

# IVM Challenges and Impact in Tented Camps of South Sudan

A summary of evolving IVM approaches on  
malaria incidence in tented camps for displaced  
population since 2013- 2019



# Displacement in South Sudan

- After a brief period of peace after South Sudan gained independence from Sudan, civil war broke out in 2013 based on inter-ethnic fighting.
- As of December 2019, nearly a third of South Sudanese population are displaced:
  - 2.2 million South Sudanese refugees in neighbouring countries
  - 1.7 million are internally displaced
  - 298k refugees are living in South Sudan
- 103 IDP sites and 9 refugee camps (mainly for Sudanese refugees)
- Malaria is highly endemic \_ transmission season April-November in the northern areas
- Despite repeated mass distributions of LLINs, malaria caseload and deaths continue to increase nationally
- Resistance to pyrethroid class of insecticides found in LLINs has spread rapidly across the Sahel region and confirmed in localities of South Sudan



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# Camp Conditions and Malaria

- When camps form, populations with varying immunities rapidly mix together in a new environment increasing incidence and deaths in those with naturally low immunity.
- Populations seeking refuge in shelters are traumatised with low nutritional status and high susceptibility to other communicable diseases. This increases incidence of severe malaria, complicates treatment, and increases mortality.
- Sanitation infrastructure is usually weak with little to no drainage and frequent flooding increasing number and size of mosquito breeding sites during rainy season
- Without mass vector control interventions, malaria epidemics are sustained with high caseloads extending for months
- Temporary structures increase entry of the endophagic and night-biting *Anopheles* mosquitoes



# Integrated Vector Management

- MENTOR have implemented IVM in refugee and IDP camps since 2013
- IVM aims to protect communities from malaria / other VBD epidemics: by targeting vectors at different stages of life:

**Indoor Residual Spraying:** Spraying of all walls of sleeping rooms with insecticide before rainy season

**Larval Source Management:** Treatment of mosquito breeding sites with larvicide with liquid Abate

**Fly Control:** Treatment of fly breeding sites with pyriproxyfen powder

**LLIN Distribution:** Mass distribution to all households

**IEC/BCC:** Ongoing messaging to communities for proper usage/care of LLINs, increase IRS acceptance, increase health-seeking behaviour

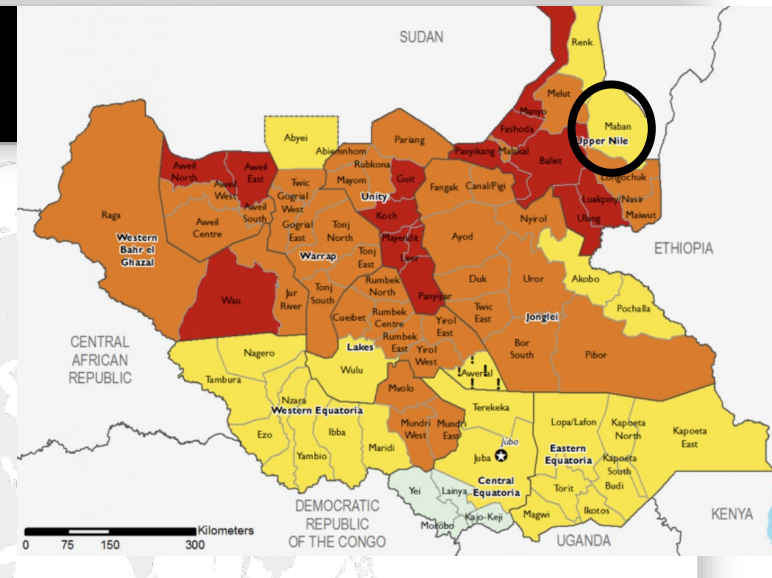


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# Camp Setting: Maban County

- Maban county has four refugee camps holding Sudanese populations fleeing armed conflict in Sudan's Blue Nile and South Kordofan states
- UNHCR constructed standard emergency tents or wooden frames with plastic sheeting initially
- As the sites have become more established due to low numbers of refugees returning, more shelters are now converted to clay / mud walls fortified with sticks
- Sporadic fighting and insecurity regularly breaks out within camps and between refugees and host communities



Camp	Population (2019)
Gendrassa	17,455
Doro	59,700
Batil	36,754
Kaya	22,903



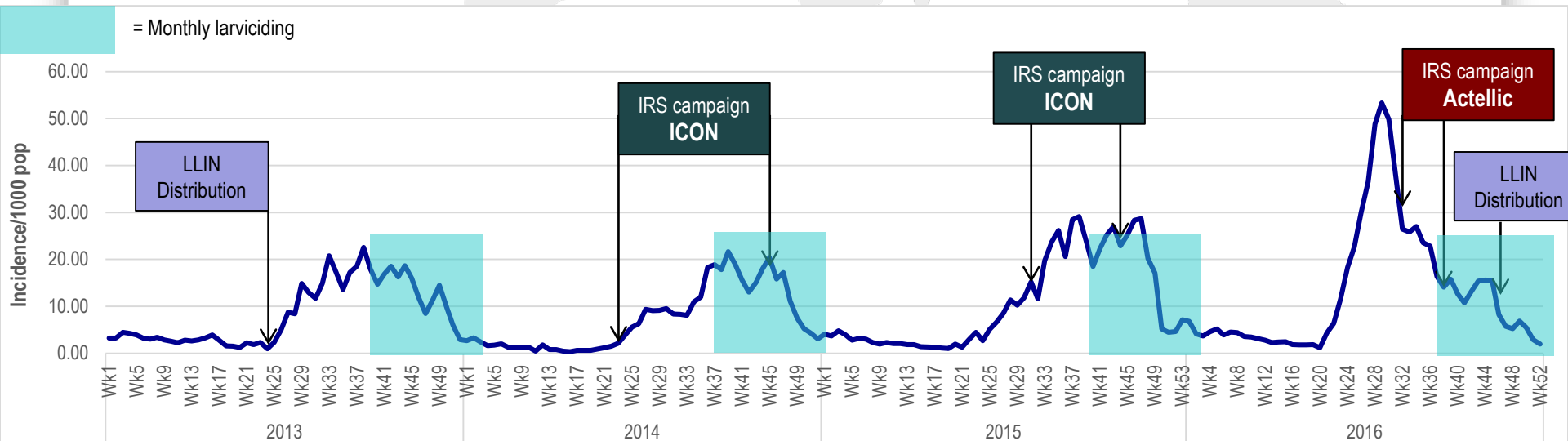
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# Maban Refugee Camps: 2013-2016



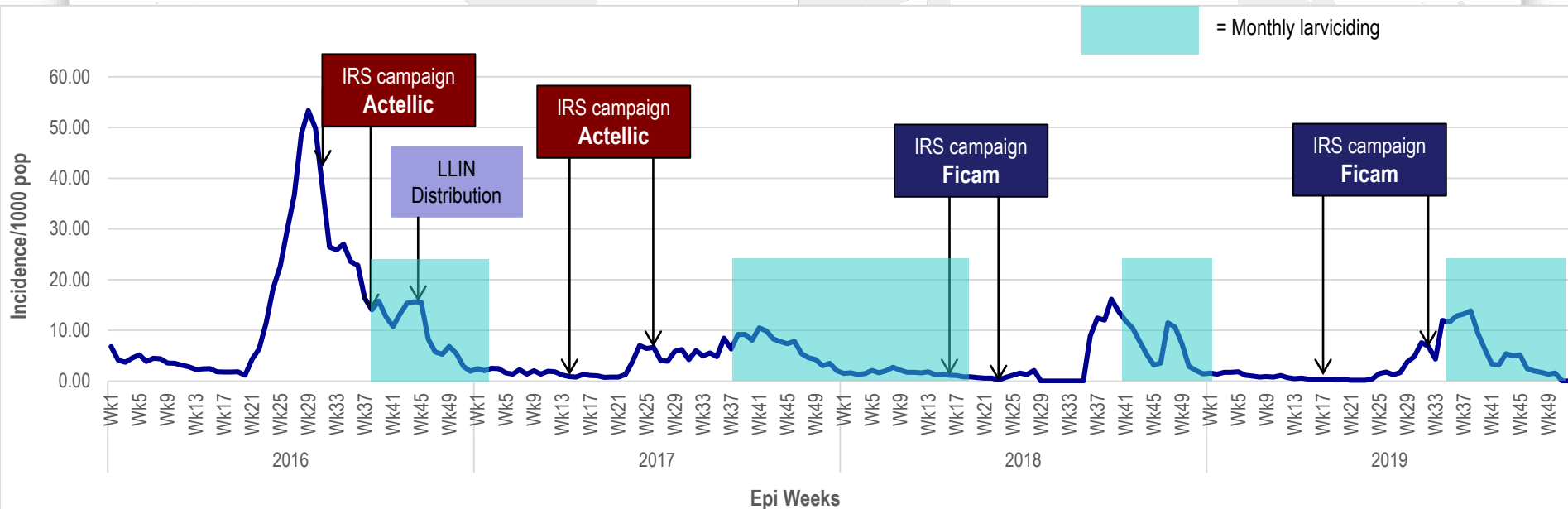
- Epidemiological data shows clear seasonal malaria outbreaks
- Mass larviciding campaign in Maban using 3 tonnes of Abate helped curb an outbreak
- Larviciding in future years is used as monthly supplementary vector control tool at the end of the rainy season when breeding sites are easily identified
- ICON (pyrethroid class) may provide some protection although little impact on the seasonal caseload implying there is vector resistance to local mosquito populations
- In 2016, insecticide was switched to Actellic (organophosphate class) although funding approval was delayed resulting in an intervention after the main peak of the epidemic



# Maban Refugee Camps: 2016-2019

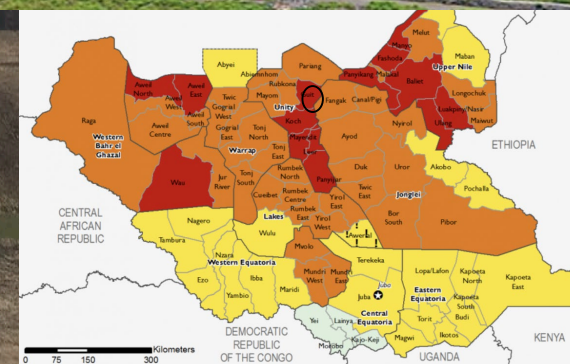


- 2017: IRS campaign was completed before transmission season began and using Actellic with a significantly high impact in preventing an outbreak
- 2018: To avoid organophosphate resistance, Ficam (carbamate class) was used. Unfortunately, targeted attacks (week 29-36) on NGO compounds caused complete shutdown of all humanitarian activities resulting in deterioration of environmental conditions (sanitation) and inaccessibility to health services
- Ficam has a shorter residual lifespan (3-6 months) which may account for the a slightly higher outbreak



# Camp Setting: Bentiu PoC

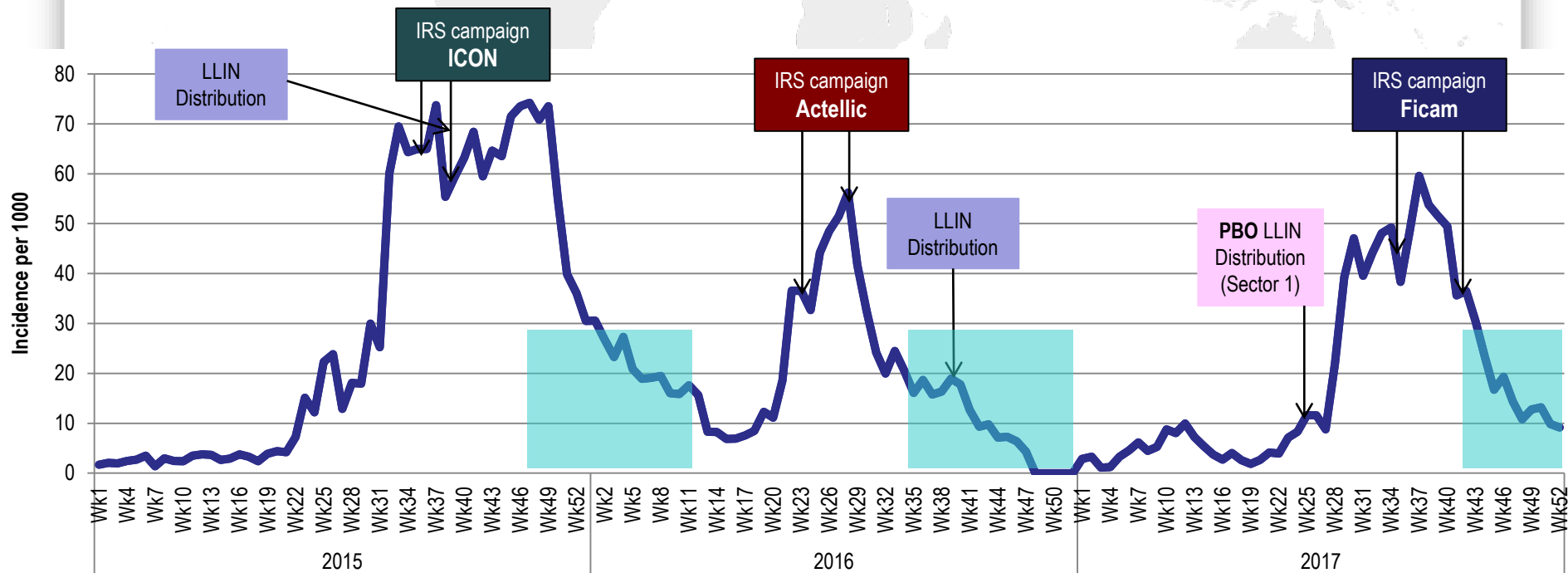
- Biggest camp in South Sudan containing IDPs from surrounding counties
- Highly fluid and mobile population: over 160,000 are registered although population counts are fluctuating at approx. 120,000
- A significant proportion of the camp are children under 5 at 36% (over 40,000)
- Camp experiences extensive flooding in rainy season as it is in a natural low-land
- Soil consistency does not soak water effectively leading to rapid formation of large breeding sites particularly in the channels around each block





# Bentiu PoC: 2015 - 2017

- 2015 suffered major epidemic despite high LLIN coverage and IRS using ICON which was then switched to Actellic for 2016
- In 2017, Sector 1 received LLINs containing PBO with remaining sectors receiving IRS with Ficam
  - PBO lost almost all residual bioefficacy after 9 months
  - Despite full-time IEC campaigns for 9 months, only 35% of distributed LLINs remained in the intended household and large proportion were regularly washing and drying in sun
  - In 2018, LLIN distribution was still implemented by partners despite evidence of pyrethroid resistance



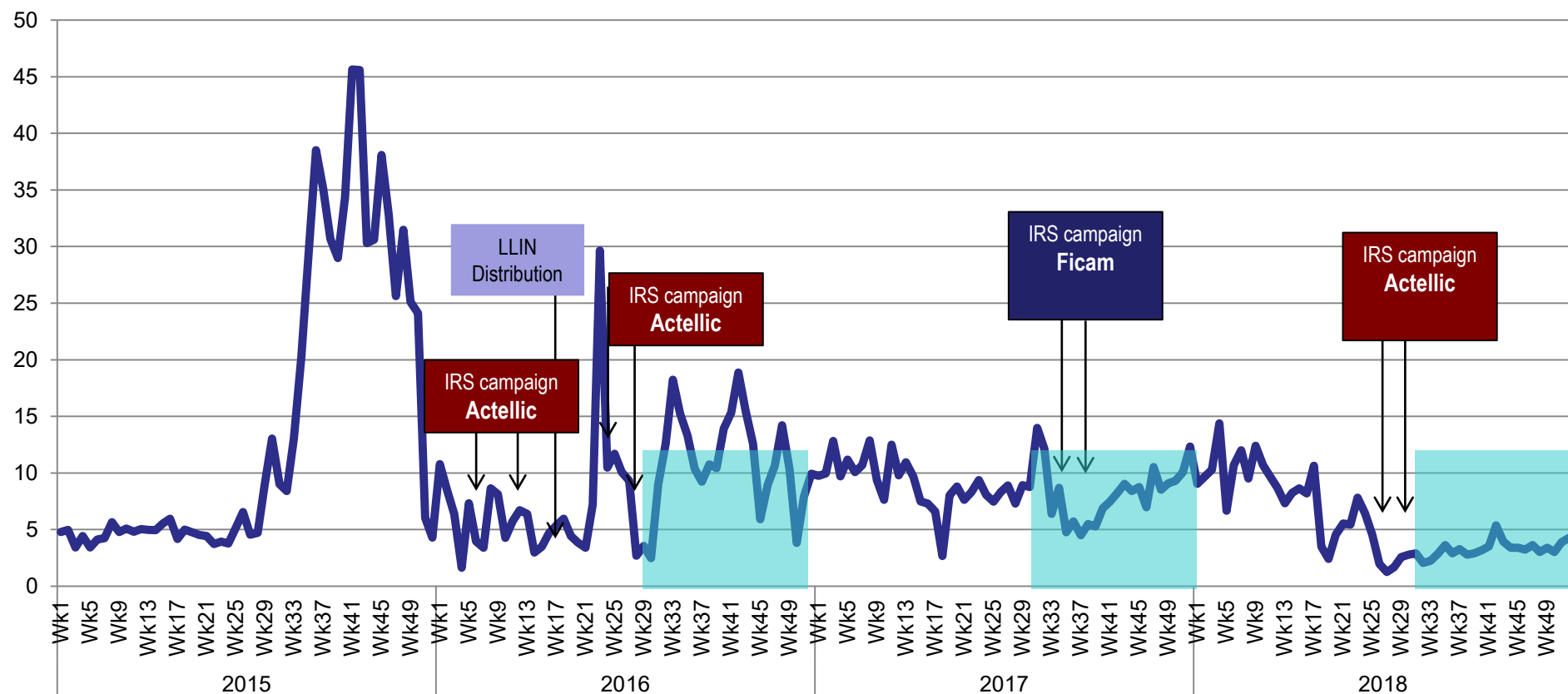
# Camp Setting: Malakal PoC

- Population consists of mainly those from Malakal city seeking refuge
- Significant overcrowding with no regularised blocks or drainage system with extensive flooding in the rainy season
- Fluctuating population of 30,000 people
- Houses are a mixture of plastic sheeting and corrugated iron structures using materials from local populations
- Seasonal malaria is usually later in the year



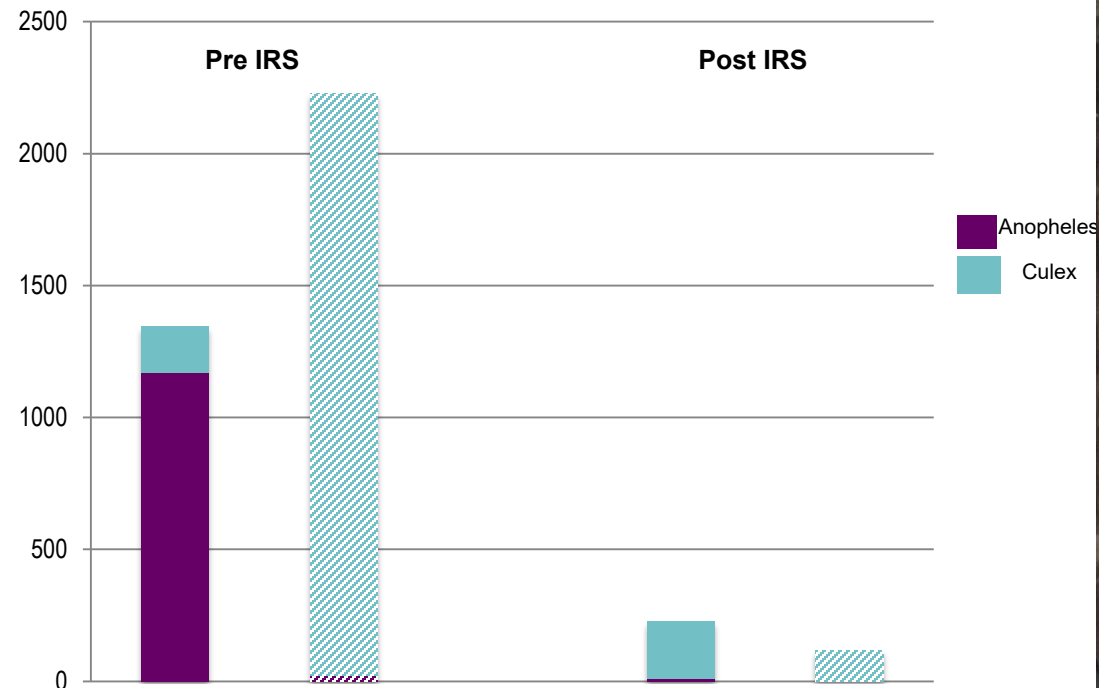
# Malakal PoC: 2015 - 2018

- In 2015, there was no IVM programme resulting in a major epidemic at the end of the year, despite LLIN distribution
- In subsequent years, IRS, using rotation between carbamate and organophosphate was utilised preventing any further malaria outbreaks
- With well-timed yearly IRS campaigns, intensity and size of outbreaks is



# Entomological Indicators

- Entomological monitoring was conducted in Bentiu & Malakal PoCs using CDC light traps to measure effect of IRS
- In Bentiu, high *Anopheles* vector density was detected even with a recent mass distribution of standard LLINs
- Bentiu PoC has naturally high *Anopheles* density although this significantly drops after IRS campaign
- IRS is highly effective at lowering vector density particularly *Anopheles*



# Insecticide Resistance: South Sudan

- MENTOR have conducted two separate susceptibility tests on local mosquito populations using WHO standard methodology
- Resistance to all classes of pyrethroids used in standard LLINs: lambda-cyhalothrin, permethrin and deltamethrin
- In these settings and across South Sudan, LLINs are acting as a physical barrier only and not a means of controlling vector density



## Wunrok, Warrap State, 2015

Insecticide Class	24 hr mortality	
Pyrethroid (type 2)	34%	●
Pyrethroid (type 2)	40%	●
Carbamate	100%	●
Organophosphate	100%	●

## Bentiu, Unity State, 2018

Insecticide Class	24 hr mortality	
Pyrethroid (type 1)	3.7%	●
Pyrethroid (type 2)	10%	●
Carbamate	94%	●
Organophosphate	99%	●

# Conclusions

- Even with repeated mass distribution of LLINs (Bentiu PoC), these are not the most effective tool for controlling vectors in this setting:
  - High insecticide resistance to pyrethroids
  - Rely heavily on human behaviour
- IRS, with the right timing and correct insecticide, is the most impactful at preventing / curbing epidemics for this environmental setting
  - High acceptance from the communities, does not rely on behaviour change or continual use
  - Provides protection for duration of transmission period
  - Insecticides can be rotated to avoid resistance
  - More cost-effective
- Larviciding used as supplementary tool at the end of rainy season to protect throughout dry season
  - More impactful when breeding sites are more fixed



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