

# Seeking Research Questions from Implementers: Considerations for Leveraging Ground Actors Research Needs in the Fight against Malaria in West Africa.

Tete Sitou Amouh (✉ [info@shine4health.com](mailto:info@shine4health.com))

Shine4Health <https://orcid.org/0000-0002-5730-3454>

Saidou Malam Ekoye

WHO

Césaire Damien Ahanhanzo

West African Health Organization

Tinga Robert Guiguemdé

Universite Nazi Boni Bobo-D

Issiaka Sombié

West African Health Organization

---

## Commentary

**Keywords:** Malaria, research collaboration, West Africa, implementation science

**Posted Date:** December 28th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-65587/v3>

**License:**   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

**Version of Record:** A version of this preprint was published on March 8th, 2021. See the published version at <https://doi.org/10.1186/s12936-021-03634-0>.

# Abstract

In the Sahel countries of West Africa, malaria remains a public health scourge. To strengthen the fight against malaria, it is imperative to identify weaknesses and possible solutions before programs implementation. This study reports experiences gained from collaboration between decision-makers and researchers from a project undertaken by the World Bank, titled: Malaria and Neglected Tropical Diseases in the Sahel (SM/NTD). The objectives of this World Bank project were to identify bottlenecks in malaria program implementation as well as related research questions they bring up. Questionnaire addressed to National Malaria Control Program managers and prioritization workshops were used as a medium to identify research questions. Identified research questions were implemented in selected countries and the results, as presented in this study showed that priority issues were those related to prevention, governance, drugs, monitoring and evaluation. The first five priority questions were: (1) compliance with drug doses on the second and third days during the seasonal chemoprevention (SMC) campaigns, (2) the contribution of community-based distributors to the management of severe cases of malaria in children under 5 years, (3) the SMC efficacy, (4) artemisinin-based combination therapy (ACTs) tolerance and efficacy according to existing guidelines, and (5) the quality of malaria control at all levels of the health system. In conclusion, this work showed the effectiveness of collaboration between implementers, programs managers, and researchers in identifying research questions. Furthermore, the results of this study will contribute to improving the implementation of malaria control programs across African countries.

# Background

More often than not, local social determinants of health are hidden or overlooked by funding agencies, institutional researchers, and health systems, yet they may be slowing down or reducing program implementation and impact. In addition, many of the physical constraints that impede the regular and effective delivery of health interventions to those who need them are much more pronounced in Low-to-Middle-Income Countries (LMIC) than in high income countries (1). Hence bridging the research divide between the obligations of donors and researchers or field actors are of paramount importance in the fight against diseases, especially malaria in Africa.

Indeed, despite recent trends showing a reduction in malaria mortality rates in Africa generally, and in the region in particular (2), mortality rates remain high in countries such as Nigeria, Burkina Faso, Niger, Mali, Cote d'Ivoire, Ghana, and Guinea (3). This raise questions about the effectiveness of the fight against malaria in these countries. An approach to identify these weaknesses, opportunities, and the search for solutions to reduce these preventable mortalities can improve control and bring these countries nearer to their pre-elimination targets.

This study reports experiences gained from collaborations between decision-makers and researchers, a part of a project undertaken in the framework of the regional World Bank funded project titled: Malaria and Neglected Tropical Diseases in the Sahel (SM/NTD). The objectives of this World Bank project were

to identify bottlenecks in program implementation as well as the related research questions they present. The results of this study can help funding agencies to prioritize and fund research activities in a bid to improve the fight against malaria in the beneficiary countries.

## Methodology

Local and primary providers along with malaria program managers were approached in the 15 countries of the Economic Community of West African States (ECOWAS), including eight French-speaking, five English-speaking and two Portuguese-speaking countries using two approaches, namely: a questionnaire survey and regional validation workshops were held as part of the SM/NTD project's activities. This paper only focuses on malaria.

### a) The questionnaire survey

The questionnaire translated into the 3 official languages of ECOWAS, namely English, French and Portuguese, were sent to the malaria control programs managers in the last semester of trimester of 2016. The questionnaires were divided into two (2) parts: i) Bottlenecks in malaria program implementation ii) Priority research questions on malaria program. Each part covered seven thematic areas: **governance, human resources, drugs, service provision, use of prevention methods, monitoring and evaluation (M&E), and public support or buy-in**. Questionnaires were thereafter sent through electronic messages (Email) to national malaria control program managers/coordinators of the 15 ECOWAS countries, with instructions on how to fill the questionnaires.

Follow up actions were undertaken for two months to obtain a satisfactory response rate. Even though the countries have similarities as well as differences regarding their governance structure, epidemiological trends, and public health research, we conducted an initial in-depth analysis country by country. We then split bottlenecks recorded and questions into the seven "ECOWAS regional topics of interest" according to the thematic areas mentioned above. This analysis was then presented at the ECOWAS malaria regional workshop.

### b) Organization of the regional validation workshop:

A two-day regional workshop was organized in Bamako by the West African Health Organization (WAHO), the ECOWAS specialized Institution dealing with health concerns such as malaria as well as NTDs program in West Africa. Participants included malaria program managers, NTDs program managers, Directors of Public Health of the various Ministries, monitoring/evaluation officers, countries project management unit coordinators, technical and financial partners (World Health Organization, World Bank, Helen Keller International, Malaria Consortium, Catholic Relief Services, and several WAHO officers). The results of the questionnaire survey were analyzed, presented, and discussed in two plenary and two breakout sessions.

The first breakout session on malaria was organized with two groups of 12 people each. The breakout sessions brought together malaria program coordinators, researchers, partners, and the regional project team. These teams worked to validate the research problems and questions. The two breakout teams were tasked to review, complete the problems, prioritize, and justify the research questions. The two breakout teams reviewed the survey results using individual and average ratings. For the first plenary session, each group was instructed to choose the top 20 research questions. On the second plenary session, the representative of each group shared the top 20 research questions they have selected. The questions selected by the participants clarified some research questions and allowed to finalize list related to malaria management.

The second breakout session focused on individual countries' participants. The participants worked together to select three priority research questions from the list of questions established during the plenary session. Representatives of each country were asked to prioritize the three questions they selected and to address them over a three year (2017, 2018 and 2019) period. Finally, a third plenary session allowed each country's team to share their key questions to address and prepare a plan for the subsequent years, 2017, 2018 and 2020.

The workshop was moderated by a world-renowned parasitology and malaria research professor in West Africa and at the end, the moderator reformulated some of the questions and justifications in accordance with the adopted guidelines.

## **Results**

Out of the 15 ECOWAS countries, 11 (Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, and Togo) responded to questions related to malaria and table 1 shows the bottlenecks identified by program managers/coordinators according to the seven areas addressed in the questionnaire.

**Table 1: Bottlenecks in MALARIA program implementation in West Africa**

Theme	Malaria
<b>governance,</b>	<ul style="list-style-type: none"> <li>• Difficulty in accessing information from some partners</li> <li>• Inadequate collaboration with the private, para-public and religious communities at the district and regional levels.</li> <li>• Inadequate capacity for management and coordination of control at the regional and district levels.</li> <li>• Inefficiency in the implementation of SMC strategy?</li> <li>• Low availability of funds to support program management activities</li> <li>• Weak cross-border collaboration and networking</li> <li>• Difficulty in delimiting partners' intervention zones</li> </ul>
<b>Human resources</b>	<ul style="list-style-type: none"> <li>• Lack of capacity, mobility</li> <li>• Lack of adequate Motivation</li> <li>• Lack of a career plan</li> <li>• Inadequate capacity to design at the program level</li> </ul>
<b>Drugs</b>	<ul style="list-style-type: none"> <li>• Out of stock (management)</li> <li>• Incomplete and poor data quality</li> <li>• Low storage capacity (districts, sites)</li> <li>• Low follow-up of efficiency and resistance</li> <li>• Shortage of SP( Sulfadoxine Pyrimethamine)</li> <li>• Poor adverse reaction reporting</li> <li>• Weak quality control</li> <li>• Counterfeit medicines</li> </ul>
<b>Service provision</b>	<ul style="list-style-type: none"> <li>• Absence of initial treatment prior to transfer of severe malaria case</li> <li>• What happened to tablets/drug left to the parents after 1st SMC distribution?</li> <li>• Insufficient direct observed Sulfadoxine Pyrimethamine treatment</li> <li>• Organizational deficiency in ANC( ante natal care )</li> <li>• Low coverage of pregnant women with IPT2 /3 at ANC</li> <li>• Insufficient funding for LLIN EC campaign and operational costs</li> <li>• Poor compliance with guidelines</li> <li>• Insufficient coverage of services</li> </ul>
<b>Use of prevention methods</b>	<ul style="list-style-type: none"> <li>• Non-optimal use of LLINs, IPT</li> <li>• Absence of insecticides for impregnating curtains</li> <li>• Population's poor perceptions of the use of LLINs</li> <li>• Low utilization/late attendance of ANC for IPT/SP</li> <li>• Insufficient mechanism for monitoring home dosing</li> <li>• Insufficient coverage of services</li> </ul>
<b>Monitoring and evaluation</b>	<ul style="list-style-type: none"> <li>• How to get and Projection Community and private data</li> <li>• Availability, quality, completeness, timeliness and archiving of data</li> <li>• Inadequate supervision</li> <li>• Insufficient dissemination of research results</li> </ul>
	<ul style="list-style-type: none"> <li>• Lack of data on mortality due to malaria</li> <li>• Weak monitoring system</li> </ul>
<b>Public support or buy-in</b>	<ul style="list-style-type: none"> <li>• Poor adoption of behaviors in favor of the fight against malaria</li> <li>• Insufficiency, reluctance, non-adherence to the O2 home doses of the SMC by some parents</li> <li>• Fixed strategy disallowed by some parents, door-to-door preference as for NIDs( national Immunization Days)</li> </ul>

In all seven thematic areas, there were challenges that limited the effectiveness of program implementation. In the area of governance, issues of coordination and collaboration with partners in the field came up as well as weaknesses in the managerial capacity at the regional and district levels. The human resources problems identified were mainly related to capacity, competence, motivation of community health workers, weaknesses in research skills and capacity of program actors. There were also difficulties in the area of management of medicine logistics, from ordering commodities to the distribution to patients, and also difficulties in pharmacovigilance. In service provision thematic area,

difficulties of direct observed treatment were pointed out, especially for the second and third day doses of SMC, while for prevention, low uptake of vector control measures, the absence of insecticides for the impregnation of protective materials, and the low use of protective means were the major problems mentioned. In terms of monitoring and evaluation, challenges of access to quality data, especially from the community level, and inadequacy in the dissemination of research results were reported.

Finally, in terms of public support, refusal or reluctance to participate in mass drug distribution during SMC campaigns, failure in adopting preventive measures and behavior were reported by program managers.

Table 2 presents the 21 priority issues as ranked by the participants by thematic areas.

Table 2: Priority research questions on malaria specific program areas, in West Africa

RANK	RESEARCH QUESTIONS	JUSTIFICATIONS
<b>GOUVERNANCE</b>		
3	What is the most effective strategy (door-to-door, cluster sites...) for seasonal malaria chemo-prevention?	There is a need to find adequate strategies for a good implementation of SMC campaigns, taking into account local constraints
5	What is the quality of malaria management at different levels of the health system?	The insufficient quality data on the management of malaria in health facilities and poor estimation of malaria cases, is often a challenge for decision making for planning and implantation
14	What part NICT (new information and communication technology) has in the management of quality data?	.Due to the low level of completeness, promptitude and archiving,, there is need to look into the use of technology
17	What system of collaboration should be put in place between Ministry of Health and other partners?	Insufficient coordination of activities have been recorded across the board
<b>HUMAN RESOURCES</b>		
2	What is the contribution of Community Drug Distributors in the management of severe malaria cases in children under five years of age as part of pre-transfer treatment?	There is often inadequate treatment (pre-transfer treatment) of severe malaria before the transfer to better facility. This delays treatment on arrival and recovery
16	Can CHWs contribute to improving the supervised administration of IPT-2 and IPT-3?	There is a need to know how programs can improve the low coverage of IPT-2 and IPT-3
<b>DRUG/malaria medicines</b>		
4	How effective and tolerable are ACT (artemisinin-based combination therapy) under actual conditions of use?	More data are needed on the efficacy and tolerability of ACTs under actual conditions of use.
6	What are the adverse effects of antimalarial drugs (ACT, SP-QA)? [ sulfadoxine-pyrimethamine (SP) + amodiaquine (AQ)]	More data are needed on the pharmacovigilance of antimalarial drugs in mass drug distribution: toxicological effects especially hepatic.
13	How effective are the medicines used in traditional medicine in the of malaria case management at the community level?	The high use of traditional medicine by the population and the low collaboration between traditional and modern medicine should be explored.
21	What is the comparative advantage of the Dihydroartemisinin (DHA)-Piperazine combination over SP-AQ?	Due to its side effects and limitations, programs should look also for an alternative to SP-AQ as part of the SMC.
<b>SERVICE</b>		
11	What is the quality of the supply/commodities?	There are counterfeit medicines in circulation, leading to treatment failure and difficult diagnosis
10	What is the performance of input supply chain systems?	Commodities stock-outs, insufficient rational management of medicines, are often recorded.
<b>PREVENTION</b>		
7	How effective are insecticides in long-lasting insecticidal nets (LLINs) in vector control?	After few years of use, there is a lack of updated efficacy data on insecticides used in LLINs
9	What are the factors for non-use of LLINs in vector control?	Managers and health workers have noticed a low level of public support for the use of LLINs
18	What is the level of use and effectiveness of IRS (Indoor Residual Spraying) for malaria prevention at the community level?	There are insufficient data on its IRS efficiency
19	How effective is the mosquito repellent soap developed in Burkina Faso as part of a multicenter study?	Research should contribute to find new alternative means of prevention to LLINs
20	What is the feasibility and effectiveness of impregnating nets with two insecticides?	With few years of the current tools, there is a need to develop of new means or tool of vector control in order to limit the spread of resistance of malaria vectors
<b>MONITORING AND EVALUATION</b>		
1	What are the factors that influence adherence to Day 2 and Day 3 doses during SMC?	The effectiveness of the ongoing strategy is not fully documented leading to insufficient data and monitoring of compliance with 2nd and 3rd doses in the community.
12	What is the diagnostic performance of RDTs at the facility level?	Little is known about the performance of real-world/real-time RDTs (Rapid Diagnostic Test)
15	What is the level of morbidity and mortality attributable to malaria?	There is a need to evaluate the impact of control programs
<b>POPULATIONS Adherence/buy-in</b>		
8	What are the communication channels, supports and strategies that induce the most behavior change?	Behavioral change at community and individual level has been slow

The first five priority questions were related to (1) compliance with drug doses for the second and third days of SMC campaigns, (2) contribution of community-based distributors to severe malaria cases management in children under 5 year, (3) SMC efficacy, (4) ACTs efficacy and tolerance of ACTs under current guidelines, and (5) quality of malaria cases management at all health system levels.

The prevention theme was ranked first with 5 questions, followed by the governance and medicines with 4 questions and the monitoring and evaluation with 3 questions. The five prevention questions were

related to the effectiveness and non-use of insecticide-treated nets (LLIN), the level of use and effectiveness of indoor residual spray (IRS), conducting a study on the effectiveness of mosquito soap, and the possibility of using two insecticides to impregnate nets. Governance issues were related to the best strategy for the implementation of SMC campaigns, quality of malaria case management at all health system levels, the place of information and communication technology in data quality management and the type of collaboration framework between the Ministry of Health and partners. For the medicines theme, the four priority questions focused on the efficacy and tolerance of ACTs under current guidelines, the side effects of ACTs, the efficacy of traditional medicines and the comparative advantage of the Dihydroartemisinin (DHA)-Piperazine combination over sulfadoxine–pyrimethamine (SP) + amodiaquine (SP-AQ). Regarding M&E, questions related to adherence for the second and third dose during seasonal chemoprevention campaigns, the performance and use of rapid diagnostic tests. In terms of human resources, the two priority issues were related to the contribution of community health workers in severe malaria case management and the supervision of the second and third doses during SMC campaigns. At the service delivery level, both issues were related to the quality and performance of the drug supply and management chains. Finally, in terms of public support, the questions were related to communication channels, media and strategies to ensure behavior change.

Table 3 shows the three priority issues identified by the three project country teams, namely Burkina, Mali and Niger.

**Table 3: Countries programming priority research questions on malaria**

<b>Countries</b>	<b>Priority issues MALARIA</b>
<b>Burkina Faso</b>	What is the most efficient strategy (door-to-door, cluster sites...) for seasonal malaria chemo-prevention (SMC)?
	What are the factors that influence adherence to Day 2 and Day 3 doses during SMC?
	What is the role of CHW in the supervised administration of IPT2 and IPT3 in pregnant women?
<b>Mali</b>	What are the factors that influence adherence to Day 2 and Day 3 doses during SMC campaign?
	What are the adverse toxicological effects of multiple administration of antimalarial drugs, SP-QA)? [ sulfadoxine–pyrimethamine (SP) + amodiaquine (AQ) in children
	What is the impact of communication interventions on the adoption of behaviors favorable to the fight against malaria?
<b>Niger</b>	What are the factors that influence adherence to Day 2 and Day 3 doses during SMC campaign?
	Quelle est l'efficacité thérapeutique de l'AQ+SP ?
	What is the therapeutic effectiveness of QA+SP?
	What is the role of CHW in the supervised administration of IPT2 and IPT3 in pregnant women?

It was noted that the research question on factors influencing adherence to second day (Day 2) and third day (Day 3) doses of (SMC came first in two countries (Mali and Niger) and second in Burkina. It was followed by questions related to the contribution of community health workers in the supervision of the second and third doses of drug during the SMC campaigns in Burkina and Niger. The final ones were in order of importance, the questions on the most efficient strategy in the implementation of SMC in Burkina Faso, the toxicological effects of administering multiple doses of SP-QA in children, the impact of communication interventions in 2nd and 3rd days in Mali, and the therapeutic effectiveness of SP-QA in Niger.

## Discussion

This work allowed the identification of key challenges limiting the implementation of national malaria control programs in West Africa. Priority research themes in malaria has helped to highlight similarities between countries regarding malaria control programs. Most of the bottlenecks highlighted by this work are related to the poor coordination and collaboration with partners, the skills and motivation of community health workers responsible for drug distribution during mass treatment. In addition, the bottlenecks were also due to weaknesses in the supply and distribution chain, poor use of prevention measures, difficulties in accessing quality data, especially at community level, and the population buy-in

and acceptance of strategies. The problems that have emerged in malaria control programs in this work have already been reported by some authors in Africa (5-11). Our results are consistent with previous reports regarding difficulties related to malaria management. With regards to research questions, there is an urgent need for information sharing on SMC strategy and implementation to allow effective malaria control and eradication. Community health workers and the general population must be mobilized and involved in the fight against malaria. The research questions on SMC seem consistent with reports that showed that there is little implementation research in malaria eradication programs in the three countries, Burkina, Mali and Niger. The majority of the research conducted related to SMC in west Africa, were clinical studies on the effectiveness of the malaria programs strategies and these studies (12-16) provide some answers to operational questions, however, more research is needed in malaria control across different countries.

This work was designed to assess the implementation, operational bottlenecks, and success of public health practice in West Africa. Furthermore, this study evaluated the relationship between program implementing actors, African researchers, and the constraints they face in their respective countries. Local researchers should work in coordination with program actors to address local problems. The New Partnership for Africa's Development (NEPAD)'s Consolidated Plan of Action 2005–2014 (CPA) and the Science Technology Innovation Strategy 2024 (17) attempted to ensure the continent's collective commitment towards an innovation-led knowledge development. Science and technology must be incorporated in different local strategies to address African problems, as evidence based research interventions are often required by donors and governments to improve the implementation of public health activities.

The landscape of global health keeps changing because new innovations and new discoveries are being implemented in interventions against emerging diseases (infectious and non-communicable). New discoveries either technically or "process, are not easy to incorporate in public health interventions since they require drawing new strategic plans and other logistics. Hassan (18) reported the difficult conditions in developing countries regarding research expertise and the lack of evidence-based research required to inform interventions, this makes developing countries inexistent when it comes to research in the context of globalization. Southern partners (especially developing countries) have generally identical social burdens and environmental conditions (19), therefore there is a need to increase intra-regional collaboration.

After the identification of research priority questions, the project funded some research activities taking into account these priorities. For instance, a regional research was commissioned in the three countries related to the factors that influence adherence to Day 2 and Day 3 doses during SMC. The research started in 2018 and the primary result will be obtained in 2020. The overall results will be validated in the countries and published in 2021. Still at the regional level, a second research was conducted to analyze all communication interventions and impact on malaria programs. Currently the preliminary results on the mapping of communication interventions are being finalized and the impact study is ongoing. Between 2018 and 2020, a Lot Quality Assurance Sampling Survey (LQAS) was conducted in Burkina Faso and

Mali in order to analyze the performance of the SMC campaign. Further research work is needed to on research questions not addressed in this study. In Mali, three studies were conducted including the prevalence of *Plasmodium falciparum* carriage rate in the Season Malaria Chemoprevention implementing areas; on adverse toxicological effects of multiple administration of sulfadoxine-pyrimethamine (SP) + amodiaquine, and on potential factors affecting adherence to mass drug Administration (MDA) in nomadic population. All the studies will be published soon.

Further research work is needed on research questions not addressed in this study. The result of this study in combination with the research projects funded will improve malaria control programs.

In conclusion, this work showed the effectiveness of collaboration between policy makers and researchers in identifying and funding research needed to improve malaria control programs. The research questions identified can be adapted to other ongoing research to improve malaria control in different countries.

## References

1. H. Manisha Yapa and Till Bärnighausen. Implementation science in resource-poor countries and communities. *Implementation Science* (2018) 13:154 <https://doi.org/10.1186/s13012-018-0847-1>
2. Gething PW, Casey DC, Weiss DJ, Bisanzio D, Bhatt S, Cameron E, Battle KE, Dalrymple U, Rozier J, Rao PC, Kutz MJ, Barber RM, Huynh C, Shackelford KA, Coates MM, Nguyen G, Fraser MS, Kulikoff R, Wang H, Naghavi M, Smith DL, Murray CJ, Hay SI, Lim SS. Mapping *Plasmodium falciparum* Mortality in Africa between 1990 and 2015. *N Engl J Med*. 2016 Oct 10. [Epub ahead of print]
3. World malaria report 2018 <https://www.who.int/malaria/publications/world-malaria-report-2018/en/> Accessed 20 December 2019
4. Sahel Malaria and Neglected Tropical Diseases (SM/NTD) Project 2016-2020
5. 2nd African Think Tank Summit: The Rise of Africa's Think Tanks - Practical Solutions to Practical Problems," <https://www.acbfpact.org/sites/default/files/2nd%20African%20Think%20Tank%20Summit.pdf>. Accessed December 2019
6. Tine RC, Ndiaye P, Ndour CT, Faye B, Ndiaye JL, Sylla K, Ndiaye M, Cisse B, Sow D, Magnussen P, Bygbjerg IC, Gaye O. Acceptability by community health workers in Senegal of combining community case management of malaria and seasonal malaria chemoprevention. *Malar J*. 2013 Dec 30; 12: 467. doi: 10.1186/1475-2875-12-467.
7. Lo AC, Faye B, Ba el-H, Cisse B, Tine R, Abiola A, Ndiaye M, Ndiaye JL, Ndiaye D, Sokhna C, Gomis JF, Dieng Y, Faye O, Ndir O, Milligan P, Cairns M, Hallett R, Sutherland C, Gaye O. Prevalence of molecular markers of drug resistance in an area of seasonal malaria chemoprevention in children in Senegal. *Malar J*. 2013 Apr 23; 12: 137. doi: 10.1186/1475-2875-12-137.
8. Kuehne A, Tiffany A, Lasry E, Janssens M, Besse C, Okonta C, Larbi K, Pah AC, Danis K, Porten K. Impact and Lessons Learned from Mass Drug Administrations of Malaria Chemoprevention during

- the Ebola Outbreak in Monrovia, Liberia, 2014. *PLoS One*. 2016 Aug 31; 11(8):e0161311. doi: 10.1371/journal.pone.0161311.
9. Nonvignon J, Aryeetey GC, Issah S, Ansah P, Malm KL, Ofosu W, Tagoe T, Agyemang SA, Aikins M. Cost-effectiveness of seasonal malaria chemoprevention in upper west region of Ghana. *Malar J*. 2016 Jul 16; 15: 367. doi: 10.1186/s12936-016-1418-z.
  10. Toure OA, Kone PL, Coulibaly MA, Ako BA, Gbessi EA, Coulibaly B, N' Guessan LT, Koffi D, Beourou S, Soumahoro A, Bassinka I, Nougou M, Swa T, Gba B, Esmel B, Bokossa EM. Coverage and efficacy of intermittent preventive treatment with sulphadoxine pyrimethamine against malaria in pregnancy in Côte d'Ivoire five years after its implementation. *Parasit Vectors*. 2014 Nov 20; 7: 495. doi: 10.1186/s13071-014-0495-5.
  11. Dabo A, Bary B, Kouriba B, Sankaré O, Doumbo O. Factors associated with coverage of praziquantel for schistosomiasis control in the community-direct intervention (CDI) approach in Mali (West Africa). *Infect Dis Poverty*. 2013 Jun 10; 2 (1):11. doi: 10.1186/2049-9957-2-11.
  12. Cairns M, Cheung YB, Xu Y, Asante KP, Owusu-Agyei S, Diallo D, Konate AT, Dicko A, Chandramohan D, Greenwood B, Milligan P. Analysis of Preventive Interventions for Malaria: Exploring Partial and Complete Protection and Total and Primary Intervention Effects. *Am J Epidemiol*. 2015 Jun 15; 181 (12):1008-17. doi: 10.1093/aje/kwv010.
  13. Nonvignon J, Aryeetey GC, Issah S, Ansah P, Malm KL, Ofosu W, Tagoe T, Agyemang SA, Aikins M. Cost-effectiveness of seasonal malaria chemoprevention in upper west region of Ghana. *Malar J*. 2016 Jul 16; 15: 367. doi: 10.1186/s12936-016-1418-z.
  14. Walker PG, Griffin JT, Ferguson NM, Ghani AC. Estimating the most efficient allocation of interventions to achieve reductions in *Plasmodium falciparum* malaria burden and transmission in Africa: a modelling study. *Lancet Glob Health*. 2016 Jul; 4(7):e474-84. doi: 10.1016/S2214-109X(16)30073-0
  15. Tine RC, Ndiaye P, Ndour CT, Faye B, Ndiaye JL, Sylla K, Ndiaye M, Cisse B, Sow D, Magnussen P, Bygbjerg IC, Gaye O. Acceptability by community health workers in Senegal of combining community case management of malaria and seasonal malaria chemoprevention. *Malar J*. 2013 Dec 30; 12:467. doi: 10.1186/1475-2875-12-467.
  16. Tine RC, Ndour CT, Faye B, Cairns M, Sylla K, Ndiaye M, Ndiaye JL, Sow D, Cisse B, Magnussen P, Bygbjerg IC, Gaye O. Feasibility, safety and effectiveness of combining home based malaria management and seasonal malaria chemoprevention in children less than 10 years in Senegal: a cluster-randomised trial. *Trans R Soc Trop Med Hyg*. 2014 Jan; 108 (1):13-21. doi: 10.1093/trstmh/trt103.
  17. African Union; Committee Education, Science and Technology  
[https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english\\_-\\_final.pdf](https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf)  
Accessed December 2019
  18. Hassan, M. A. H. (2000). Challenges, opportunities and strategies in South-South cooperation. *Cooperation South*, 1, 29–42. Publication by the Special Unit for Technical Cooperation among

Developing Countries (TCDC), United Nations Development Programme, New York

19. Kane, O. (2000). Priority sectors and actions for science and technology cooperation. Cooperation South, 1, 66–73. Publication by the Special Unit for Technical Cooperation among Developing Countries (TCDC), United Nations Development Programme, New York.

## **Declarations**

There's no financial/personal interest or belief that could affect objectivity of the authors.

### **Ethics approval and consent to participate**

“Not applicable”

### **Consent for publication**

“Not applicable”. All Authors reviewed the contents and consented before publication

### **Availability of data and material**

Data supporting the results reported in the manuscript article can be found at West African Health Organization (WAHO) archives and in the references provided in the manuscript

### **Competing interests**

There is no competing interest and financial gain publishing this article

### **Funding:**

Participation to the regional meeting mentioned in the document was funded by WAHO and the World Bank

### **Authors' contributions**

All Authors reviewed the contents and consented, before publication

### **Acknowledgement**

We would like to thank all countries participating in the malaria elimination effort in West Africa