Challenges to Malaria Control and Elimination: The West African ICEMR Perspective in Mali

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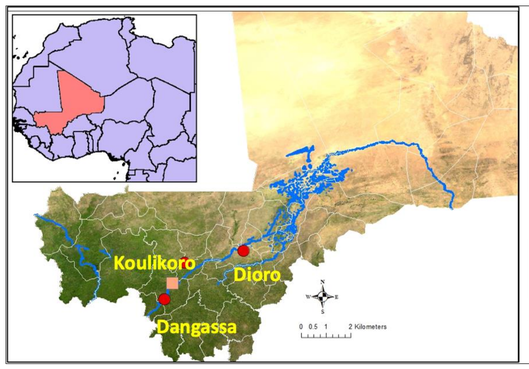
BACKGROUND

Following the scaling-up of effective control interventions, the malaria burden has significantly decreased across sub–Saharan African (SSA) countries over the past decades. However, interruption of malaria transmission in SSA remains a challenge in many regions still carrying a disproportionate share of the global burden of malaria. The West Africa International Centers for Excellence in Malaria Research (WA-ICEMR, Mali), a multidisciplinary approach performing implementation research, has provided a unique opportunity to determine critical barriers related to changing epidemiological patterns in both human and mosquito vectors, and to provide perspective of developing contextually tailored interventions that may address the evolving needs of malaria control programs.

The WA-ICEMR in Mali collects data on malaria prevalence and incidence, vector transmission indicators, and molecular markers of insecticides and drug resistance, in relation with ongoing control interventions leveraging a study cohort enrolled for more than twelve (12) years in Dangassa and Koila Bamana and over seven years in Sirakorola. Each study site represents a specific malaria transmission pattern across the countries.

Data shows that the expansion and enhancement of interventions such as long-lasting insecticide-treated bed nets (LLINs), and seasonal malaria (SMC) targeting children under 5 years old, have significantly reduced at least by 50% both asymptomatic infection prevalence and the incidence of clinical malaria. However, about 10 to 15% of individuals asymptomatically infected with *P. falciparum* at the end of transmission season (November) tend to persist or remain infected during the long dry season (December to May). An extended incidence of malaria cases through the dry season in identified hot spots was observed, calling for more attention to factors associated with dry-season malaria as well as the contribution of the dry-season parasite reservoir to the uptake of transmission at the onset of the rainy season.

METHODS



Characteristics	Dangassa	Sirakorola/Kouli koro	Koila B /Dioro
Ecology	South Savana	North Savana	Sahel, irrigated
Transmission	June-Nov	June-Oct	July-Oct
Malaria Control Intervention			
ACTs	Free for children <5 +ICEMR cohort	Free for children < 5	Free for all age and to <5 only since 2014
LLINs/Universal	2015 Aug 2015 Aug 2018	2015 Aug 2015 Aug 2018	since 2008 2014 Dec 2019
IRS	No	2008-2016	No
SMC: SP+Amodiaquine to children < 5 (July, August, Sept, Oct) Since 2015 in all sites			

ENTOMOLOGICAL APPROACHES

- **Vector biting behavior was measured at HLC.**
- **Genotyping of pyrethroid and carbamate resistance markers by Taqman**

STUDY DESIGN

Cohort of **1400 children & adults**

Longitudinal cohort surveys (malaria infection & transmission)
start & end of transmission season

Passive Case-Detection
(Uncomplicated and severe malaria in study cohort)

Follow-up of a Sub cohort of 250 children under SMC
(Monthly Cross-Sectional Survey and active case detection)

RESULTS

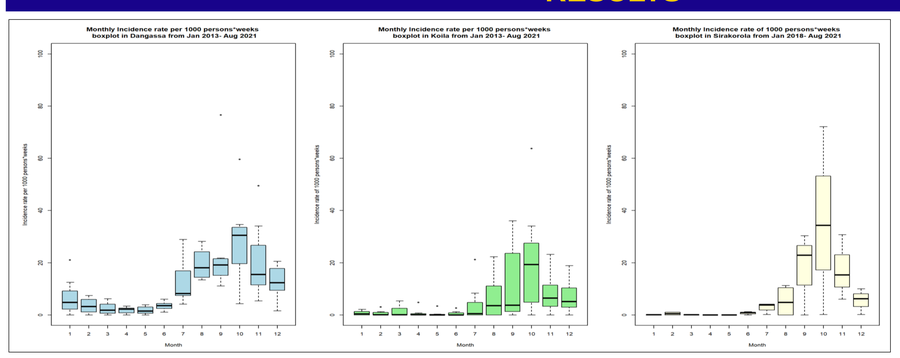


Fig.2: Seasonality of malaria in Dangassa, Koila Bamana and Sirakorola from 2012-20123 October.

Fig.3: Dry-season clinical malaria distribution in Dangassa: ***Possible clustering despite low number of cases***

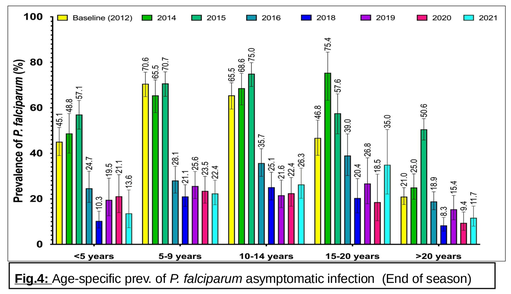


Fig.4: Age-specific prev. of *P. falciparum* asymptomatic infection (End of season)

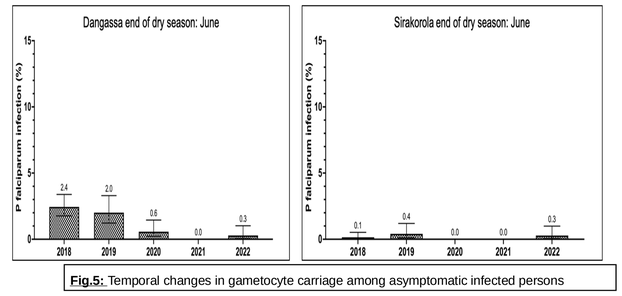


Fig.5: Temporal changes in gametocyte carriage among asymptomatic infected persons

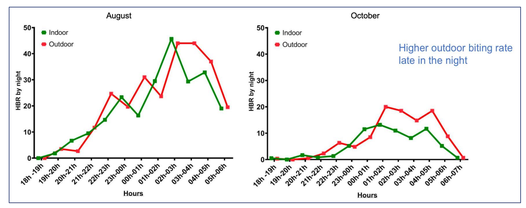


Fig.6: Anopheline biting behavior at peak malaria season: August & October)

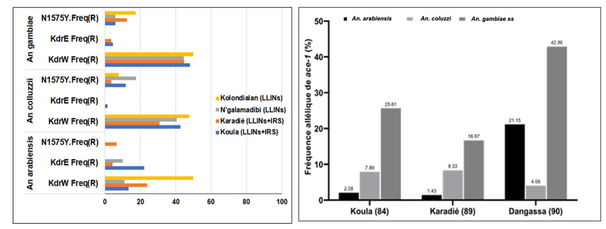


Fig.7: Anopheline biting behavior at peak malaria season: August & October)

DISCUSSION

- Regardless of the endemicity of malaria, the disease remains highly seasonal (more than 60% of cases during the rainy season)
- The relative lower number of cases observed during the dry-season showed a clustering in March that can be targeted for intervention such as "mass testing and treating to accelerate the elimination"
- Upward **age shift** of the burden of the disease (from < 5 to 5-9 and 10-14) and temporal change in gametocyte carriage prevalence overtime BUT still sufficient to maintain transmission
- Current vector control tools (LLINs, IRS) focus on indoor whereas Outdoor Biting Rates are similar to Indoor biting Rates: There is a need for new tools such as ATSBs
- Potential impact of wide **spread of insecticide resistance** (pyrethroid and carbamate): Increase in cost of effective LLINs and IRS in such a case
- Recrudescence or rebound of malaria after withdrawal of control programs such as IRS and SMC
- Increase number of cases reported among urban sites like Bamako as per the national surveillance data
- Climate change: increase in annual rainfall and temperature (both favorable to malaria vector abundance)
- Inadequate funding: The budget needed in 2021 to stay on track of GTS goals was 50% shorter

CONCLUSION

Despites the impact of current control interventions, many challenges are emerging in the fight against malaria in Mali, such as climate change, poverty, substandard health services and coverage, increased outdoor transmission and the emergence of new vectors, and the growing threat of resistance to antimalarial drugs and insecticides.

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- PMI-USAID, Mali

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