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New Nets Project interim results

Output 3—evidence from pilots

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1 Project overview

2 Progress on activities to date

3 Interim results

4 Key issues

New Nets Project partners

IVCC

- Lead and coordinator
- Liaison with industry partners
- Link to vector control product development pipeline

psi
Healthy lives. Measurable results.

- Compilation of cross-country lessons learned from pilot studies, funding for process evaluations

The Alliance for Malaria Prevention

- Technical assistance

Imperial College London

- Modelling of trials design and implementation impact

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- Cost-effectiveness determination from pilot implementations

LSTM
LIVERPOOL SCHOOL OF TROPICAL MEDICINE

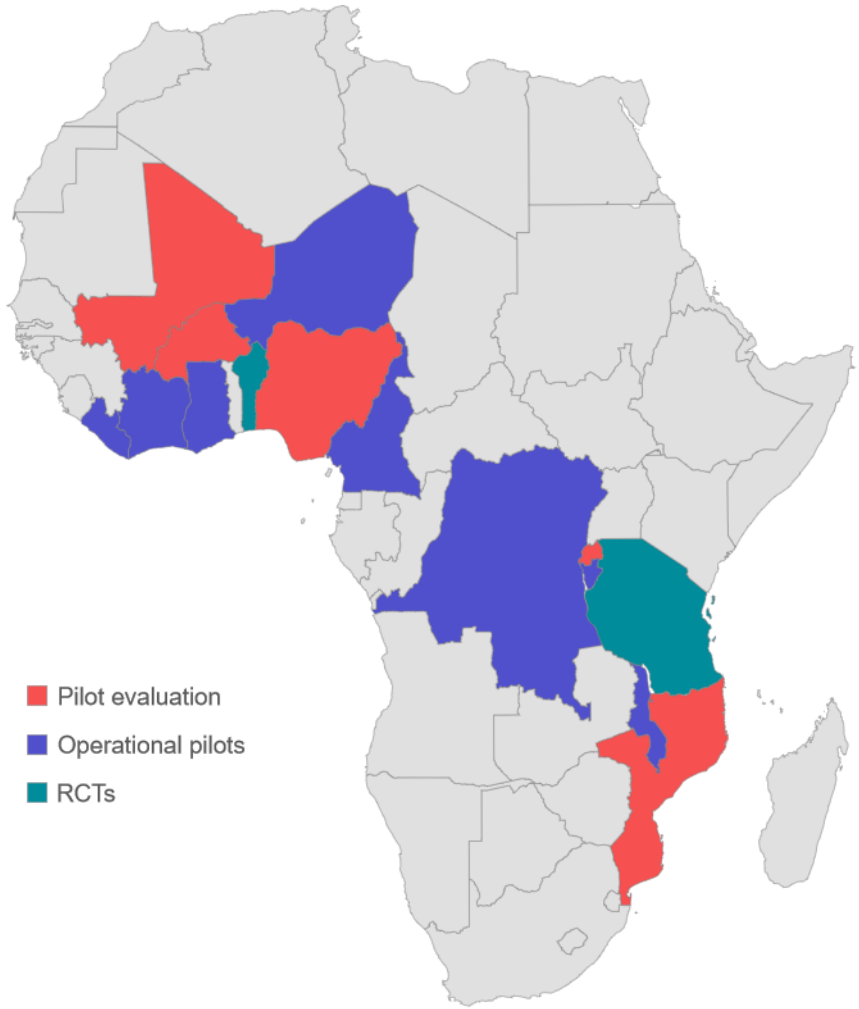
- Entomological correlates of epidemiological Impact

Tulane University

- Cost effectiveness study design and data collection

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

- Cluster-randomised trials of dual active-ingredient ITNs and entomological correlates in trials



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Interim results – interpret with caution

The NNP will support research and enhanced surveillance activities to evaluate the impact of the different ITN types (2020 – 2022)

- Interceptor® G2 ITN
- Royal Guard® ITN
- PBO ITN
- Standard ITN

Epidemiology

- Measure impact of new nets and standard ITNs, and if feasible PBO ITNs, through observational studies comparing trends in:
  - Parasite prevalence
  - Malaria prevalence in antenatal care
  - Malaria case incidence

Entomology

- Evaluate the impact of new nets and standard ITNs, and if feasible PBO ITNs, on vector population density, behavior, infection and resistance status

Anthropology

- Map social determinants of impact for new nets and determine transmission risk through gathering evidence on ITN uptake and usage; collecting data on patterns, both indoors and outdoors, becomes an essential component of the evaluation of the ITN pilots for both modeling and contextual analysis of impact

Cost-effectiveness

- Estimate the cost and cost-effectiveness through data on product price, delivery and deployment costs and effectiveness based on incidence rates

Durability monitoring

- Estimating survivorship, attrition, physical integrity and insecticidal content throughout the study time period

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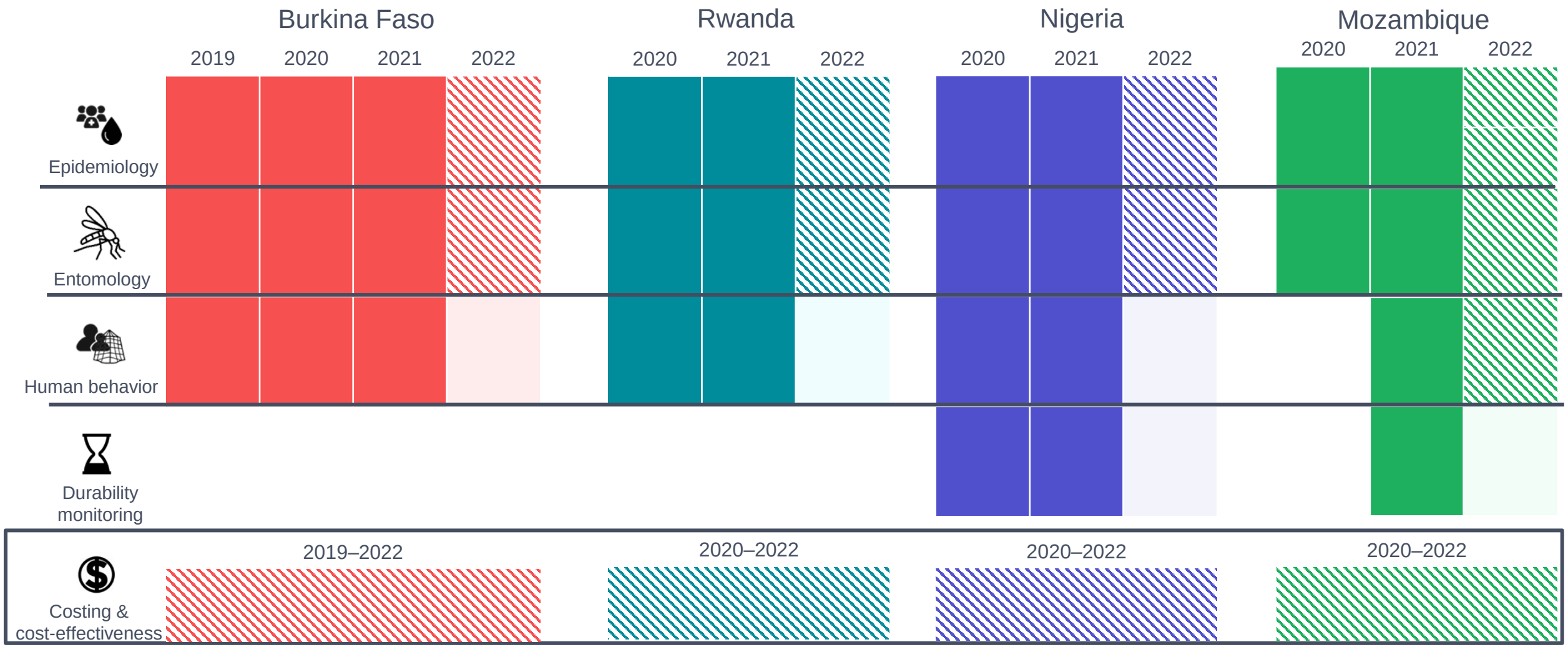
Progress on study activities



Interim results – interpret with caution

Burkina Faso

Baseline vector landscape

Burkina Faso

	Gaoua (Standard ITNs)		Banfora (IG2 ITNs)		Orodara (PBO ITNs)	
	2019	2020	2019	2020	2019	2020
Most abundant vector (% of likely vector species collected)	*An. gambiae* s.l. (67.9%)	*An. gambiae* s.l. (83.7%)	*An. gambiae* s.l. (97.7%)	*An. gambiae* s.l. (99.7%)	*An. gambiae* s.l. (92.9%)	*An. gambiae* s.l. (99.6%)
Second most abundant vector (% of all anophelines collected)	*An. funestus* s.l. (23.4%)	*An. funestus* s.l. (15.6%)	*An. coustani* (0.5%)	*An. funestus* s.l. (0.3%)	*An. funestus* s.l. (0.5%)	*An. funestus* s.l. (0.4%)
***An. gambiae* molecular IDs**						
An. gambiae s.s.	93.3%		35.1%		81.1%	
An. coluzzii	5.2%		64.7%		18.9%	
An. arabiensis	1.5%		0.2%		0.0%	
HLC nightly landing rates (*An. gambiae* s.l.)						
Indoor:outdoor ratio	0.86	1.22	0.75	0.99	0.64 *	0.83
Pyrethroid resistance profile	**HIGH resistance: Partially mitigated by PBO**					
WHO tube test morality	Less than 50%		Less than 50%		Less than 50%	

- District-level resistance patterns are currently being assessed, but early data indicates **HIGH pyrethroid resistance** (WHO tube test mortality < 50%) by multiple mechanisms (partially mitigated by PBO pre-exposure)

- Mix of *Anopheles gambiae* s.s., *An. coluzzii, An. funestus*.
- High levels of pyrethroid resistance by multiple mechanisms.
- Roughly equal rates of indoor and outdoor biting.

*Significantly lower than 1.0 (95% confidence internal on the ratio excludes 1) indicates a strong preference for feeding outdoors.

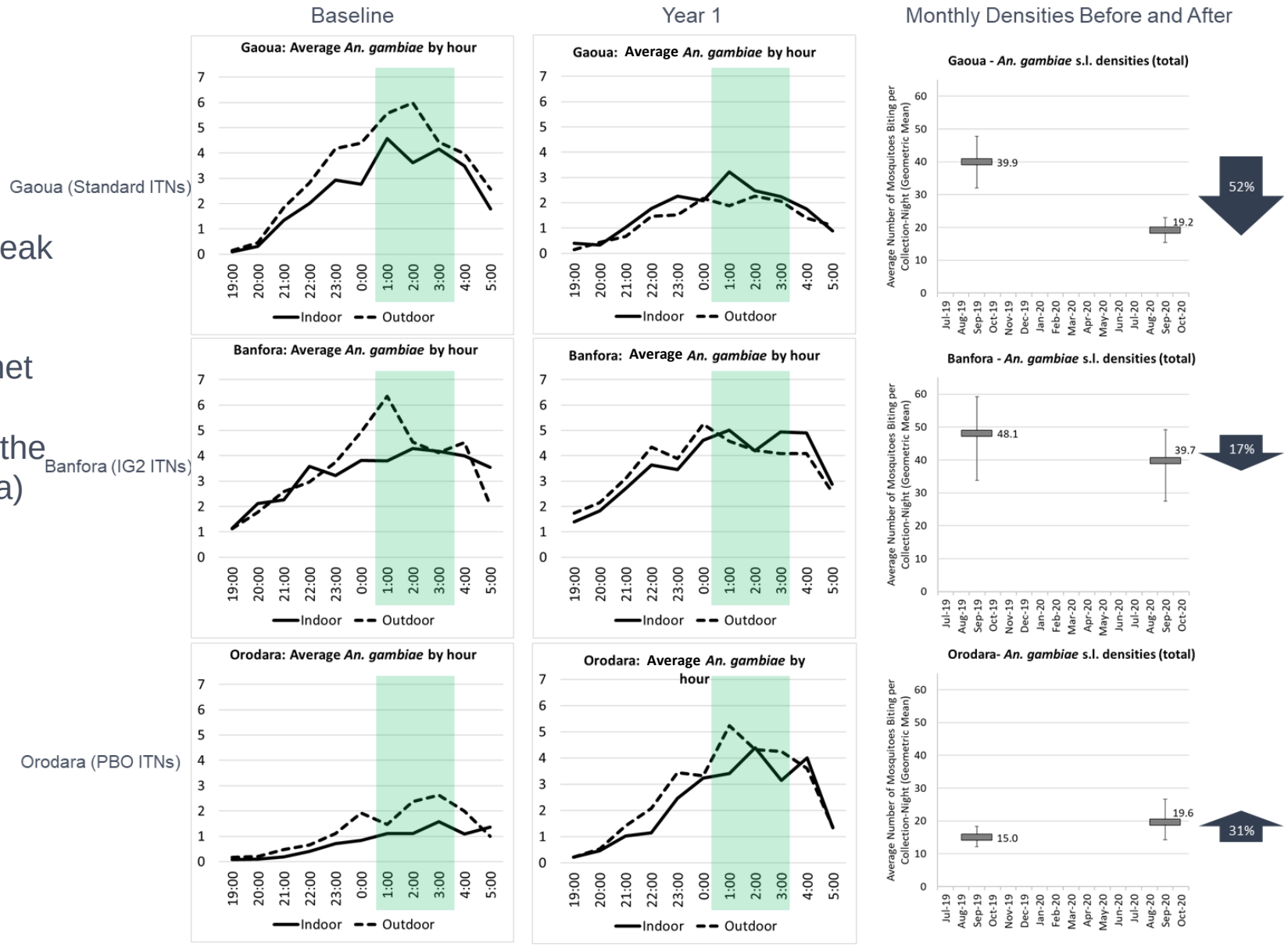
Interim results – interpret with caution

Vector landscape

Burkina Faso

- Nightly variation in biting rates, with peak biting very early in the morning
- Some indication that increasing bed net coverage associated with decreased vector densities – in the districts with the most mosquitoes (Gaoua and Banfora)

Nightly biting patterns of dominator vectors by district



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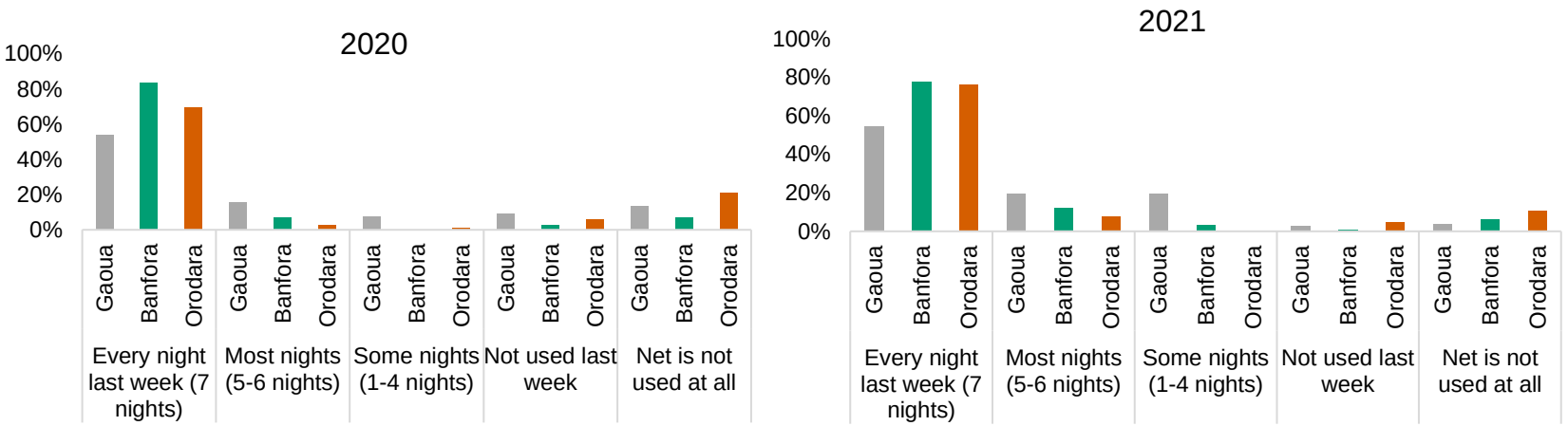
Interim results – interpret with caution

ITN landscape

Burkina Faso

	Gaoua (Standard ITNs)			Banfora (IG2 ITNs)			Orodara (PBO ITNs)		
	2019	2020	2021	2019	2020	2021	2019†	2020	2021
Population that slept under a net last night (95% CI)	**20.8%** (18.6%–23.1%)	**44.2%** (40.9%–47.5%)	**37.0%** (30.5%–42.5%)	**67.7%** (64.9%–70.3%)	**90.4%** (88.5%–92.1%)	**82.8%** (79.0%–86.6%)	**78.8%** (76.1%–81.2%)	**84.8%** (82.3%–87.0%)	**83.5%** (79.9%–87.1%)
Population ITN access (95% CI)	**44.4%** (42.4%–46.2%)	**53.8%** (51.4%–56.2%)	**40.5%** (37.9%–43.1%)	**58.9%** (57.1%–60.7%)	**84.2%** (83.1%–85.3%)	**74.9%** (73.5%–76.2%)	**94.0%** (93.1%–94.9%)	**87.4%** (86.3%–88.5%)	**82.0%** (80.7%–83.3%)
Use given access*	**0.47**	**0.82**	**0.91**	**1.15**	**1.07**	**1.11**	**0.84**	**0.97**	**1.02**

Proportion of bednets used every night last week (7 nights), most nights (5-6 nights), some nights (1-4 nights), not used last week, and not used at all



†The ITN distribution campaign was complete at the time of the cross-sectional survey.
*Use given access is calculated by dividing use (population that slept under a net last night) by access. Values over 1 are possible given that the calculation is a ratio.

Interim results – interpret with caution

Malaria burden to date

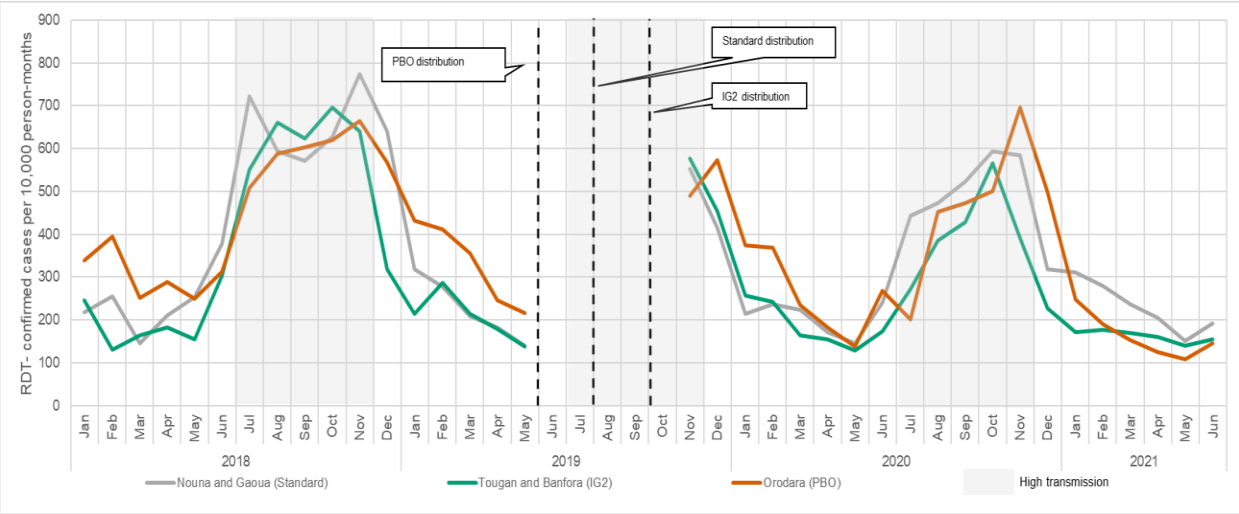
Burkina Faso

Malaria prevalence for children under 5 years old (RDT+) (95% CI)

Gaoua (Standard ITNs)			Banfora (IG2 ITNs)			Orodara (PBO ITNs)		
2019	2020	2021	2019	2020	2021	2019†	2020	2021
81.0% (74.9%–86.0%)	**48.9%** (41.9%–56.1%)	**21.1%** (15.5%–27.5%)	**39.6%** (33.0%–46.6%)	**18.4%** (13.5%–24.6%)	**11.6%** (7.4%–17.0%)	**28.4%** (22.4%–35.3%)	**3.7%** (1.8%–7.5%)	**2.1%** (0.6%–5.3%)

†The ITN distribution campaign was complete at the time of the cross-sectional survey.

Average monthly incidence rate (per 10,000 person-months) by district, 2018–2021



Difference-in-difference (DiD) comparison of malaria incidence with next-generation ITNs and standard ITNs.

	Year 1 (May–June) change from baseline	Year 1 DiD relative to standard ITNs	Year 2 (May–June) change from baseline	Year 2 DiD relative to standard ITNs
Gaoua and Nouna (Standard ITNs)	**−18.4%** (−24.8% to −14.8%)		**−20.6%** (−24.9% to −17.5%)	
Banfora and Tougan (IG2 ITNs)	**−0.76%** (−6.1% to 1.8%)	**−18%**	**−35.3%** (−36.7% to −34.6%)	**14.7%**
Orodara (PBO ITNs)	**−22.9%** (−28.8% to −2.7%)	**4.5%**	**−26.4%** (−29.2% to −24.8%)	**5.8%**

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Interim results – interpret with caution

Rwanda

Baseline vector landscape

Rwanda

	Nyamagabe (Standard ITNs)	Karongi (IG2 ITNs)	Ruhango (Standard ITNs + IRS)
	2020 baseline	2020 baseline	2020 baseline
Most abundant vector (% of likely vector species collected)	*An. funestus* s.l. (92%)	*An. gambiae* s.l. (91%)	*An. funestus* s.l. (51%)
Second most abundant vector (% of likely vector species collected)	*An. gambiae* s.l. (8%)	*An. coustani* (6%)	*An. gambiae* s.l. (49%)
	–	*An. funestus* s.l. (3%)	–
***An. gambiae* molecular IDs**			
An. gambiae s.s.	77.8%	93.5%	81.4%
An. arabiensis	22.2%	6.5%	18.6%
Monthly CDC LT densities			
HLC nightly landing rates (*An. gambiae* s.l.)			
Indoor:outdoor ratio	0.50	1.10	0.53
Pyrethroid-resistance profile	**LOW to MODERATE: Mitigated by PBO**		
WHO tube test mortality	97%–100%	93%–100%	86%–100%

- Mix of *An. gambiae* s.s., *An. funestus*, *An. arabiensis.*
- Low to moderate levels of pyrethroid resistance—mitigated by PBO.
- Roughly equal rates of indoor and outdoor biting.

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Interim results – interpret with caution

Vector landscape

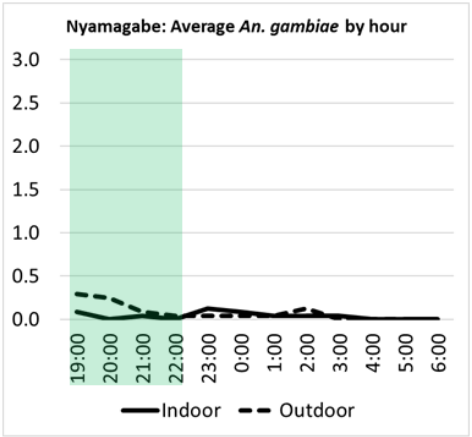
Rwanda

- Overall, relatively low rates of biting
- No obvious peaks – consistent throughout the night

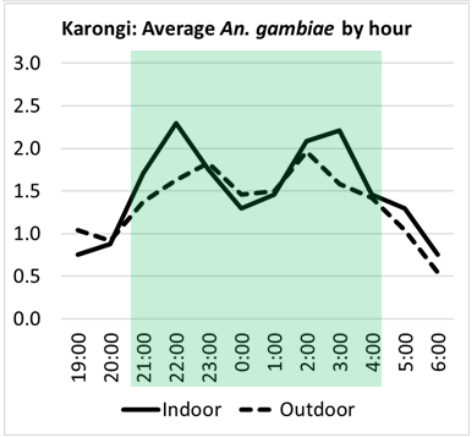
Nightly biting patterns of dominator vectors by district

Baseline

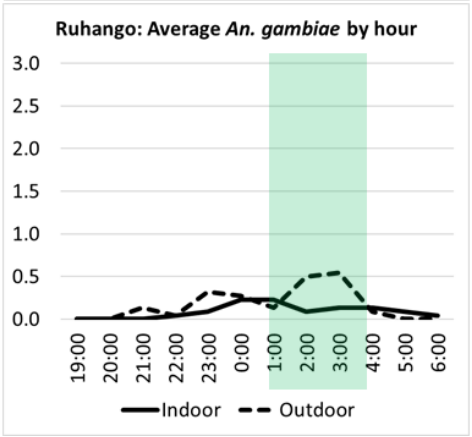
Nyamagabe (Standard ITNs)



Karongi (IG2 ITNs)



Ruhango (Standard ITNs + IRS)



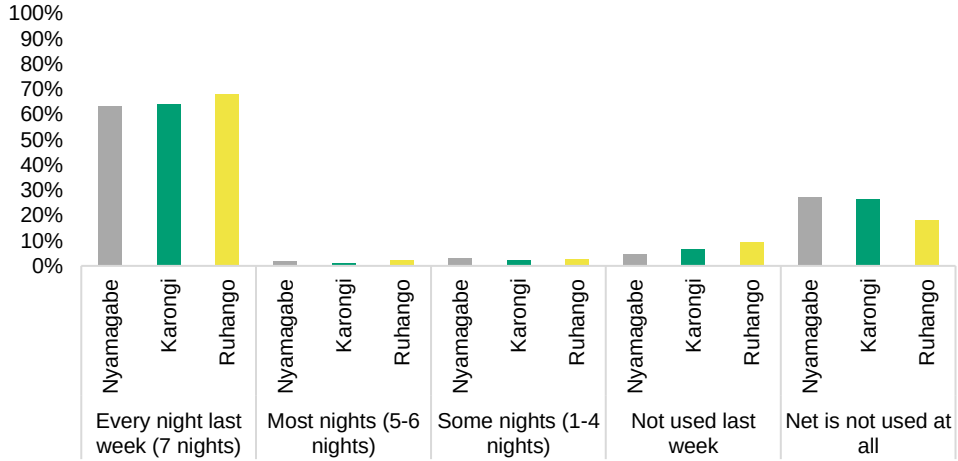
Interim results – interpret with caution

ITN landscape

Rwanda

	Nyamagabe (Standard ITNs)		Karongi (IG2 ITNs)		Ruhango (Standard ITNs + IRS)	
	Feb* 2020	Dec 2020	Feb 2020	Dec 2020	Feb* 2020	Dec 2020
Population that slept under a net last night (95% CI)	**70.5%** (66.8%–74.0%)	**68.7%** (65.0%–72.2%)	**68.2%** (64.5%–71.8%)	**70.9%** (67.3%–74.3%)	**73.3%** (69.8%–76.6%)	**78.8%** (75.4%–82.0%)
Population ITN access (95% CI)	**81.8%** (79.5%–84.1%)	**80.7%** (78.6%–82.7%)	**82.2%** (79.8%–84.7%)	**86.1%** (84.3%–87.9%)	**88.1%** (86.5%–89.8%)	**88.6%** (87.2%–90.0%)
Use given access†	**0.86**	**0.85**	**0.83**	**0.82**	**0.83**	**0.89**

Proportion of bednets used every night last week (7 nights), most nights (5-6 nights), some nights (1-4 nights), not used last week, and not used at all, December 2020



† Use given access is calculated by dividing use (population that slept under a net last night) by access. Values over 1 are possible given that the calculation is a ratio.
*The ITN distribution campaign was ongoing at the time of the cross-sectional survey.

Interim results – interpret with caution

Malaria burden to date

Rwanda

Malaria prevalence for all ages (RDT+) (95% CI)

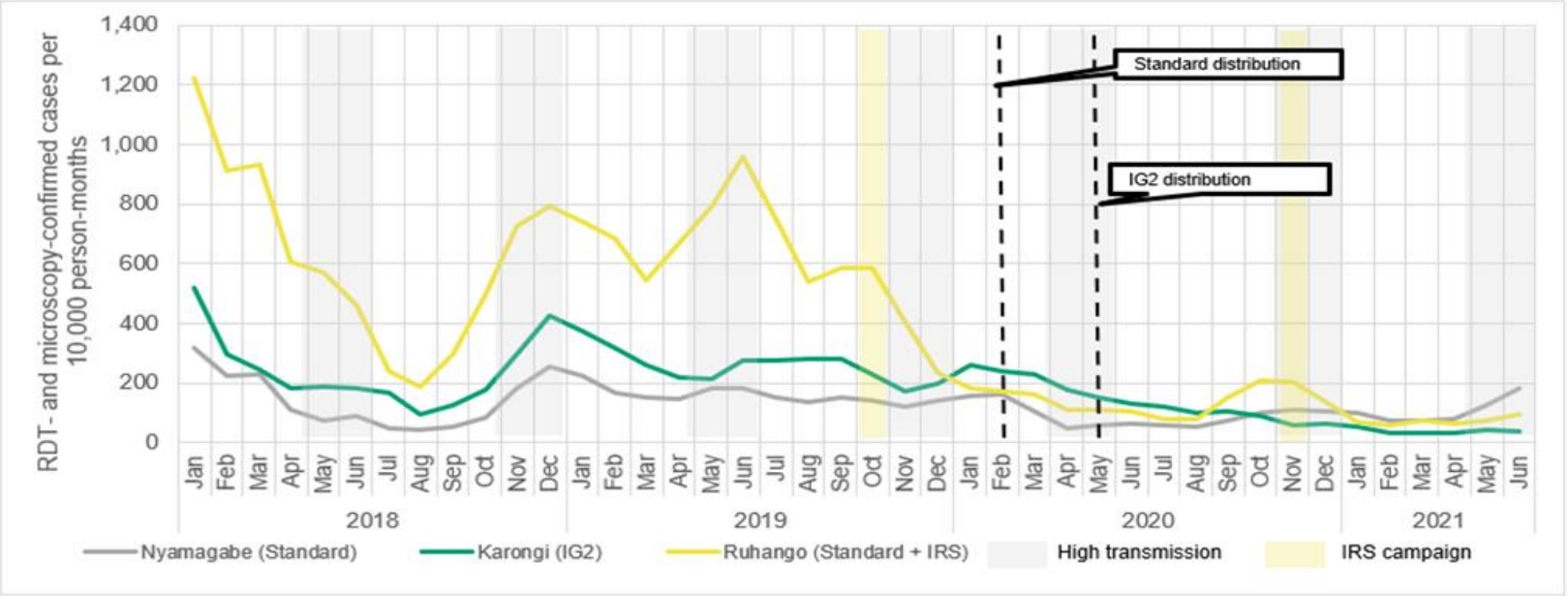
Nyamagabe (Standard ITNs)		Karongi (IG2 ITNs)		Ruhango (Standard ITNs + IRS)	
Feb* 2020	Dec 2020	Feb 2020	Dec 2020	Feb* 2020	Dec 2020
2.36% (1.14%–4.30%)	**2.70%** (1.36%–4.78%)	**2.47%** (1.24%–4.38%)	**2.69%** (1.40%–4.65%)	**1.33%** (0.49%–2.87%)	**5.24%** (3.27%–7.89%)

*The ITN distribution campaign was ongoing at the time of the cross-sectional survey.

Difference-in-difference (DiD) comparison of malaria incidence with next-generation ITNs, standard pyrethroid ITNs, and standard pyrethroid ITNs + IRS

	Year 1 (April–March) change from baseline	DiD relative to standard ITNs
Nyamagabe (Standard ITNs)	**−48%** (−53% to −45%)	
Karongi (IG2 ITNs)	**−62%** (−71% to −54%)	**13%**
Ruhango (Standard ITNs + IRS)	**−77%** (−78% to −75%)	**29%**

Average monthly incidence rate (per 10,000 person-months) by district, 2018–2020

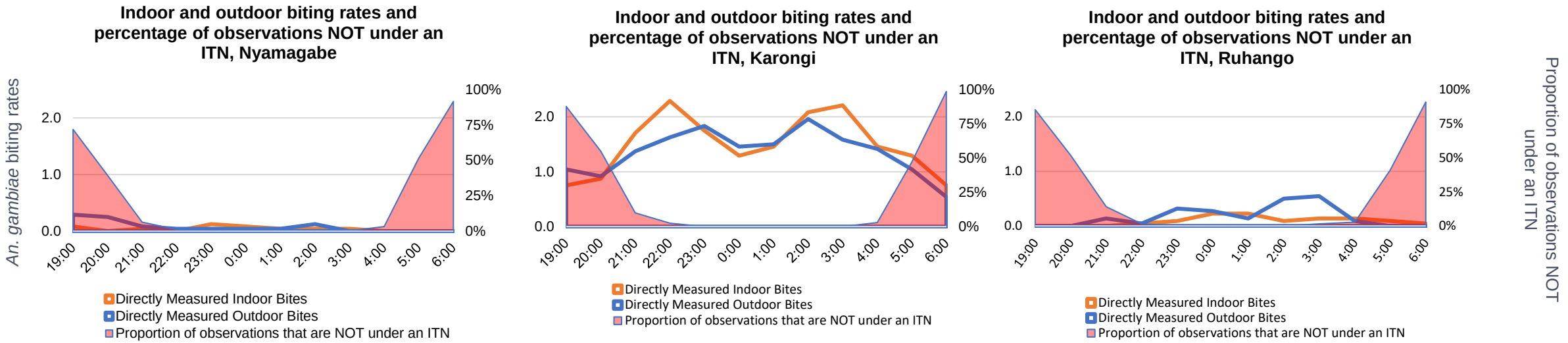


Interim results – interpret with caution

Vector landscape

Rwanda

Indoor and outdoor biting rates and percentage of observations not under an ITN by district.



First steps toward understanding the intersection of human and mosquito behaviors in driving malaria transmission risk: mapping the proportion of time (observations made) not under an ITN to indoor and outdoor biting rates.

Interim results – interpret with caution

Northern Mozambique

Baseline vector landscape

Northern Mozambique

	Gurue (Standard ITNs)	Cuamba (IG2 ITNs)	Mandimba (RG ITNs)
	2020	2020	2020
Most abundant vector (% of likely vector species collected)	*An. gambiae* s.l. (57%)	*An. gambiae* s.l. (100%)	*An. funestus* s.l. (57%)
Second most abundant vector (% of all anophelines collected)	*An. funestus* s.l. (42%)	–	*An. gambiae* s.l. (42%)
***An. gambiae* molecular IDs**			
	Pending	*Pending*	*Pending*
HLC nightly landing rates (An. gambiae s.l.)			
Indoor:outdoor ratio	1.0	0.6	1.1
Pyrethroid resistance profile	MODERATE to HIGH: Mitigated by PBO		
WHO tube test mortality	5%–75% (gambiae); 60%–100% (funestus)[a]		

[a]Historical data, 2018 and 2019.

- Mix of *An. gambiae* s.s. and *An. funestus.*
- High to Moderate levels of pyrethroid resistance—mitigated by PBO.
- Roughly equal rates of indoor and outdoor biting.

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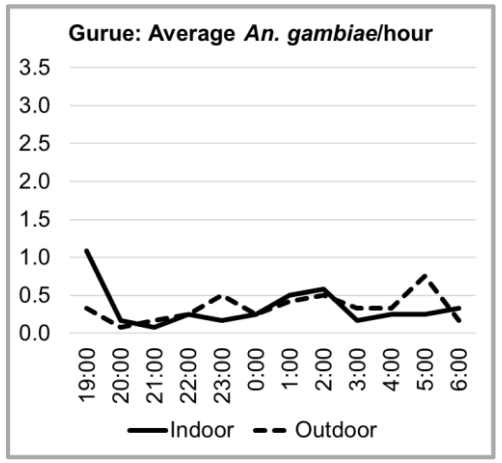
Interim results – interpret with caution

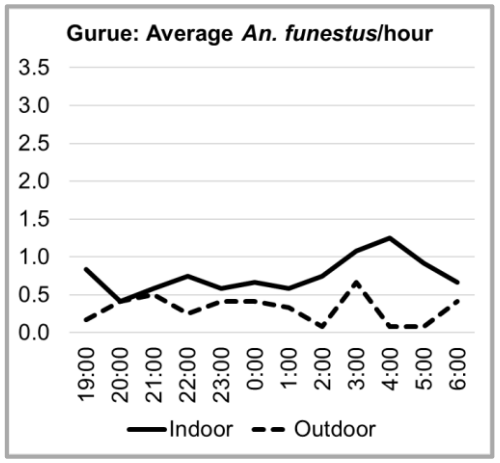
Vector landscape

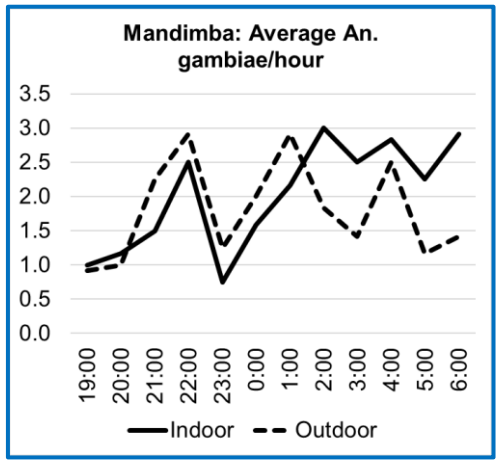
Northern Mozambique

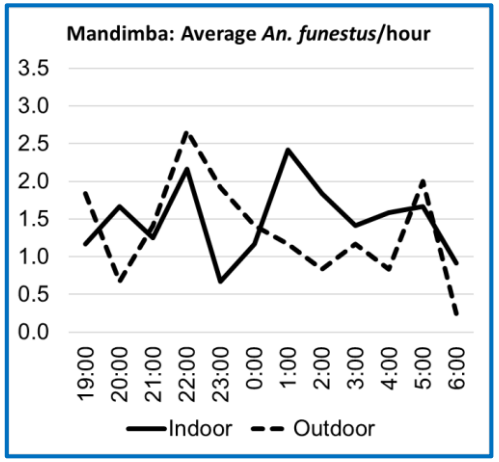
Nightly biting patterns of dominator vectors by district

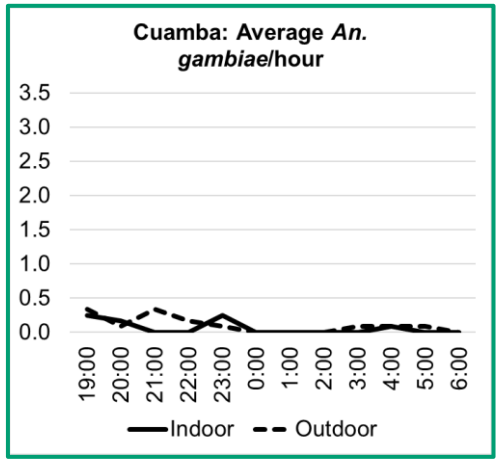
- No obvious peaks hours for biting – consistent throughout the night











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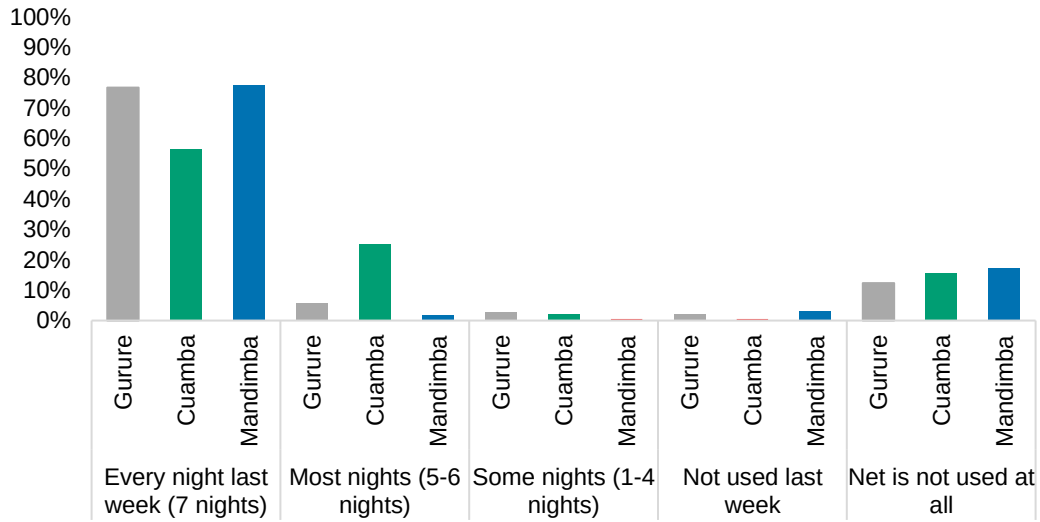
Interim results – interpret with caution

ITN landscape

Northern Mozambique

	Gurue (standard ITNs)		Cuamba (IG2 ITNs)		Mandimba (RG ITNs)	
	2020	2021	2020	2021	2020	2021
Population that slept under a net last night (95% CI)	**23.0%** (21.3%–24.7%)	**87.4%** (82.8%–90.8%)	**19.4%** (17.9%–21.0%)	**67.9%** (57.0%–77.1%)	**17.0%** (15.5%–18.6%)	**81.6%** (74.7%–87.0%)
Population ITN access (95% CI)	**23.1%** (21.8%–24.4%)	**85.7%** (82.5%–88.8%)	**21%** (19.7%–22.3%)	**64.8%** (54.8%–74.8%)	**16.4%** (15.3%–17.6%)	**75.5%** (69.0%–82.3%)
Use given access*	**0.99**	**1.02**	**0.92**	**1.05**	**1.03**	**1.08**

Proportion of bednets used every night last week (7 nights), most nights (5-6 nights), some nights (1-4 nights), not used last week, and not used at all, 2021



†The ITN distribution campaign was complete at the time of the cross-sectional survey.
*The ITN distribution campaign was ongoing at the time of the cross-sectional survey.

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Interim results – interpret with caution

Malaria burden to date

Northern Mozambique

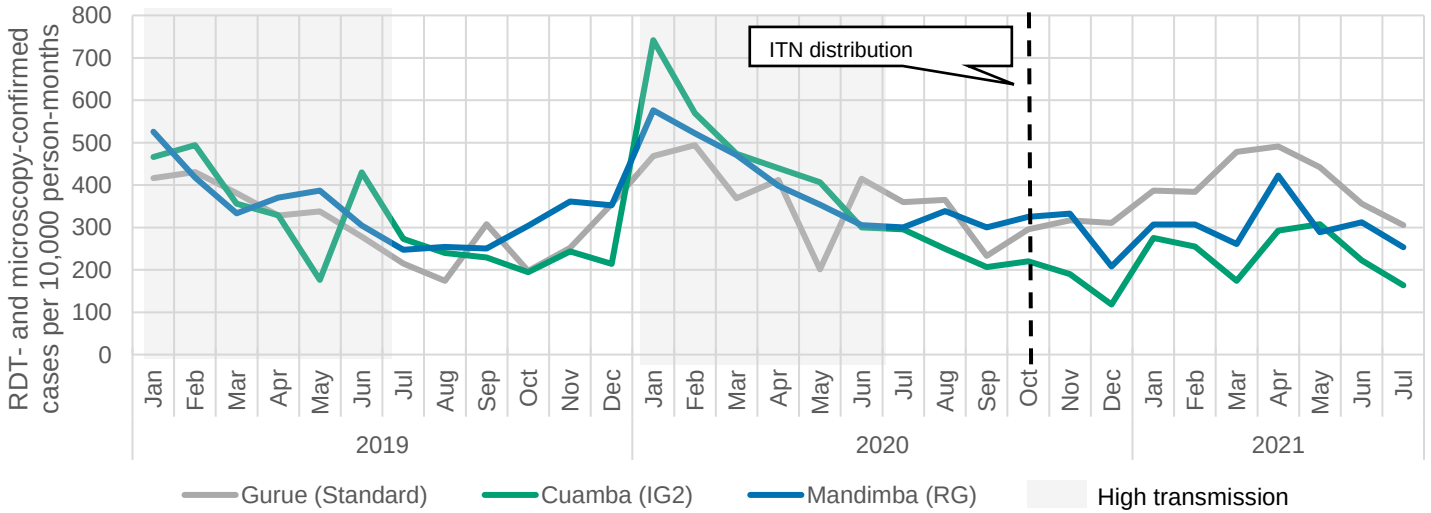
Malaria prevalence for children under 5 years old (RDT+) (95% CI)

Gurue (Standard ITNs)		Cuamba (IG2 ITNs)		Mandimba (RG ITNs)	
2020	2021	2020	2021	2020	2021
64.9% (54.8%–75.0%)	52.5% (42.9%–61.9%)	47.5% (38.1%–57.0%)	29.4% (20.9%–39.5%)	66.0% (57.5%–74.4%)	46.2% (38.2%–54.4%)

Difference-in-difference (DiD) comparison of malaria incidence with next-generation ITNs and standard pyrethroid ITNs

	2021 year 1 (Jan–June) change from baseline	DiD relative to standard ITNs
Gurue (Standard ITNs)	8% (−3% to 24%)	
Cuamba (IG2 ITNs)	−48% (−52% to −40%)	56%
Mandimba (RG ITNs)	−28% (−31% to −23%)	36%

Average monthly incidence rate (per 10,000 person-months) by district, 2019–2020



Interim results – interpret with caution

Western Mozambique

Baseline vector landscape

Western Mozambique

	Chemba (Standard ITNs)	Guro (IG2 ITNs)	Changara (PBO ITNs)
	2020	2020	2020
Most abundant vector (% of all likely vectors collected)	*An. funestus s.l. (76%)*	*An. gambiae* s.l. (100%)	*An. gambiae* s.l. (100%)
Second most abundant vector (% of all anophelines collected)	*An. gambiae s.l. (24%)*	–	–
***An. gambiae* molecular IDs**			
	Pending	*Pending*	*Pending*
HLC nightly landing rates (*An. gambiae* s.l.)			
Indoor:outdoor ratio	0.4	1.0	1.1
Pyrethroid resistance profile	**MODERATE to HIGH: Mitigated by PBO**		
WHO tube test mortality	5%–75% (*gambiae*); 60%–100% (*funestus*)[a]		

[a] Historical data, 2018 and 2019.

- Mix of *An. gambiae* s.s. and *An. funestus.*
- High to moderate levels of pyrethroid resistance—mitigated by PBO.
- Roughly equal rates of indoor and outdoor biting.

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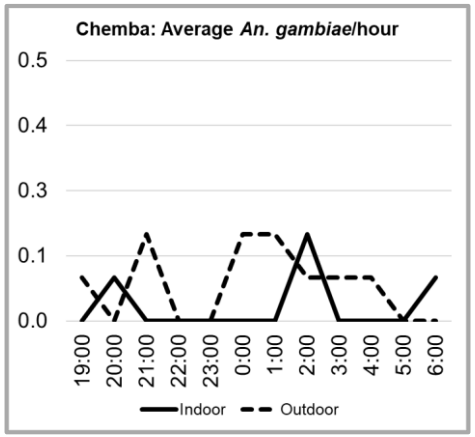
Interim results – interpret with caution

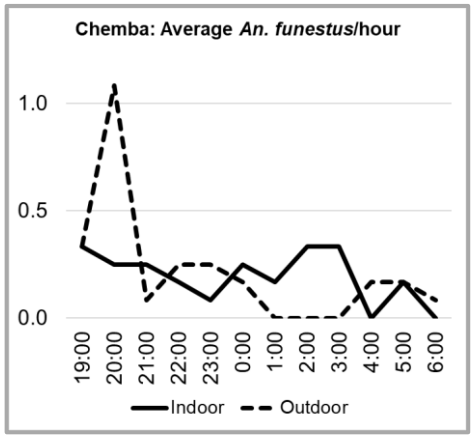
Vector landscape

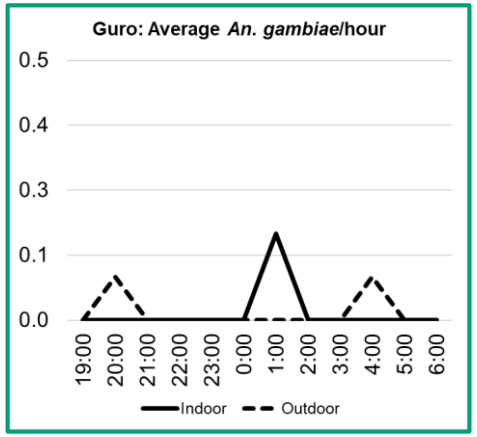
Western Mozambique

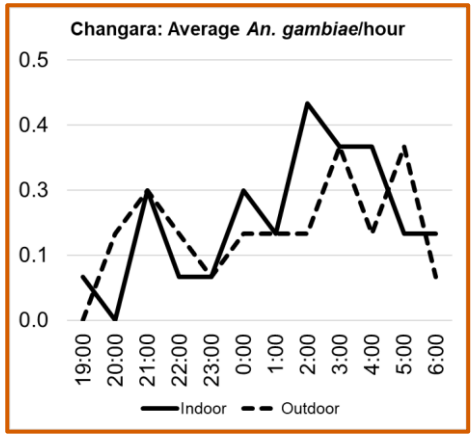
- No obvious peaks hours for biting – consistent throughout the night

Nightly biting patterns of the dominant vectors









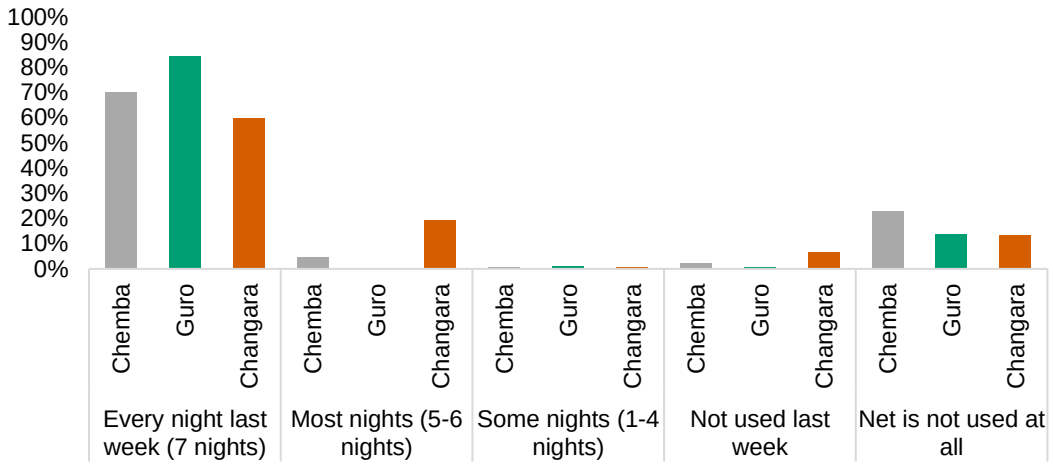
Interim results – interpret with caution

ITN landscape

Western Mozambique

	Chemba (Standard ITNs)		Guro (IG2 ITNs)		Changara (PBO ITNs)	
	2020	2021	2020	2021	2020	2021
Population that slept under a net last night (95% CI)	**33.3%** (32.1%–34.7%)	**90.1%** (87.1%-92.4%)	**18.5%** (17.2%–19.8%)	**92.8%** (90.4%–94.7%)	**23.0%** (21.8%–24.2%)	**84.6%** (80.5%–88.0%)
Population ITN access (95% CI)	**30.4%** (29.3%–31.6%)	**86%** (82.0%–90.1%)	**18.8%** (17.5%–20.1%)	**88.9%** (86.8%–91.1%)	**26.3%** (24.9%–27.6%)	**84.2%** (81.1%–87.3%)
Use given access*	**1.10**	**1.05**	**0.98**	**1.04**	**0.88**	**1.00**

Proportion of bednets used every night last week (7 nights), most nights (5-6 nights), some nights (1-4 nights), not used last week, and not used at all, 2021



*Use given access is calculated by dividing use (population that slept under a net last night) by access. Values over 1 are possible given that the calculation is a ratio.

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Interim results – interpret with caution

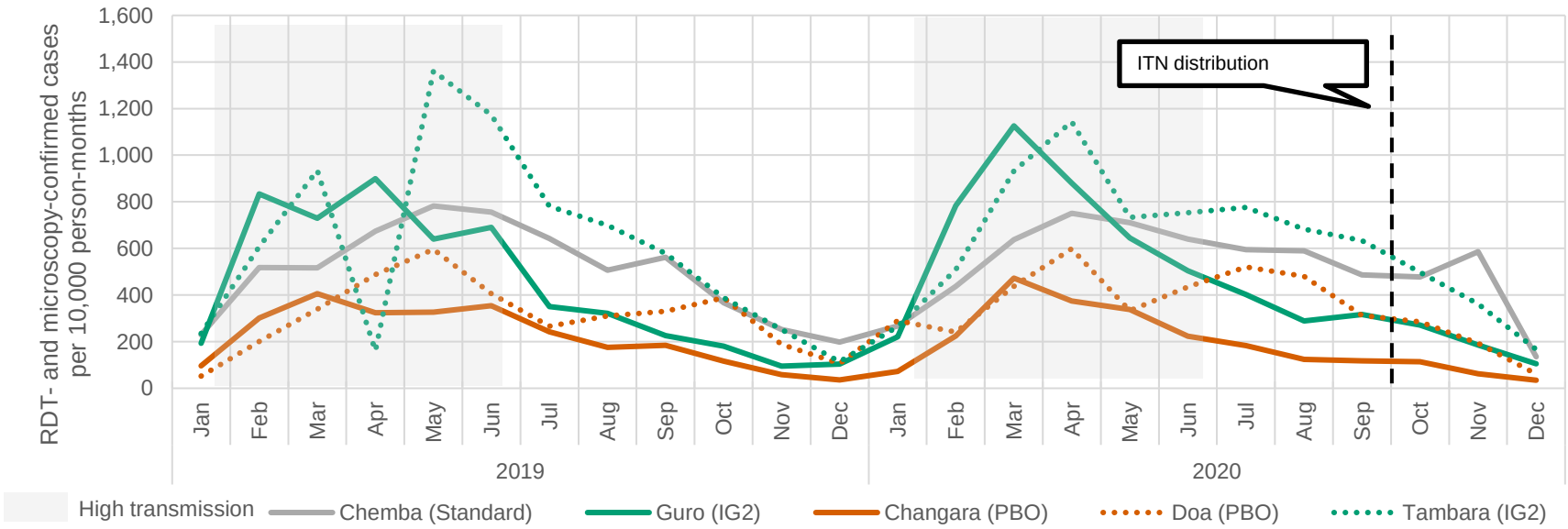
Malaria burden to date

Western Mozambique

Malaria prevalence for children under 5 years old (RDT+) (95% CI)

Chemba (Standard ITNs)		Guro (IG2 ITNs)		Changara (PBO ITNs)	
2020	2021	2020	2021	2020	2021
44.3% (36.5%–52.1%)	**39.0%** (31.3%– 47.2%)	**17.1%** (11.6%–22.7%)	**3.8%** (2.2%– 6.7%)	**5.7%** (2.3%–9.1%)	**2.1%** (0.8%– 5.4%)

Average monthly incidence rate (per 10,000 person-months) by district, 2019–2020



Interim results – interpret with caution

Nigeria

Baseline vector landscape

Nigeria

	Ejigbo (Standard ITNs)	Asa (IG2 ITNs)	Moro (RG ITNs)	Ife North (PBO ITNs)
	2020	2020	2020	2020
Most abundant vector (% of likely vector species collected)	*An. gambiae* s.l. (88%)	*An. gambiae* s.l. (100%)	*An. gambiae* s.l. (100%)	*An. funestus* s.l. (82%)
Second most abundant vector (% of all anophelines collected)	*An. funestus* s.l. (6%)	–	–	*An. gambiae* s.l. (14%)
***An. gambiae* molecular IDs**				
An. gambiae s.s.	73.3%	66.7%	73.4%	66.7%
An. coluzzii	26.7%	26.7%	21.5%	33.3%
An. arabiensis	–	2.5%	5.1%	–
Monthly CDC LT densities				
HLC nightly landing rates (*An. gambiae* s.l.)				
Indoor:outdoor ratio	0.92	9.75	2.50	10.00
Pyrethroid resistance profile	**MODERATE to HIGH: Partially mitigated by PBO**			
WHO tube test mortality	73%–94%	12%–38%	41%–57%	20%–71%

- Mix of *An. gambiae* s.s., *An. funestus, An. coluzzii, An. arabiensis.*
- Moderate to high levels of pyrethroid resistance—partially mitigated by PBO.
- Tendency for higher indoor than outdoor biting rates.

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Interim results – interpret with caution

Vector landscape

Nigeria

- Overall, relatively low rates of biting
- *An. gambiae* biting tends to peak very early in the morning

Nightly biting patterns of dominator vectors by district, November 2020 to April 2021

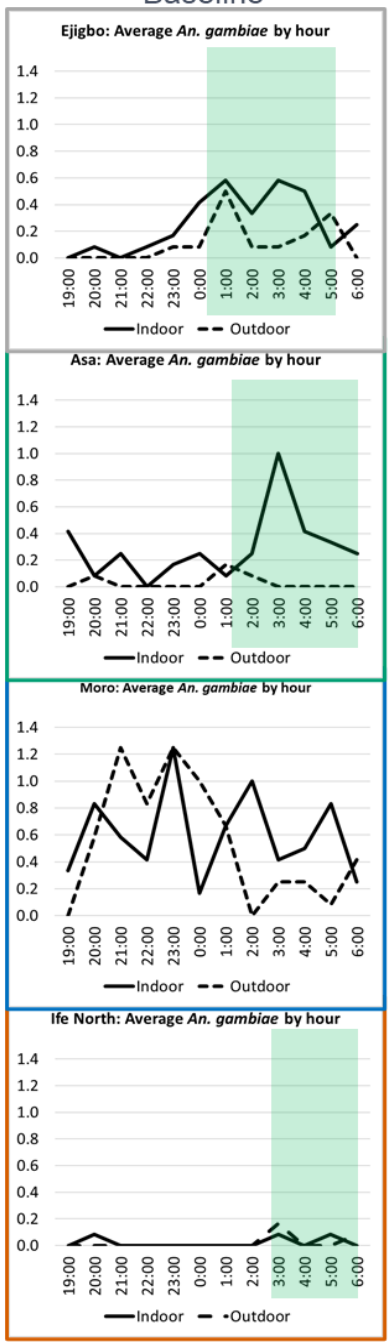
Baseline

Ejigbo (Standard ITNs)

Asa (IG2 ITNs)

Moro (RG ITNs)

Ife North (PBO ITNs)



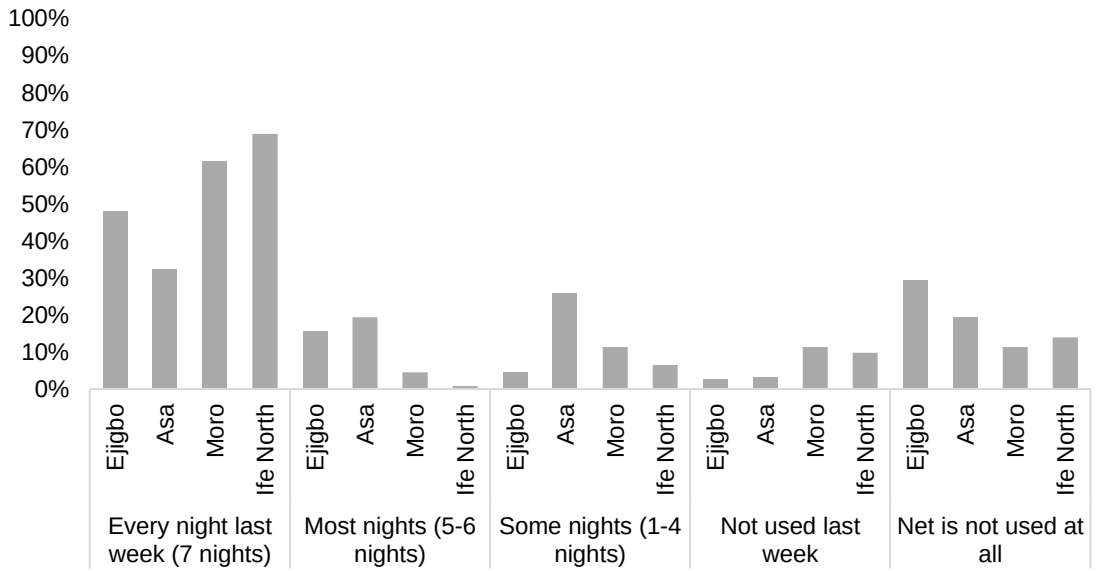
Interim results – interpret with caution

ITN landscape

Nigeria

	Ejigbo (Standard ITNs)	Asa (IG2 ITNs)	Moro (RG ITNs)	Ife North (PBO ITNs)
	2020	2020	2020	2020
Population that slept under a net last night (95% CI)	**19.7%** (17.8%–21.7%)	**3.0%** (2.2%–3.9%)	**18.1%** (16.2%–20.1%)	**24.2%** (22.2%–26.3%)
Population ITN access (95% CI)	**26.9%** (25.2%–28.5%)	**4.4%** (3.6%–5.2%)	**17.1%** (15.6%–18.5%)	**24.4%** (22.8%–26.0%)
Use given access*	**0.73**	**0.68**	**1.05**	**0.99**

Proportion of bednets used every night last week (7 nights), most nights (5-6 nights), some nights (1-4 nights), not used last week, and not used at all, 2021



Interim results – interpret with caution

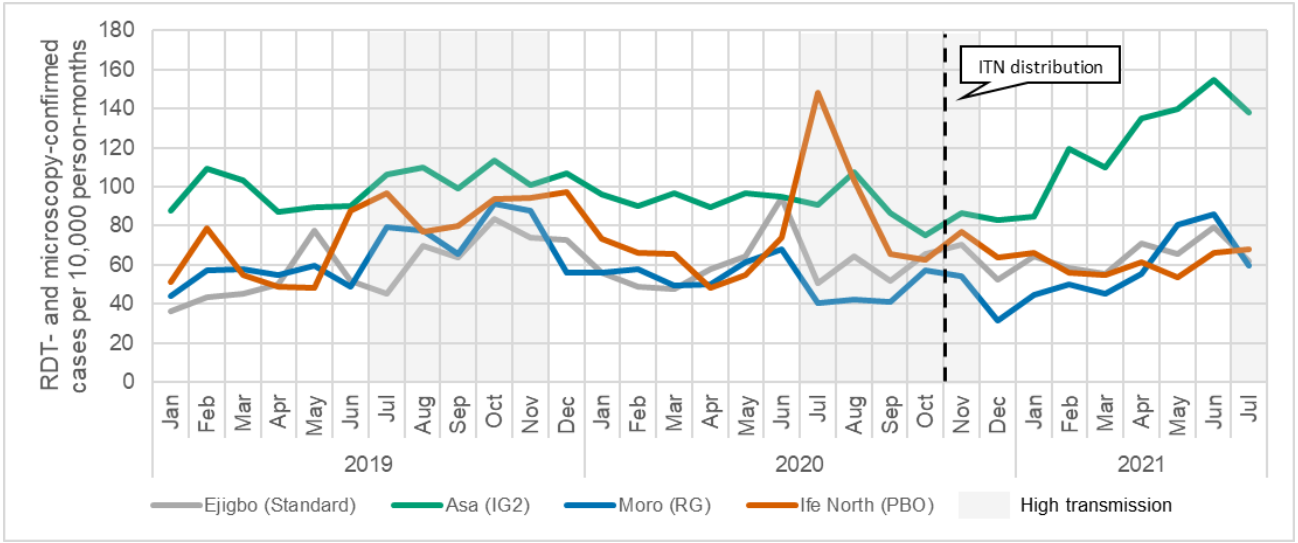
Malaria burden to date

Nigeria

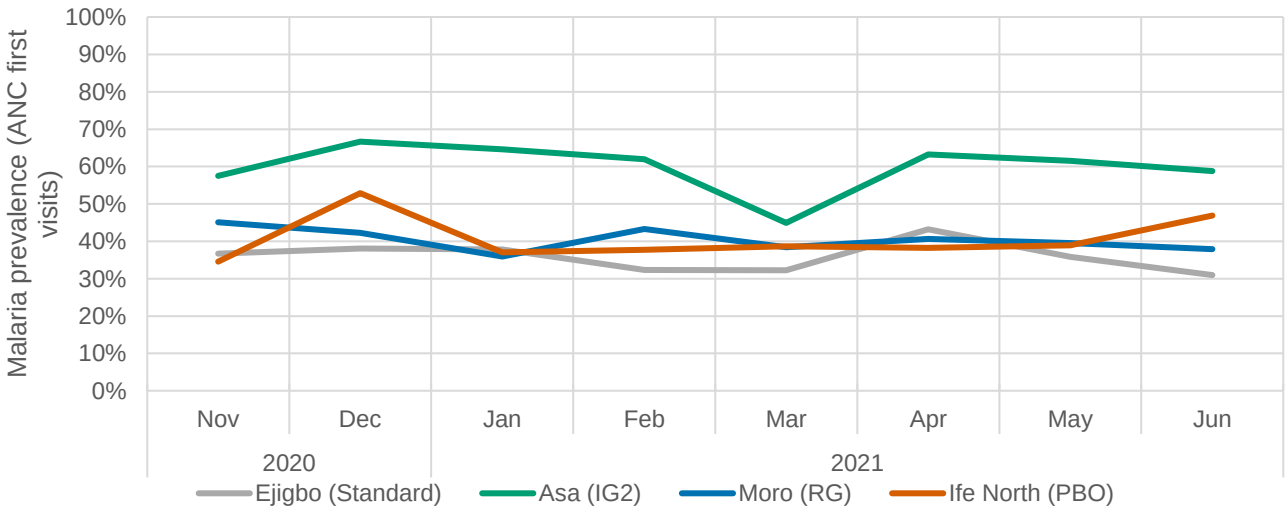
Malaria prevalence for children under 5 years old (RDT+) (95% CI)

Ejigbo (Standard ITNs)	Asa (IG2 ITNs)	Moro (RG ITNs)	Ife North (PBO ITNs)
2020	2020	2020	2020
38.4%	**63.1%**	**49.9%**	**48.3%**
(33.8%–43.3%)	(58.3%–67.7%)	(45.0%–54.8%)	(43.5%–53.2%)

Average monthly incidence rate (per 10,000 person-months) by LGA, 2019–2021



Monthly prevalence (RDT+) at ANC first visits



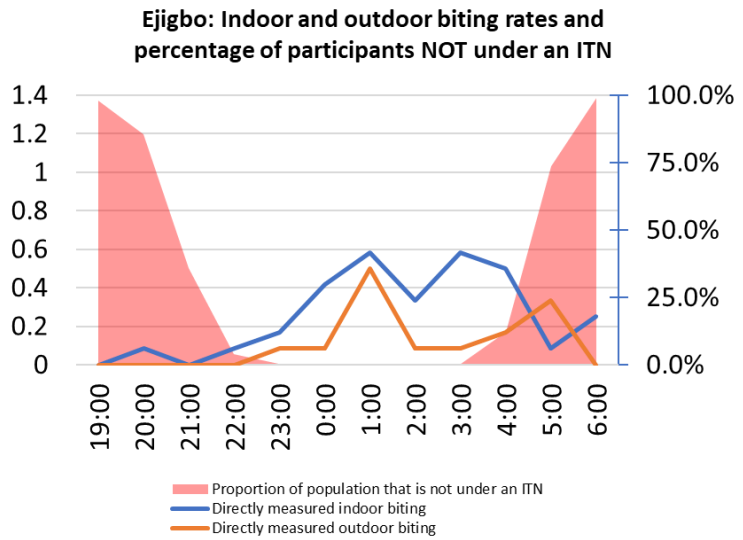
Interim results – interpret with caution

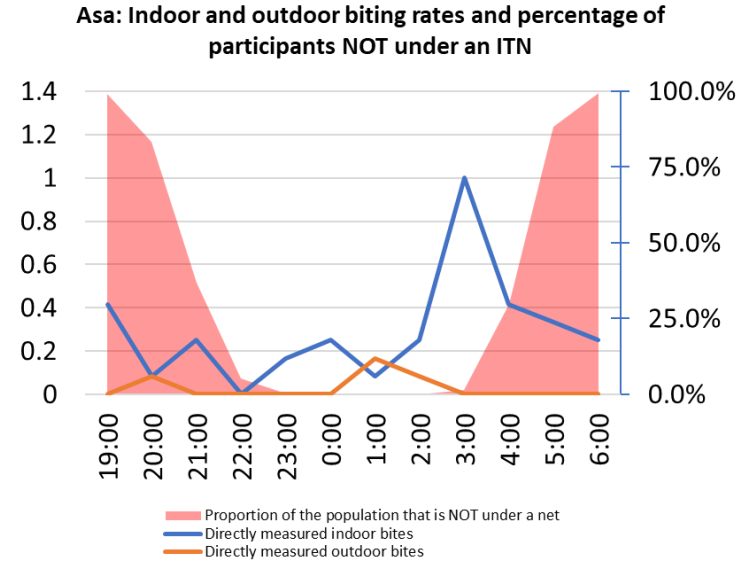
Vector landscape

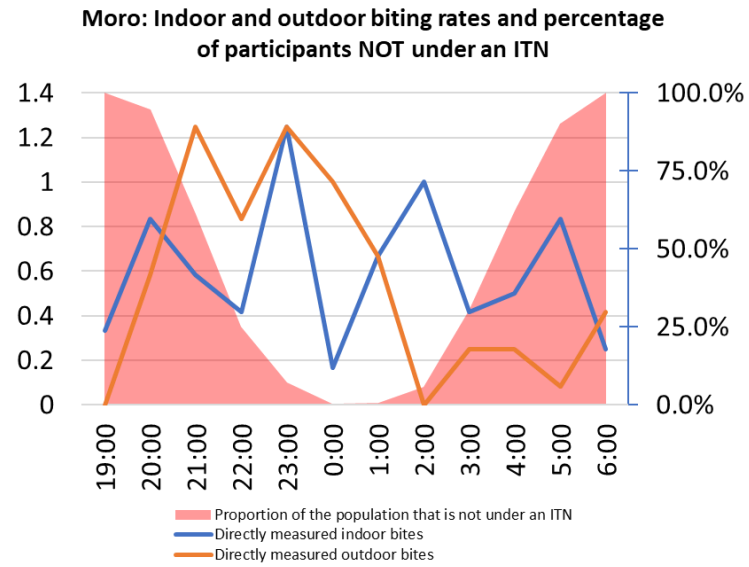
Nigeria

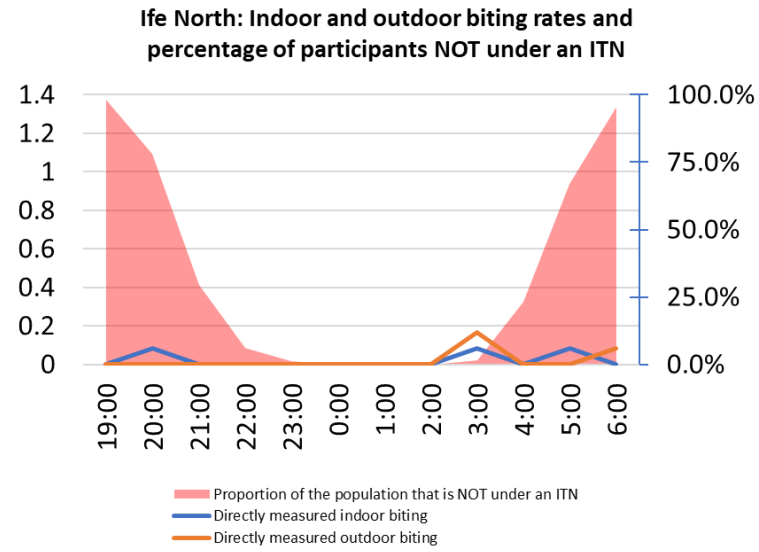
First steps toward understanding the intersection of human and mosquito behaviors in driving malaria transmission risk: mapping the proportion of time (observations made) not under an ITN to indoor and outdoor biting rates.

An. gambiae biting rates









Proportion of observations NOT under an ITN

Interim results – interpret with caution

Key issues

- Variability and diversity in malaria transmission dynamics across and within countries
- Variability and changes in other key malaria interventions
- Human and vector behavior could be an important factor in determining ITN effectiveness
- Next steps and future analyses

Key takeaways – interim results

- Mass ITN distributions (universal coverage campaigns) are strongly associated with increased ITN use and decreases in malaria transmission regardless of ITN type
- In areas of moderate to high transmission with pyrethroid resistant vectors
    - Distribution of any of the new net types (IG2, PBO, and RG ITNs) seem more effective at controlling malaria than campaigns distributing standard, pyrethroid-only ITNs
    - May be less pronounced in West African settings with complex resistance profiles
- More complete and nuanced analyses will consider access, impact, and durability of ITNs after more than one year, as well as sleeping and ITN use patterns.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