros Okumu (Ifakara Health Institute, Tanzania) and co-hosts, Dr. Nana Aba Williams (MESA, ISGlobal, Spain) and Dr. Sheila Ogoma (PMI VectorLink Abt Associates, Kenya). Each session is guided by a set of curated questions that stem from scientific literature, policy documents, and program experience on a specific topic. The questions aid the discussion with the technical experts invited to contribute to the comprehensive and technical understanding of the chosen topic on malaria disease and control. The sessions typically last about 150 minutes, with the expert/s speaking most of that time, and the hosts probing for additional details where necessary.

Given their format, the sessions provide a platform for international experts, students, and workers across the world to come together in one "room" and participate in real-time to learn and have questions answered. These meetings, albeit voluntary and non-funded, present a unique opportunity to highlight challenges and barriers that remain for

malaria elimination, as well as emphasize research priorities, and discuss future partnerships and training.

Overall, the goal is to promote essential scientific discourse on malaria and its control and to provide technical understanding of specific subjects for the audience. The MasterClasses were created by Dr. Okumu in December 2020 and organically grew in response to interest from the global malaria community. To date, 42 editions have been completed (see supplementary **Table S1** for details).

This report presents insights from five of the MasterClasses to illustrate the value of the platform for the broader community of malaria stakeholders. These sessions were selected to highlight a multifaceted approach for malaria elimination, covering topics ranging from control interventions to vaccine development. Key lessons from five guest experts Prof. Brian M. Greenwood (London School of Tropical Medicine and Hygiene, UK), Prof. Kevin Marsh (University of Oxford, UK), Prof. Stephen Hoffman (Sanaria Inc., USA), Prof. Adrian Hill (University of Oxford, UK), and Prof. Marcel Tanner (University of Basel, Switzerland) are presented. Where relevant, specific references are made to the key publications used to guide the expert discussions. The selected sessions broadly cover important policy and Research and Development (R&D) agendas for malaria.

Voices of a quintet: Key lessons and big ideas from expert sessions on malaria

The long road to malaria elimination: A MasterClass with Prof. Brian M. Greenwood

Prof. Greenwood discussed the history of malaria control efforts, noting that despite steady progress and acceleration due to high-impact interventions, the disease still

claims hundreds of thousands of lives annually [1, 2]. He emphasized the need for continued innovations and adaptations in malaria control strategies [3], as well as sustained financial and political support, to achieve malaria elimination [1, 2]. He highlighted the importance of research and development in combating malaria, citing the successes of insecticide-treated bed nets (ITNs) and artemisinin-based combination therapies (ACTs) as examples.

Prof. Greenwood also discussed some of the main challenges facing malaria elimination efforts, including the emergence of drug-resistant strains of the malaria parasite and insecticide-resistant mosquitoes [4]. He argued that surveillance systems are a critical component of malaria control and elimination efforts, and must be sustained to address the current and future challenges [5]:

“It isn’t an end to get your certificate [of elimination] from the World Health Organization (WHO) Director General and then say malaria is done, we can do something else… that [the effort] has to be kept. The battle continues…”

In addition, he outlined the importance of partnerships in malaria control, emphasizing that the different parties involved should have coordinated efforts pursuing similar targets [6]. He particularly encouraged epidemiologists and vector biologists to work together, as well as governments, international organizations, and local communities. Effective public engagement was also identified as crucial given that local knowledge and participation can address local challenges. Finally, Prof. Greenwood discussed the importance of sustained funding for malaria control efforts, noting that current levels remain below the budgetary needs and that greater efficiencies can be achieved

through policies guided by science to prioritize the most effective interventions in different settings:

“An important lesson, which can relate to any infectious disease, is that policy should be guided by science. If data show that the thing that has been most effective in reducing deaths and the burden in malaria has been the distribution of ITNs, then if you have limited amount of money, and you believe the science and it has been done by reputable people and ideally confirmed by other groups, then you should be putting the resources into what the science tells you to do.”

The big malaria questions: A MasterClass with Prof. Kevin Marsh

In this session, Prof. Marsh shared his journey as a scientist before exploring various topics related to malaria. He discussed the global trends in malaria control using real-life examples from his work across Africa. He appreciated the current risks [3, 7] and limitations such as the rise in artemisinin resistance [8], as well as the challenges in understanding malaria immunology [9], which would be crucial for developing high impact vaccines and therapeutics. He also discussed the impacts of current interventions, such as expanded ITN coverage [10], and emphasized the importance of health systems in controlling and reducing the malaria burden while also building a strong foundation towards eventual malaria eradication.

Prof. Marsh also discussed the application of various control and prevention mechanisms such as larvicides, ITNs, indoor residual spraying (IRS), mass drug administration (MDA) [11] and seasonal malaria chemoprevention (SMC) [12]. He

particularly highlighted the importance of integrating different control options and the need to apply basic biology of the disease to optimize its control in local settings:

"It comes back, as these things often do, to things we know very well – the importance of integrated vector management, instead of a single approach…the important thing is always to look at the biology of what one is to do. Does it fit here, in this circumstance?"

Prof. Marsh also discussed the timeline of research and development for malaria eradication [13, 14], including progress on the vaccine front with RTS,S and the potential of gene drives. He underscored the importance of capacity sharing in all directions (as opposed to capacity building) and drawing on lessons of the past to inform improved efforts. He encouraged the alignment of ongoing research with the key questions that policymakers need answers to, rather than just academic interests. He concluded by reiterating the importance of functioning health systems, continued R&D, and greater investments towards malaria elimination and eradication:

"What we really need to do is to make sure that our research as a community, whether we work on vaccines or drugs or community interventions or health systems, we need to make sure that our research is very closely aligned to what are the key questions that policymakers need answers to, not just what are we interested in as academic research."

The enduring search for malaria vaccines: A MasterClass with Prof. Stephen Hoffman

This session focused on the development of malaria vaccine candidates [15], including RTS,S, the most advanced malaria vaccine [16] now recommended by the WHO for at-risk children [17], and the whole sporozoite vaccines being developed by Sanaria, Inc..

Prof. Hoffman shared his journey in malaria research [18], then highlighted both the basic principles and recent developments in creating vaccines for protozoan parasites in contrast to other types of vaccines [19]. He described the current consensus roadmap of the development of malaria vaccine technologies [20, 21] and highlighted the importance of the RTS,S as the first vaccine against a human parasite, having been approved for widespread use in areas of moderate to high *Plasmodium falciparum* transmission. He however noted that while RTS,S vaccine was an enormous step forward for the field [22], its efficacy was limited, with only 36% against symptomatic malaria [23]. Prof. Hoffman emphasized that vaccines are incredibly powerful tools for disease control and recognized the need to integrate them into ongoing malaria control programs, including seasonal chemoprevention [24, 25], depending on local transmission:

"Malaria is not just one disease from an epidemiological point of view. In some places we have a long road ahead of us, where we will have to be hitting malaria with every tool we potentially have, and in other areas we may actually be able to get to the point of even elimination… We need new tools and vaccines are the most effective tools for limiting infectious disease, but it doesn't obviate the need for other tools… it's [one single vaccine] not a winner-take-all, it's too hard a problem and we need everybody's efforts as we go forward…you will get knocked down over and over again by malaria – it is a tough foe but we are making progress, inching forward every day and we have to keep up the work."

Prof. Hoffman then presented the innovative approaches that Sanaria Inc. has taken to develop a metabolically active, non-replicating sporozoite vaccine [26], which has

shown promising results in clinical trials [27, 28]. In concluding his session, he highlighted the importance of international collaboration and how this has contributed to the development of this particular vaccine through the PfSPZ consortium. This example highlights the scientific strides that can be made toward a common goal through collaborative efforts and collective knowledge generation:

"Individuals from so many different organizations and different countries… I like to think that it is a model for how we can really pursue global health and research together, as one team, dedicated to solving enormously difficult and important problems."

The next malaria vaccine: A MasterClass with Prof. Adrian Hill

In this session, Prof. Adrian Hill started by describing vaccination in the context of Covid-19 [29] and transitioned to discussing the current state of malaria control [1], emphasizing the need for new tools to complement existing interventions such as drugs and insecticides. He noted that malaria vaccines could offer new opportunities for more effective control, but described the difficulties experienced over the past century of malaria vaccine research [30, 31]. He also discussed the recent delays in pre-qualification by the Strategic Advisory Group of Experts on Immunization (SAGE) from the WHO [32] of the new malaria vaccines with the identification of a non-trivial increased female mortality signal [33]. He proceeded to describe the progress made in developing and evaluating the R21 vaccine [34], an effort that he spearheaded from the early 1990s, from vaccine design to protocol and implementation. The R21 vaccine is a variant of the RTS,S that will likely be the second human malaria vaccine to be approved. He highlighted some major similarities and differences between this vaccine

and RTS,S, in particular the higher efficacy of the R21 vaccine, which achieved 77% in Phase 2 trials in West Africa [35] and the greater “manufacturability” of the R21 compared to RTS,S. Prof. Hill also highlighted the urgent need to address funding gaps for the implementation of effective vaccines and the need to accelerate vaccine regulatory processing and roll-out. He encouraged researchers, regulators, and public health authorities to be more demanding of international organizations who support malaria to do so in the present rather than in years’ time:

“…The sooner you start the more lives you save and believe me we have been waiting for decades for malaria vaccines to be rolled out; let’s not waste another two or three years after it’s available by fooling around to organize it, we are giving notice now – these vaccines are coming. There’s going to be enough of them between the two [RTS,S and R21] of them, and the challenge then is to use them as efficiently as possible to save lives. And you don’t have to think too hard about doing other things, you are doing those already, just bring the vaccine on top and see what the impact is.”

He acknowledged the potential advantage of combining vaccines with other interventions in the field like SMC [36], or multi-stage vaccines which target different parasite stages [37], and argued that these could accelerate progress toward eliminating malaria [38]. Prof. Hill concluded by recognizing the importance of local community involvement, education, and sharing research to accelerate vaccine supply for malaria. He noted manufacturing of vaccines should be done in Africa to ensure self-sufficiency and increase pipelines and access. He encouraged the momentum of vaccinology in Africa and emphasized the need for continued investment in R&D to

address challenges in malaria elimination. Dr. Hill's final words left the session attendees with motivation and further hope to continue the difficult research:

"It's fantastic to see more and more young African scientists demanding that they have access to capacity… it's ridiculous having a lot of it done thousands of miles away so my congratulations to everyone who is involved in this renaissance, if you like, of vaccinology in Africa. Please keep the momentum going; money is coming in faster. It's a long way to go but it's the right time."

At the time of this piece, recent data were released which showed that the R21/Matrix-M achieved the WHO-specified efficacy goal of > 75%, and this ignited its regulatory clearance for use in children aged 5-36 months in Ghana, followed by provisional approval in Nigeria [39].

Malaria strategies: A MasterClass with Prof. Marcel Tanner

Prof. Tanner started the session by discussing the current strategies for malaria control, including the use of vector control methods (mainly ITNs and IRS), and antimalarial drugs. He noted that these strategies have led to significant reductions in malaria incidence and mortality, but that progress has plateaued in recent years. Next, he discussed the challenges facing malaria elimination [40], including the emergence of drug-resistant malaria parasites and insecticide-resistant mosquitoes which threaten the possibility of eradication [13]. He emphasized the need for continued investment in research and development to address these challenges, as well as financing to develop and evaluate new tools for malaria control such as monoclonal antibodies [41] or vaccines [38]. He however also argued that while funding is crucial [3], efforts must

extend beyond just the amount of money. He particularly stressed the importance of tailoring strategies to the local setting and investing in personnel development and capacity building:

"It is not just the amount of money, but it is how you invest it…it is tailoring a strategy to the local setting, which also entails that you are investing in personnel development, capacity building, which are specifically needed...really going into investments so you can build the capacity. Invest in a systemic approach. Understand the context, reconcile the different needs, and focus on the key question."

In this context, Prof. Tanner also discussed the importance of community engagement and ownership in ensuring more impactful malaria interventions [42]. He notes that engaging with affected communities and empowering them can be highly effective in reducing malaria incidence. He also accentuated the need for collaboration and multi-stakeholder partnerships bringing together researchers, policymakers, and affected communities to develop comprehensive malaria control strategies [43]. Lastly, he put forth his "mutual learning for change" idea:

"Being a scientist is carried by the three joys – the joy to discover [to actually do science and ask questions], the joy to share [to be here in this webinar], the joy to see and be involved in translation [to actually change something]… I am enthused by the fact that I can also share my knowledge. It's wonderful to share the data at any time because we learn together to make a real difference. The science system must honor and reward this type of attitude and not the monument-carving metric system. At least we should adhere to the DORA principles [San Francisco Declaration on Research Assessment – a set of recommendations designed for the purpose of ensuring the appropriate and

accurate evaluation of the quality and impact of scientific outputs [44]]… much more needs to be done and then we see changes."

Impact of the MasterClasses and next steps

Overall, the Ifakara MasterClasses emphasize the urgent need for transformative efforts to combat malaria and increased investments to accelerate the malaria elimination agenda. In the five sessions highlighted, there was agreement that current interventions, such as insecticide-treated bed nets and anti-malarial drugs, have allowed for significant progress in reducing malaria deaths, but there is still much work to be done. The development of effective malaria vaccines was discussed as a promising strategy for reducing the burden of malaria, with a particular focus on recent advances in the R21/Matrix-M vaccine. The experts emphasized the importance of continued funding for research and development of new tools, as well as the need for collaboration among international organizations, governments, and local communities to effectively address the challenges of malaria control and elimination. Finally, there was consensus on the call to action for increased investment in training and capacity sharing for African scientists and healthcare workers, as well as for manufacturing vaccines in Africa to increase access and self-sufficiency in the region.

MasterClasses provide a unique forum to explore challenges that remain for malaria elimination, to emphasize research priorities, and discuss future partnerships and training. In-depth discussions are centered around published scientific findings and agendas, providing a review of how specific published work fits within the big picture of a given topic of discussion. The sessions are free, virtual, and open to all, and bring

together a broad range of professionals from different background and at various stages in their careers. The classes have expanded naturally, and participation has been sustained at a high level, with experts from previous MasterClasses regularly joining as participants in subsequent sessions.

The MasterClasses have opened doors for collaborations, and since the year 2022, MESA, a malaria knowledge hub, contributes to the preparation and execution of these sessions. MESA is a resource that gathers the malaria community to work collaboratively towards a malaria-free world. MasterClasses may continue to evolve to meet the needs of the global malaria community. Potential examples include collating and organizing materials (such as content used for advanced review and final PowerPoint slides) and making them accessible in one place, and further exploring opportunities to effectively engage non-English speaking malaria professionals. Moving forward, forums like Ifakara MasterClasses can play important roles in democratizing technical discussions and providing platforms for engagement and cross-fertilization of ideas needed in the fight against malaria.

Resources

[i] https://www.youtube.com/@ifakarahealthinstitute/videos

References

1 WHO (2022) World malaria report 2022. World Health Organization
https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2022
2 WHO (2021) Global technical strategy for malaria 2016-2030, 2021 update.
https://www.who.int/publications/i/item/9789240031357
3 WHO (2015) Global technical strategy for malaria 2016–2030. Geneva: World Health Organization
https://www.who.int/malaria/areas/global_technical_strategy/en

4 Greenwood, B.M.*, et al.* (2008) Malaria: progress, perils, and prospects for eradication. *The Journal of Clinical Investigation* 118, 1266-1276
5 Greenwood, B. (2017) Elimination of malaria: halfway there. *Transactions of The Royal Society of Tropical Medicine and Hygiene* 111, 1-2
6 Alonso, P.L.*, et al.* (2011) A Research Agenda to Underpin Malaria Eradication. *PLOS Medicine* 8, e1000406
7 Paton, R.S.*, et al.* (2021) Malaria infection and severe disease risks in Africa. *Science* 373, 926-931
8 Balikagala, B.*, et al.* (2021) Evidence of Artemisinin-Resistant Malaria in Africa. *New England Journal of Medicine* 385, 1163-1171
9 Langhorne, J.*, et al.* (2008) Immunity to malaria: more questions than answers. *Nature Immunology* 9, 725-732
10 Bhatt, S.*, et al.* (2015) The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015. *Nature* 526, 207-211
11 WHO (2017) Mass drug administration for falciparum malaria: a practical field manual. Geneva: World Health Organization https://www.who.int/publications/i/item/9789241513104
12 Baba, E.*, et al.* (2020) Effectiveness of seasonal malaria chemoprevention at scale in west and central Africa: an observational study. *The Lancet* 396, 1829-1840
13 WHO (2020) Malaria eradication: benefits, future scenarios & feasibility. Geneva: World Health Organization https://www.who.int/publications/i/item/9789240003675
14 Feachem, R.G.A.*, et al.* (2019) Malaria eradication within a generation: ambitious, achievable, and necessary. *The Lancet* 394, 1056-1112
15 Schwartz, L.*, et al.* (2012) A review of malaria vaccine clinical projects based on the WHO rainbow table. *Malaria Journal* 11, 11
16 Zavala, F. (2022) RTS,S: the first malaria vaccine. *The Journal of Clinical Investigation* 132
17 WHO (2021) WHO recommends groundbreaking malaria vaccine for children at risk. https://www.who.int/news/item/06-10-2021-who-recommends-groundbreaking-malaria-vaccine-for-children-at-risk
18 Mullins, L. (2013) Dr. Hoffman vs. the Mosquito. https://www.washingtonian.com/2013/10/23/dr-hoffman-vs-the-mosquito/
19 Pollard, A.J. and Bijker, E.M. (2021) A guide to vaccinology: from basic principles to new developments. *Nature Reviews Immunology* 21, 83-100
20 WHO (2013) Malaria Vaccine Technology Roadmap. Geneva: World Health Organization https://www.who.int/publications/m/item/malaria-vaccine-technology-roadmap
21 malERA (2011) A Research Agenda for Malaria Eradication: Vaccines. *PLOS Medicine* 8, e1000398
22 Beeson, J.G.*, et al.* (2022) The RTS,S malaria vaccine: Current impact and foundation for the future. *Science Translational Medicine* 14, eabo6646
23 CTP (2015) Efficacy and safety of RTS,S/AS01 malaria vaccine with or without a booster dose in infants and children in Africa: final results of a phase 3, individually randomised, controlled trial. *The Lancet* 386, 31-45
24 Greenwood, B.*, et al.* (2017) Seasonal vaccination against malaria: a potential use for an imperfect malaria vaccine. *Malaria Journal* 16, 182
25 Thompson, H.A.*, et al.* (2022) Seasonal use case for the RTS,S/AS01 malaria vaccine: a mathematical modelling study. *The Lancet Global Health* 10, e1782-e1792
26 Hoffman, S.L.*, et al.* (2010) Development of a metabolically active, non-replicating sporozoite vaccine to prevent Plasmodium falciparum malaria. *Human Vaccines* 6, 97-106
27 Mordmüller, B.*, et al.* (2017) Sterile protection against human malaria by chemoattenuated PfSPZ vaccine. *Nature* 542, 445-449

28 Richie, T.L.*, et al.* (2015) Progress with Plasmodium falciparum sporozoite (PfSPZ)-based malaria vaccines. *Vaccine* 33, 7452-7461
29 Watson, O.J.*, et al.* (2022) Global impact of the first year of COVID-19 vaccination: a mathematical modelling study. *The Lancet Infectious Diseases* 22, 1293-1302
30 Hill, A.V.S. (2011) Vaccines against malaria. *Philosophical Transactions of the Royal Society B: Biological Sciences* 366, 2806-2814
31 Mance, H. (2022) Adrian Hill: 'This is the breakthrough tool — vaccines against malaria'. https://www.ft.com/content/ff5e9c24-4a63-44cb-b526-00e607a07abe
32 White, M.T.*, et al.* (2015) Immunogenicity of the RTS,S/AS01 malaria vaccine and implications for duration of vaccine efficacy: secondary analysis of data from a phase 3 randomised controlled trial. *The Lancet Infectious Diseases* 15, 1450-1458
33 Klein, S.L.*, et al.* (2016) RTS,S Malaria Vaccine and Increased Mortality in Girls. *mBio* 7, e00514-00516
34 Collins, K.A.*, et al.* (2017) Enhancing protective immunity to malaria with a highly immunogenic virus-like particle vaccine. *Scientific Reports* 7, 46621
35 Datoo, M.S.*, et al.* (2022) Efficacy and immunogenicity of R21/Matrix-M vaccine against clinical malaria after 2 years' follow-up in children in Burkina Faso: a phase 1/2b randomised controlled trial. *The Lancet Infectious Diseases* 22, 1728-1736
36 Greenwood, B.*, et al.* (2021) Combining malaria vaccination with chemoprevention: a promising new approach to malaria control. *Malaria Journal* 20, 361
37 Hill, A.V.S.*, et al.* (2014) Towards a multi-antigen multi-stage malaria vaccine. *Malaria Journal* 13, O31
38 Penny, M.A.*, et al.* (2020) Future use-cases of vaccines in malaria control and elimination. *Parasite Epidemiology and Control* 10, e00145
39 Oxford (2023) R21/Matrix-M™ malaria vaccine developed by University of Oxford receives regulatory clearance for use in Ghana. https://www.ox.ac.uk/news/2023-04-13-r21matrix-m-malaria-vaccine-developed-university-oxford-receives-regulatory
40 Alonso, P.L. and Tanner, M. (2013) Public health challenges and prospects for malaria control and elimination. *Nature Medicine* 19, 150-155
41 Gaudinski, M.R.*, et al.* (2021) A Monoclonal Antibody for Malaria Prevention. *New England Journal of Medicine* 385, 803-814
42 WHO (2018) High burden to high impact: a targeted malaria response. Geneva: World Health Organization https://www.who.int/publications/i/item/WHO-CDS-GMP-2018.25
43 Tanner, M. and Meier, L. (2019) Viewpoint: Parasites and partnerships. *Parasite Epidemiology and Control* 4, e00086
44 DORA (2017) San Francisco Declaration on Research Assessment. https://sfdora.org/read/

Supplementary file

Ifakara MasterClasses: Lessons from leading experts on the battle against malaria

Ilinca I. Ciubotariu[1*], April Monroe[2,3], Nana Aba Williams[4,5], Sheila B. Ogoma[6], Fredros Okumu[3*]

[1] Department of Biological Sciences, Purdue University, West Lafayette, USA

[2] Johns Hopkins Center for Communication Programs, Baltimore, USA

[3] Ifakara Health Institute, Ifakara, Tanzania

[4] MESA Alliance, Barcelona Institute for Global Health (ISGlobal), Barcelona, Spain

[5] Barcelona Institute for Global Health (ISGlobal), Hospital Clínic-Universitat de Barcelona, Barcelona, Spain

[6] PMI VectorLink Abt Associates, Nairobi, Kenya

[*] Correspondence: iciubota@purdue.edu (I. I. Ciubotariu), fredros@ihi.or.tz (F. Okumu)

Table S1. A list of the first 42 editions of Ifakara MasterClasses.

TITLE
Reviewing the World Malaria Report 2022 & Priority R&D for Elimination
Anopheles stephensi in Africa: a Masterclass with Global Experts & In-country Practitioners
Preventive Therapies for Malaria [including a case study of Tanzania's evaluation of preventive therapies]
The Next Malaria Vaccine: A MasterClass with Prof. Adrian Hill
The Mosquitoes Must Surrender: a MasterClass with IVCC & Partners
New Nets & New Sprays for Malaria Control: A MasterClass with Prof. Natacha Protopopoff, Corine Ngufor, Joe Wagman, Seth Irish, Abraham Mnzava &
The Big Malaria Questions: A MasterClass with Prof. Kevin Marsh
Reviewing the 2021 World Malaria Report: a Masterclass with Pedro Alonso, Abdisalan Noor, Jennifer Gardy & Richard Steketee
Infected But Not Sick: a MasterClass with Profs. Chris Drakeley & Teun Bousema
Costs & Coverage of [Malaria] Control: a MasterClass with Profs. H. Koenker, Yukich & M. Erskine
Sustaining the [Malaria] Gains: a MasterClass with Profs. Thomas Churcher & Ellie Sherrard Smith
Malaria Strategies: A MasterClass with Prof. Marcel Tanner
Malaria Meds: a MasterClass with Profs. Timothy Wells, Pierre Hugo, George Jagoe & Abdoulaye Djimde
Vectors Asia, Africa & the Americas: S. Manguin, I. Vythilingam, Y. Rubio Palis, L. Koekemoer
Malaria Maps and Models: a MasterClass with Profs. S. Bhatt, S. Kiware, L. Tusting & J. Gerardin
Two Billion Mosquito Nets & Counting: a MasterClass with Prof. Christian Lengeler
The Enduring Search for Malaria Vaccines: a MasterClass with Prof. Stephen Hoffman (Sanaria Inc.)
Genomic Surveillance: With Profs. DWirth, S Volkman, D Ishengoma, A Miles & M Lawniczak
Malaria Dalenda Est: a MasterClass with Drs. Phillip Welkhoff, Helen Jamet & Meera Venkatesan
Fixed, Few & Findable: a MasterClass with Profs. H Kafy, P Dambach, P Dechant & S Majambere
Aedes & Stephensi: a MasterClass with Profs. Peter Ryan, Basile Kamgang & Fitsum G. Tadesse
A Thousand Lives a Day: a MasterClass with Profs. Pedro Alonso, Patrick Kachur & Elizabeth Juma
The Mosquitoes Must Die: a MasterClass with Profs. Hilary Ranson & Corine Ngufor
There’s a Gene in my Mosquitoes: a MasterClass with Profs. Austin Burt, Tony Nolan & A. Diabate
The Elegant Math of Malaria Transmission & Its Control: a MasterClass with Prof. David L Smith
The Long Road to Malaria Elimination: a MasterClass with Prof. Brian M Greenwood
Vector Surveillance 101: a MasterClass with Profs. Tom Burkot & Tanya Russell
The Mosquitoes Have Refused to Die: A MasterClass with Prof. Charles Wondji
Eaves, Marshes, and Mosquitoes: a MasterClass with Prof. Steve Lindsay
The MalariaSphere: a MasterClass with Dr. Bart Geert Jan Knols

Funestus 101: Opportunities for a more realistic malaria fight: a MasterClasswith Prof. Jo Lines
The District Entomologist: Strengthening Local Capacity for Malaria Vector Surveillance: a MasterClass with District Malaria Surveillance
The District Entomologist: Why Malaria-endemic Countries Must Train More Field Entomologists: A masterclass with Prof Abraham
Lines and Dots: a MasterClass with Prof. Abdisalan Noor
Mosquitoes, Monkeys & Disease: A Masterclass with Prof. Indra Vythilingam
Vector wars: why malaria control must exploit the biology of Anopheles mosquitoes: A Masterclass with Prof. Leonard Mboera
Taxa Woes Fallacy of Malaria Control without Field Entomologists Expert: a Masterclass with Prof Maureen Coetzee
Treating the Fabric: how early entomologists harnessed biology to revolutionize malaria control: a Masterclass with Prof. Pierre Carnevale
Protective atmospheres how malaria control can transition from pesticides: a MasterClass with Prof. Willem Takken Part 2
Protective atmospheres how malaria control can transition from pesticides: a MasterClass with Prof. Willem Takken Part 1
The Rise & Fall of Medical Entomology: Reflections from Africa, Asia & The Americas: a MasterClass with Prof. Derek Charlwood
The Land of Gambiae: Malaria Entomology in the Days Before ITNs: a MasterClass with Prof Graham White

EDITION	DATE PUBLISHED ON YOUTUBE	EXTERNAL LINK	MESA LINK		
42	16-Feb-2023	https://www.youtube.com/watc	https://mesamalaria.org/reso		
41	26-Jan-2023	https://www.youtube.com/watc	https://mesamalaria.org/reso		
39 & 40	15-Dec-2022	https://www.youtube.com/watc	https://mesamalaria.org/reso		
38	4-Aug-2022	https://www.youtube.com/watc	https://mesamalaria.org/reso		
37	26-May-2022	https://www.youtube.com/watc	https://mesamalaria.org/reso		
36	12-May-2022	https://www.youtube.com/watc	https://mesamalaria.org/reso		
35	14-Apr-2022	https://www.youtube.com/watc	https://mesamalaria.org/reso		
34	15-Dec-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
33	28-Oct-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
32	21-Oct-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
31	14-Oct-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
30	12-Aug-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
29	5-Aug-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
28	15-Jul-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
27	1-Jul-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
26	24-Jun-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
25	3-Jun-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
24	20-May-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
23	12-May-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
22	5-May-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
21	21-Apr-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
20	8-Apr-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
19	31-Mar-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
18	24-Mar-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
17	10-Mar-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
16	3-Mar-2021	https://www.youtube.com/watc	https://mesamalaria.org/reso		
15	24-Feb-2021	Online Link Pending	Online Link Pending		
14	17-Feb-2021	Online Link Pending	Online Link Pending		
13	11-Feb-21	Online Link Pending	Online Link Pending		
12	5-Feb-2021	Online Link Pending	Online Link Pending		

11	28-Jan-21	Online Link Pending	Online Link Pending
10b	10-Oct-2021	No Recording	No Recording
10a	9-Dec-2020	Online Link Pending	Online Link Pending
9	14-Jan-21	Online Link Pending	Online Link Pending
8	13-Jan-2021	Online Link Pending	Online Link Pending
6	10-Dec-2020	Online Link Pending	Online Link Pending
5	8-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso
4	4-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso
3b	18-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso
3a	3-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso
2	2-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso
1	1-Dec-2020	https://www.youtube.com/watc	https://mesamalaria.org/reso

Photo 'Ciubotariu'

Click here to access/download;Figure;Ciubotariu.jpeg

Photo 'Monroe'

Click here to access/download;Figure;Monroe.jpg

Photo 'Williams'

Click here to access/download;Figure;Williams.jpg

Photo 'Ogoma'

Click here to access/download;Figure;Ogoma.png

Photo 'Okumu'

Click here to access/download;Figure;Okumu.png