



**Immunological &  
Parasitological Impact of  
Co-deployment of IRS &  
Bed Nets for malaria  
mosquito vector control in  
Uganda**

Erick.j.Okek

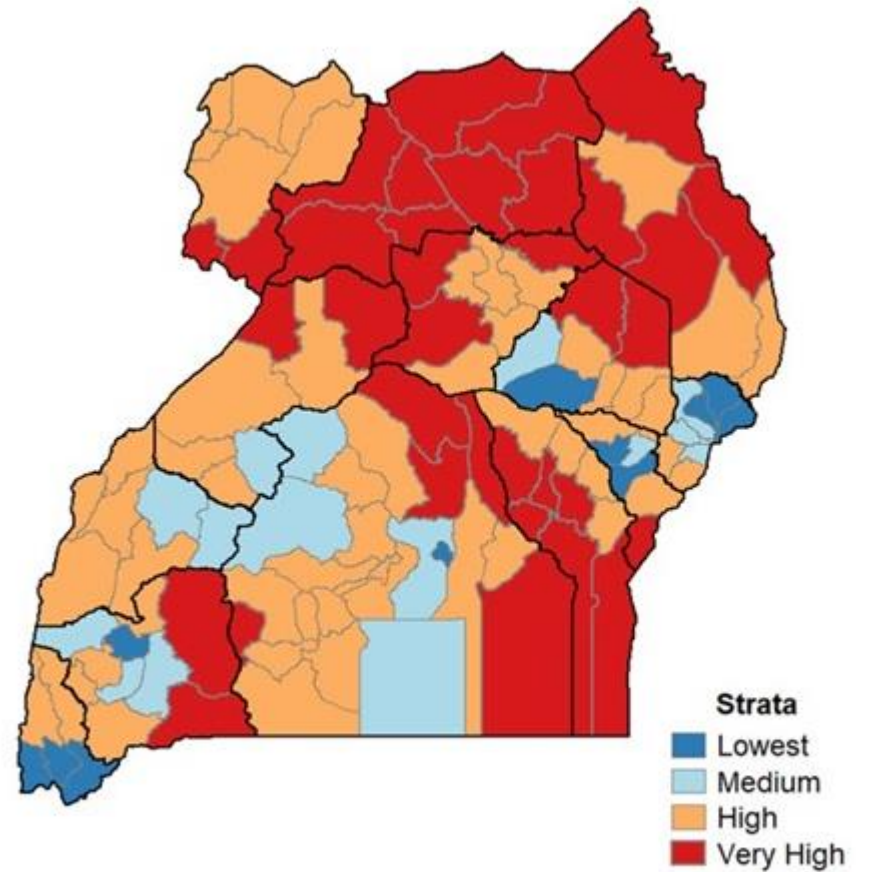
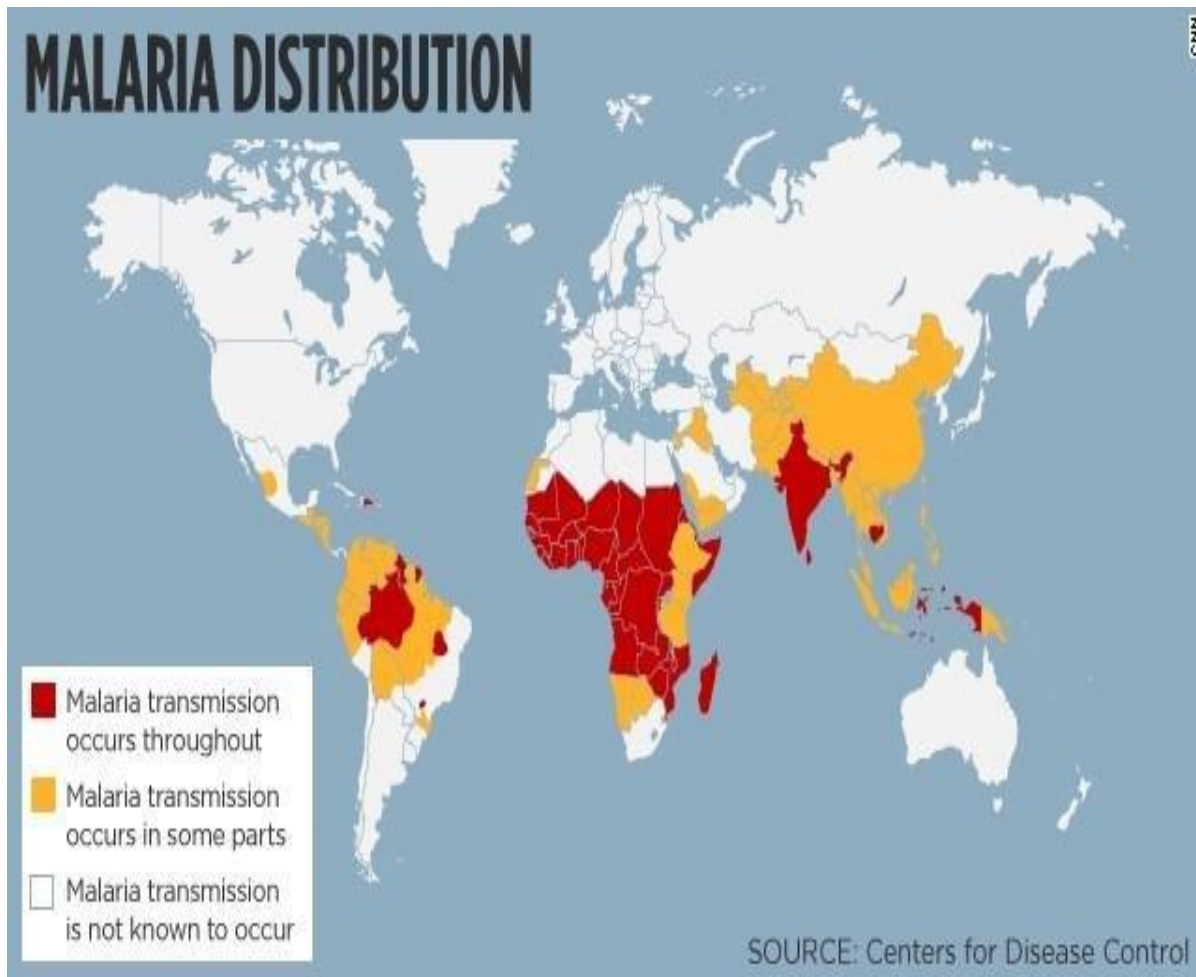
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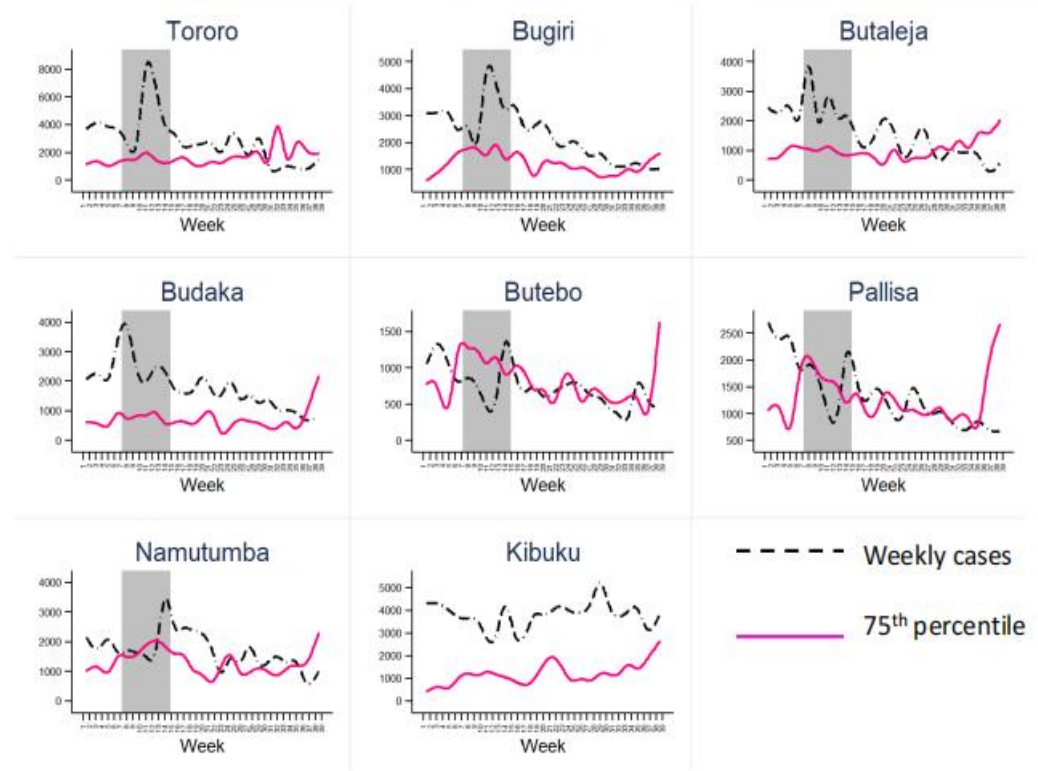
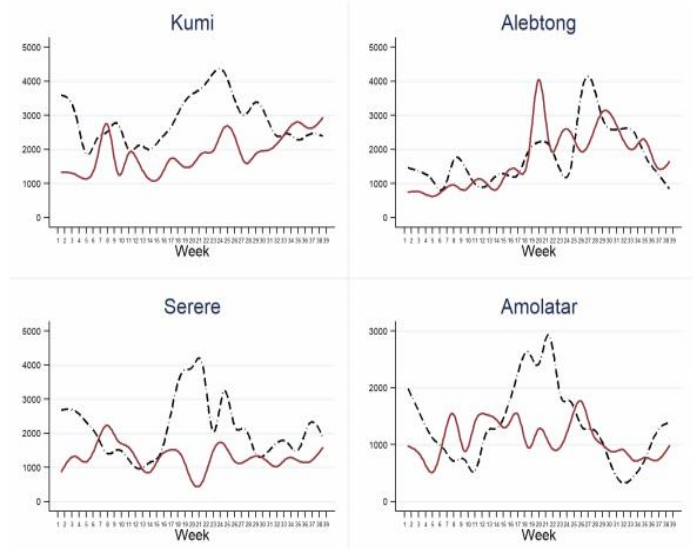


Stratification map of Uganda showing regions with the most malaria burden. Credit: The Uganda Malaria Reduction Strategic Plan (2021-2025)

# Background

All 7 districts (with grey bars-IRS weeks) have cases at or below the epidemic threshold

Non IRS district channels



IRS reduces malaria incidence, but for a short period



# Multiple interventions vs test positivity

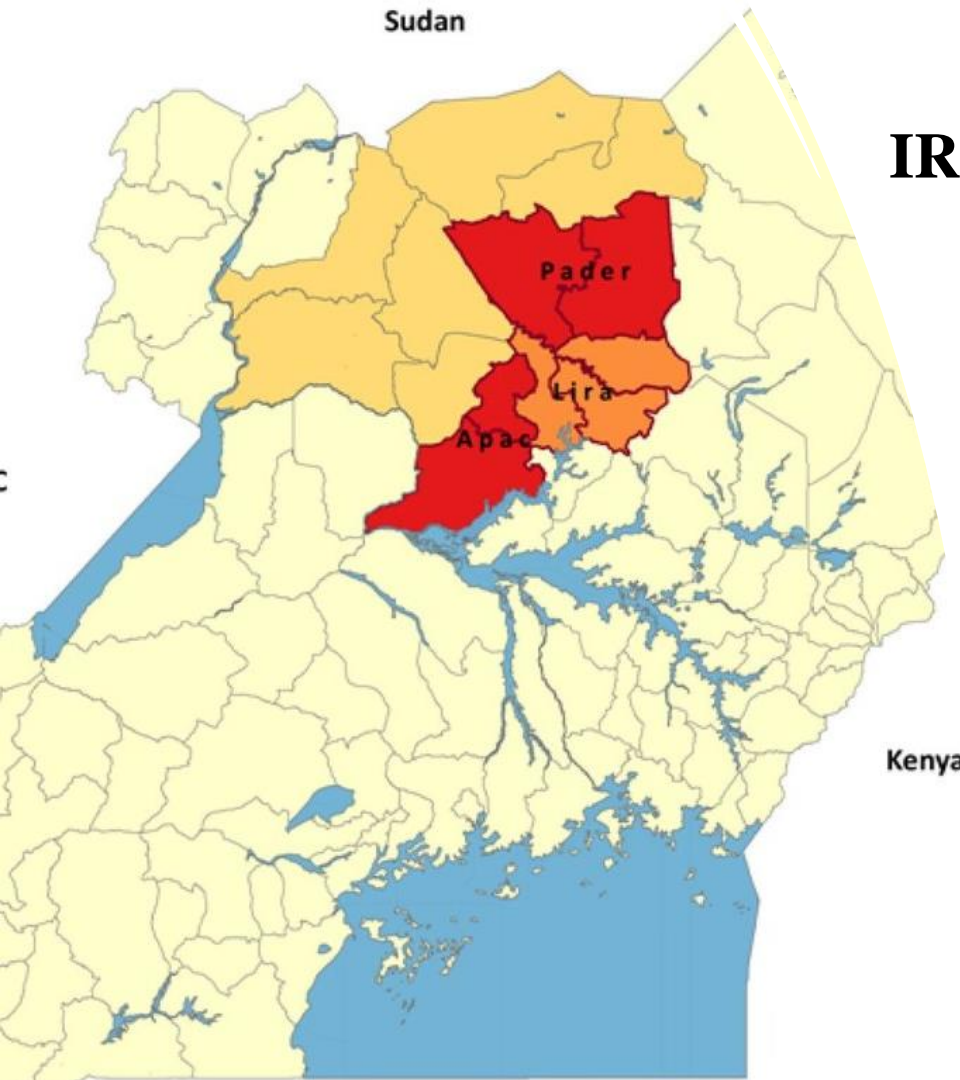
## Subcounties with the highest burden yet having key interventions

- Agikdak-86%
- Aputi-79%
- Arwotcek-76%
- Etam-74%
- Amolatar T/C-64%
- Acii-54%
- Namasale T/c-44%
- Awelo-43%
- Aputi-37%
- Muntu-36%
- Namasale-29%

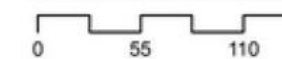
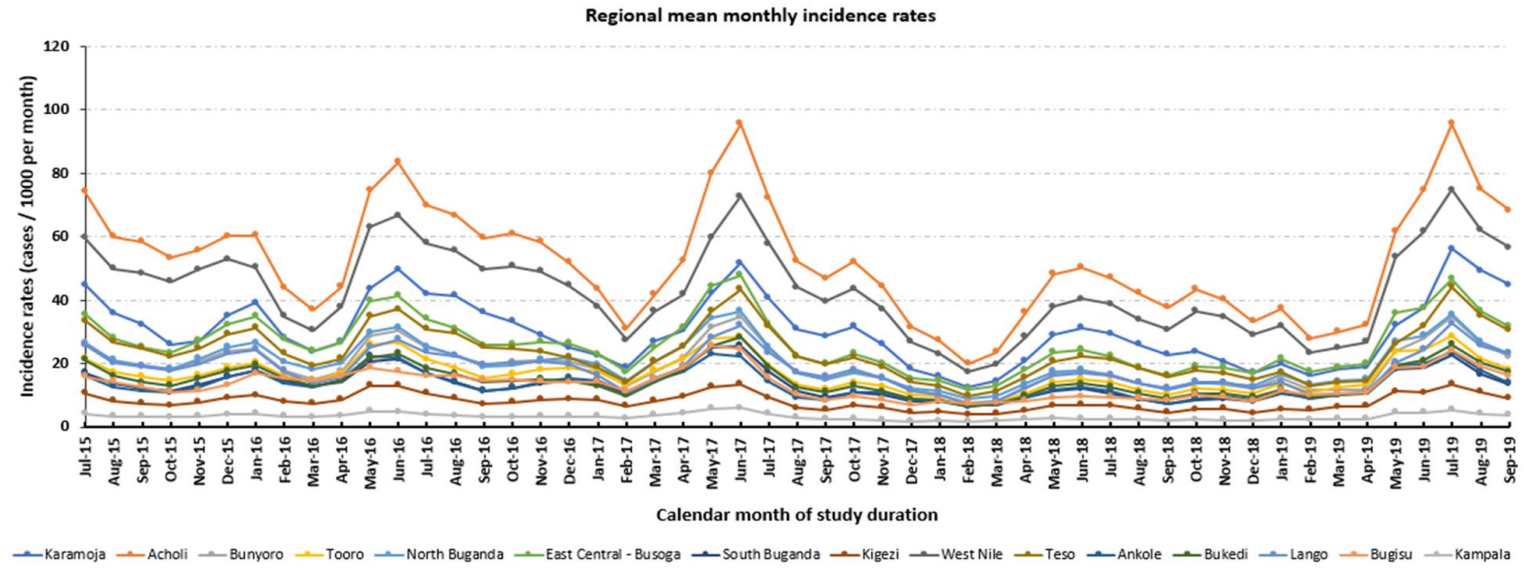
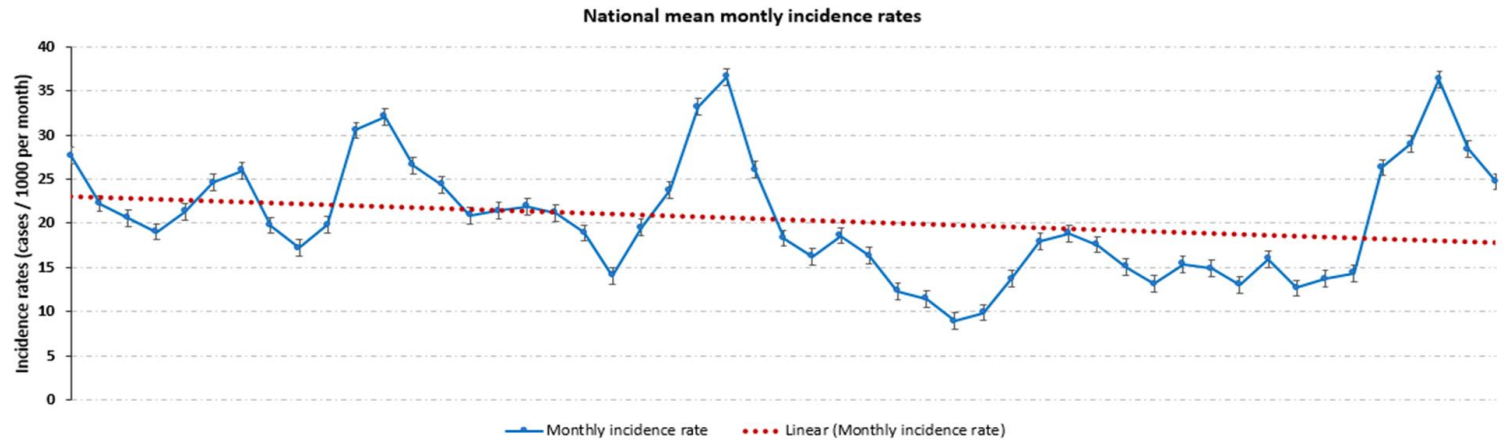
## key interventions & no. of sub-counties benefiting out of 16

- IRS-8 sub counties
- HAAM -6sub counties
- ICCM-16 sub counties
- ITNS-16 sub counties

Organisation unit name	TPR -Test Positivity Rate				Malaria Incidence Per 1000 population			
	Wk7	W8	W9	W10	Wk6	W7	W8	W9
Acii Health Centre II	52%	44%	51%	54%	524	438	512	536
Alyecmeda Health Centre III	65%	62%	68%	47%	565	568	589	470
Amai Community Hospital	69%	96%	75%	79%	306	424	396	383
Amolatar Health Centre IV	67%	63%	52%	64%	285	421	330	116
Anamwany Health Centre III	49%	35%	42%	43%	471	351	367	397
Aputi Health Centre III	62%	48%	51%	37%	565	473	494	358
Arwotcek Health Centre II	82%	68%	67%	76%	812	676	663	748
Awonangiro Health Centre III	60%	55%	85%	86%	523	554	770	742
Biko Health Centre III	68%	54%	58%	44%	587	470	580	437
Etam Health Centre III	50%	48%	68%	74%	317	290	507	605
Nakatiti Health Centre III	52%	49%	36%	36%	516	491	363	364
Namasale Health Centre III	48%	48%	41%	29%	338	338	250	177
Amolatar District	61%	54%	56%	54%	497	472	487	445



# IRS Piloted districts & trends in malaria incidence



# Study hypothesis

- In highly endemic areas, interventions that reduce parasite transmission may prevent the development of immunity due to reduced exposure, ultimately resulting in an increased overall ‘rebound’ burden of severe malaria .
- In the absence of effective vaccines to replicate the premunition state, intensified control measures may yet result in changing patterns of malaria morbidity and mortality.
- Interventions such as intermittent preventive therapy, indoor residual spraying if inconsistently applied have been shown to put pressure on parasite and vector genome to induce SNP.
- When inconsistently applied, they have also been associated with activation of var genes of the PfEMP1 family associated with chronic & severe forms of *P.falciparum* infections and immune evasion.
- This reservoir is in turn enabled by extreme antigenic diversity of the parasite and turnover of new variants which are usually resistant to common anti-malarial drugs such as ACTs.
- They are usually also un-responsive to vaccines such as RTS,S & R21MM since their haplotypes are not incorporated in the recombinant vaccine.

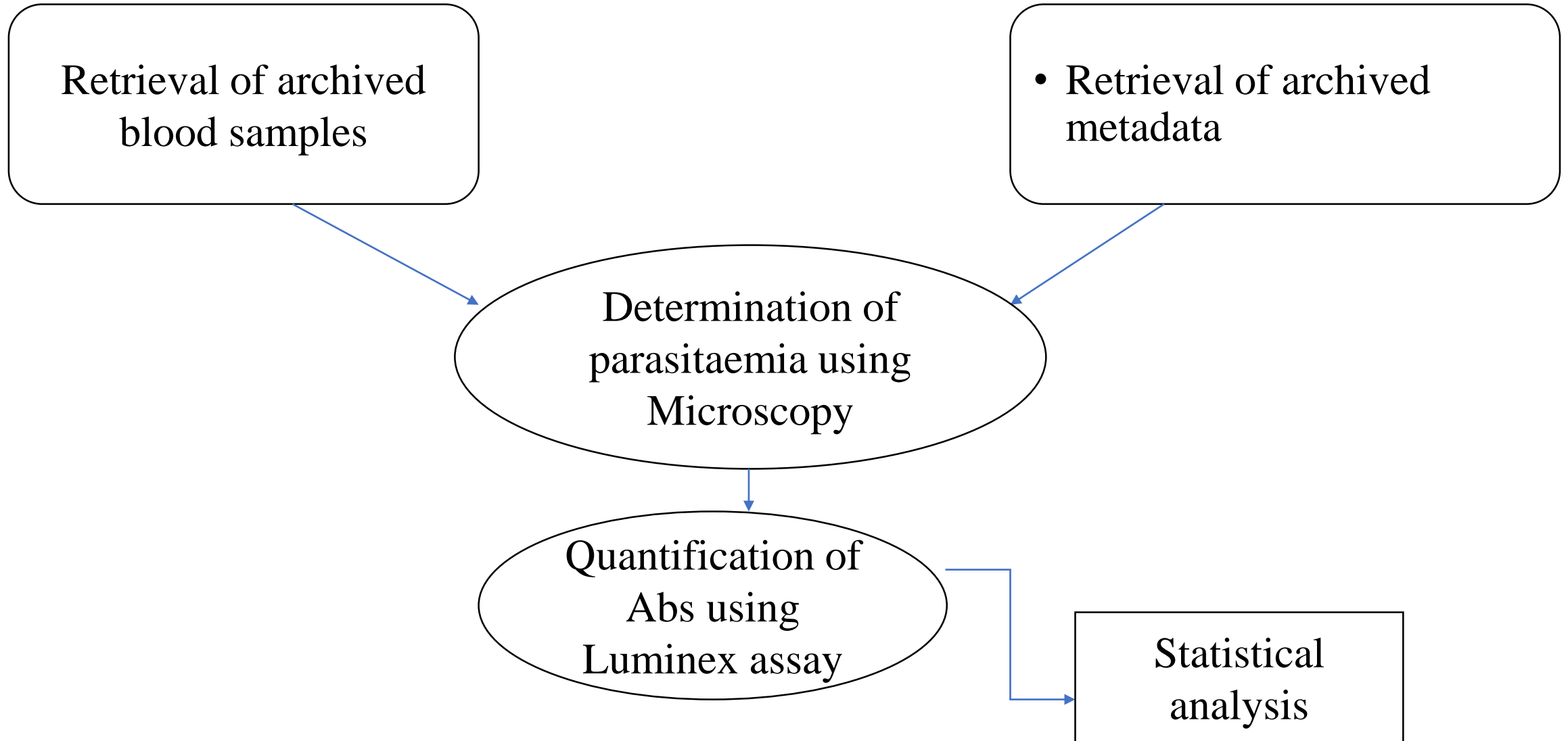
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# Study objectives

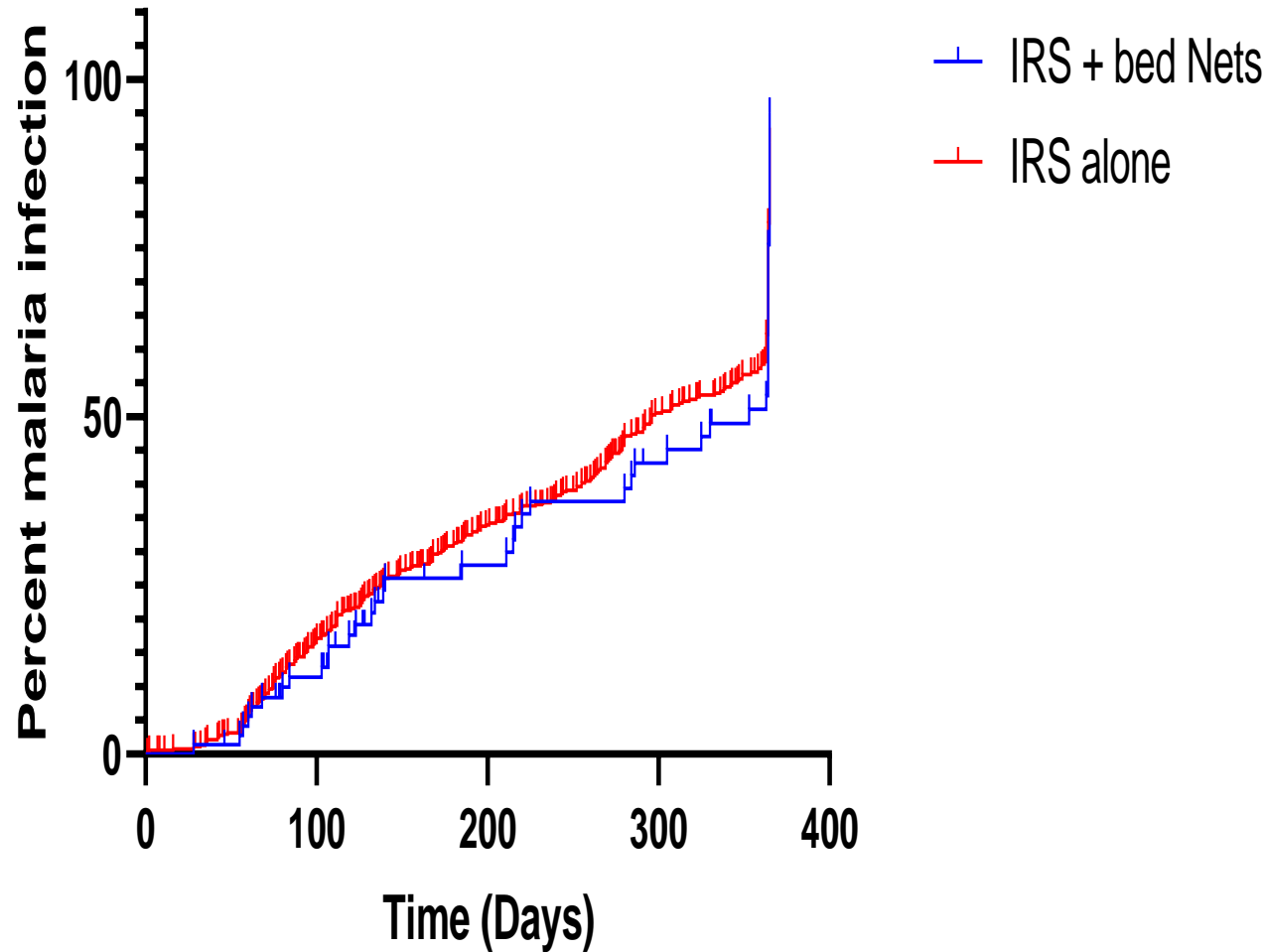
1. Ascertain the parasitological and immunological benefits of singular (IRS alone) versus multiple interventions (IRS & bed nets) for malaria vector control in areas of Eastern Uganda with high malaria.
2. Determine the effects of co-deployment of IRS + LLINS on serum expression of total IgG against signature *P.falciparum* antigens in blood samples of children from Malaria endemic areas of Eastern Uganda
3. Compare levels of total IgG against malaria specific antigens in blood samples of children with severe versus mild malaria in areas with co-deployment as a measure of immune protection.
4. Identify *P.falciparum* specific antigens that can best predict for malaria infections among children from disease endemic areas of Eastern Uganda



# Summary of Laboratory methods

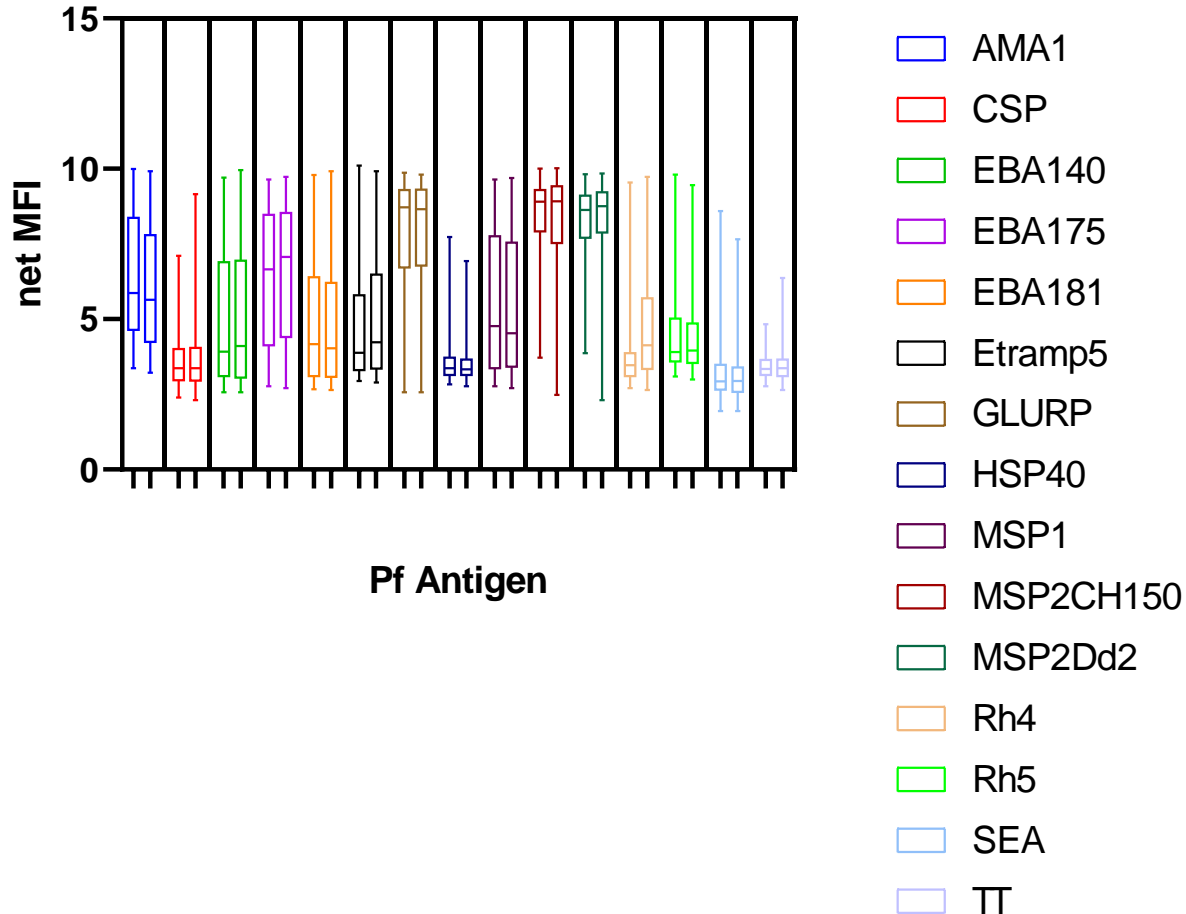


# Results



- There was no significant difference ( $p=0.4466$ ) in the survival rate between the two population though children from household with dual interventions had less malaria infections (median survival for IRS only households=296 days while that of IRS +bed nets=353 days).
- In the first 60 days , there was almost no malaria incidence in both arms of the study population; a proof of the effectiveness of either malaria mosquito vector control measures
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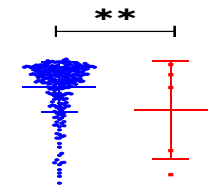
# Results



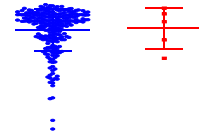
- There was no significant difference in serum total IgG level against signature antigens across the two groups.
- For certain antigens, the total IgG level was higher for the case population (AMA1, CSP, EBA181, GLURP, and MSP1-19) while others (EBA140, Etramp5Ag1, MSP2Dd2 and MSP2CH150) for control.
- There were almost equal IgG titers against tetanus toxoid for the two sets of population.
- Highest titers were noted for IgG against Merozoite Surface Proteins (MSP2CH150 & MSP2Dd2), EBA175 and GLURP
- Least titers were noted for total IgG response against CSP, HSP40, RH4.2 & Pf SEA.

# Children with severe malaria had reduced antibodies

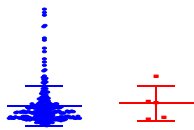
**MSPCH150**



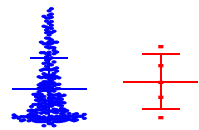
**MSP2Dd2**



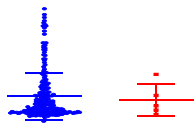
**Rh2**



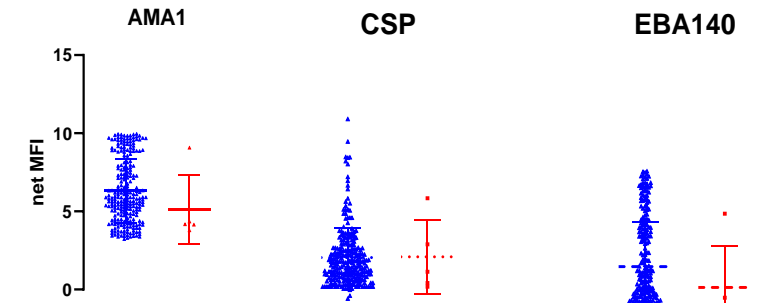
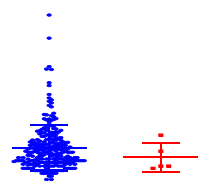
**RH4.2**



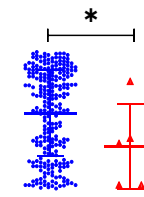
**RH5**



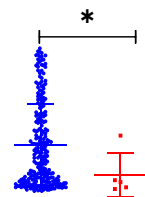
**SEA**



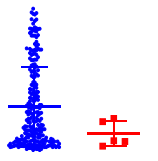
**EBA175**



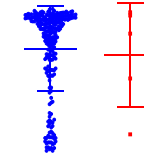
**EBA181**



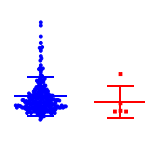
**Etramp**



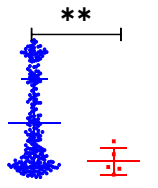
**GLURP**



**HSP40**



**MSP1**





# Cost of co-deployment

Intervention	Unit	Distribution method	Economic cost per unit	Marginal economic cost per unit	Sensitivity analysis	
					Lower value	Upper value
<b>Long lasting insecticide-treated bednets (LLIN)</b>	Net delivered	Mass campaign through community organizations [55]	\$8.52	\$8.37	\$4.26	\$17.04
<b>Indoor residual spraying (IRS)</b>	Person protected	Annual mass campaign [55]	\$0.73	\$0.34	\$0.34	\$1.46
<b>School-based intermittent screen and treat (IST)</b>	Child screened	School-based distribution [56]	\$6.32	\$2.89	\$3.16	\$12.63

All costs are in 2012 USD.

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# Conclusion & recommendation

- Co-deployment may not be necessary for areas of High Malaria transmission such as many parts of Uganda. Deployment of singular interventions may be more effective in such settings
- Co-deployment may be more effective in areas/countries nearing elimination
- Interval of Application of IRS and Net distribution must be scientifically pre-determined rather than reactionary as it is currently
- Introduction of R21MM to the already available control interventions may not come with real additional Immunological & parasitological benefits yet it attracts huge cost.
- For highly malaria endemic areas such as northern Uganda, development of Naturally acquired immunity may be a safe and cost-effective way of fighting malaria

A complex network diagram with nodes and edges. The nodes are represented by circles of various sizes and colors: dark blue, orange, and grey. The edges are thin lines connecting the nodes, creating a dense web of connections. The background is a light grey color.

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