PBO net deep dive

Summary of findings from 2021 report

Introduction

GLOBAL MALARIA COMMODITIES FORECASTING PROJECT

- In order to develop a more organized approach to navigating an increasingly complex malaria commodities market, Clinton Health Access Initiative (CHAI) assembled a consortium of partners to produce global forecasts for malaria commodities.

- The forecasting consortium includes Malaria Atlas Project (MAP), RBM Partnership to End Malaria (RBM), Innovative Vector Control Consortium (IVCC) and Medicines for Malaria Venture (MMV). Review and support has also been provided by the project Steering Committee, including representatives from GFATM, PMI, WHO PQ, RBM, PAHO, APLMA, BMGF, Unitaid, MMV, IVCC, AMP, FIND, FCDO and key opinion leaders among select national malaria programs.

- The five-year project has three annual outputs: short-term (three year) procurement forecasts, long-term (ten year) forecasts of need and demand, and deep dive reports on the market landscape for specific commodities. Funding is provided by the Bill & Melinda Gates Foundation.

The PBO Net Deep Dive Report

Purpose: This report aims to understand the factors that may influence PBO net volumes in the future and inform successful launches of other new vector control products to the market.

Overview of Process: This report was compiled by CHAI with assistance from IVCC and other partners. Information presented in this report was gathered via peer-reviewed publications, and additionally sourced from AMP, WHO, and IR Mapper. Reference price points published by Global Fund, PMI, and UNICEF were also reviewed. Interviews were also conducted with key stakeholders.

Background

Insecticide-treated nets (ITNs) have played a critical role in the reduction of malaria morbidity and mortality. However, the continued impact of ITNs is threatened by increasing prevalence of resistance among malaria vectors to the class of insecticides (pyrethroids) used to treat ITNs.

There are currently three types of ITNs deployed:

Pyrethroid-only Nets	PBO Nets	Dual AI Nets
These are the vast majority of ITNs deployed and are also called standard ITNs. Pyrethroid-only ITNs are treated with a single active ingredient in the pyrethroid class.	These nets are treated with a pyrethroid as the active ingredient as well as piperonyl butoxide (PBO), a synergist that helps counteract pyrethroid-resistance among mosquitoes expressing certain types of metabolic resistance.	Dual AI nets are treated with two active ingredients (AI). Currently all Dual AI nets have Pyrethroid + another AI. It is expected that "new non-pyrethroid Dual AIs" will enter the marker in the medium term, with neither AI being pyrethroid.

The evidence base for PBO nets is growing but gaps still remain

Impact of Design Differences on Performance: Since the majority of prequalified PBO nets were assessed using the criteria for pyrethroid-only nets, there are ongoing questions regarding the effect of design differences. This includes the type and concentration of pyrethroid used, concentration of PBO used, location of PBO application and material used in the sides of the net.

Geography of Deployment: The WHO GMP-led hut trials in Côte d'Ivoire and Tanzania found that PBO nets showed relatively poorer performance in West Africa compared to East Africa, possibly due to the historically higher levels of pyrethroid resistance and poor synergistic effect of PBO in the region.

Net Durability: Ongoing research on the physical durability and bioefficacy of PBO nets, specifically the duration of enhanced protection as compared to pyrethroid-only nets.

Cost-effectiveness: There have been a limited number of models assessing the cost-effectiveness of deploying PBO nets compared to pyrethroid-only nets or to dual AI nets.
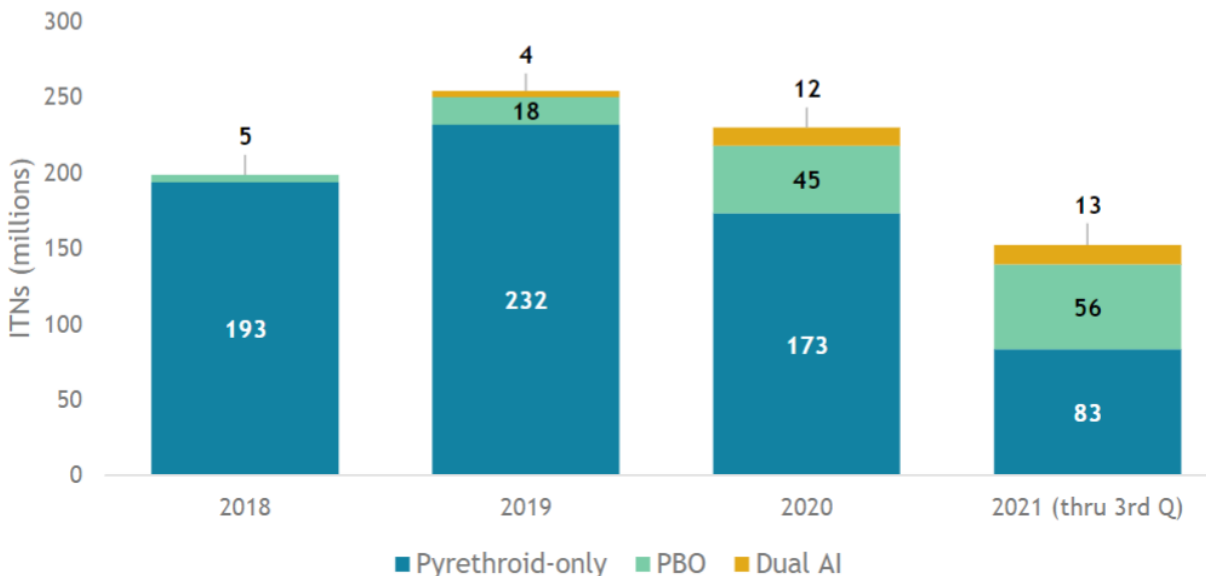
WHO Interim Recommendation (2017): WHO released an interim recommendation for the use of PBO nets as an "exception" to typical procedure, which usually requires data from two trials to merit a recommendation. A full WHO recommendation is expected to be released in 2022.

Market landscape
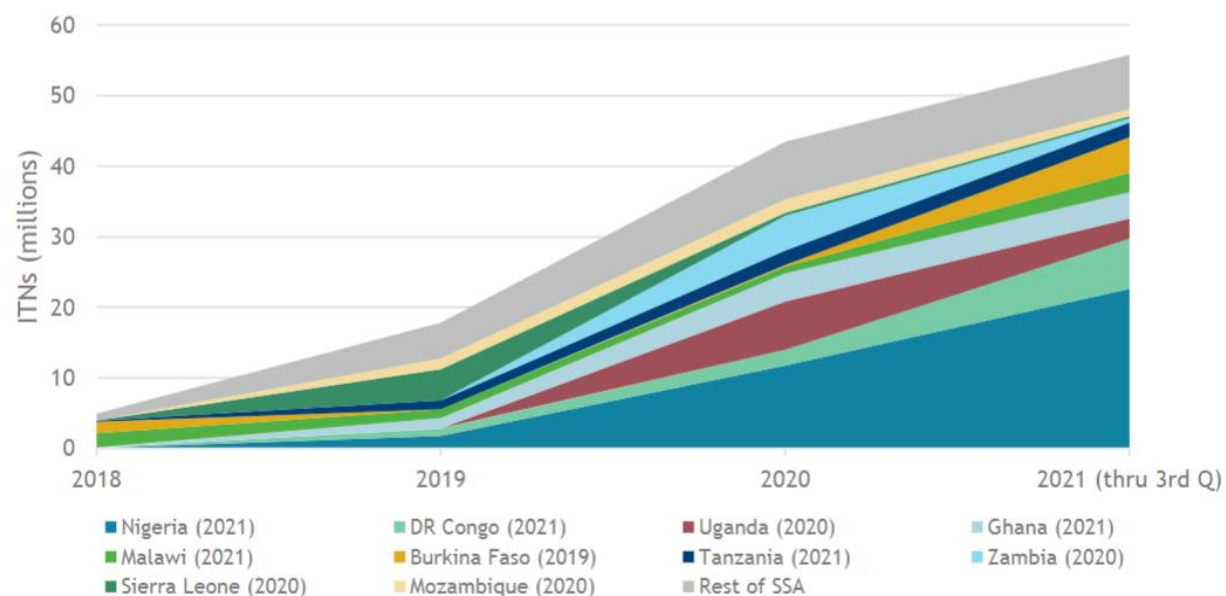
Market landscape: Market Share

BY TYPES OF NETS

Number of ITNs Shipped by Type (John Milliner data)

Spurred by the WHO conditional recommendation in 2017 and quick uptake from countries, market share for PBO nets increased rapidly between 2018 and 2021.

BY COUNTRIES

PBO Volumes Shipped by Year and by Country to the Top Ten Recipient Countries of PBO Nets

For many of the highest-volume PBO countries, most PBO net uptake has occurred since 2020. The primary factor that contributed to this scale-up was the increased malaria allocation in the current Global Fund funding cycle (2020-22).

Factors Influencing PBO Net Market: Supply

PBO Sourcing and Supply: There are only two WHO-approved suppliers of PBO raw material for prequalified ITNs that manufacture ~85% of the global supply of PBO. Lack of diversity among raw material suppliers and uncertainty of long-term demand represent risks to sustained supply.

Plastics Pricing: The rise in global oil prices has led to a 42% increase in ethylene prices in 2021. As ethylene is the base material used to fashion both polyester and polyethylene nets, higher plastic prices will affect the price of all ITNs, including PBO nets.

Order Forecasting: High fluctuations in PBO net demand and order volumes can hinder planning, both in acquiring or reconfiguring equipment to produce nets and contracting for the raw materials necessary.

Quality Assurance and Quality Control: Manufacturers of PBO nets also need to account for different quality assurance and control procedures, as it is necessary to put in place different measures to assess the quality of PBO incorporation into nets, not just the pyrethroid content.
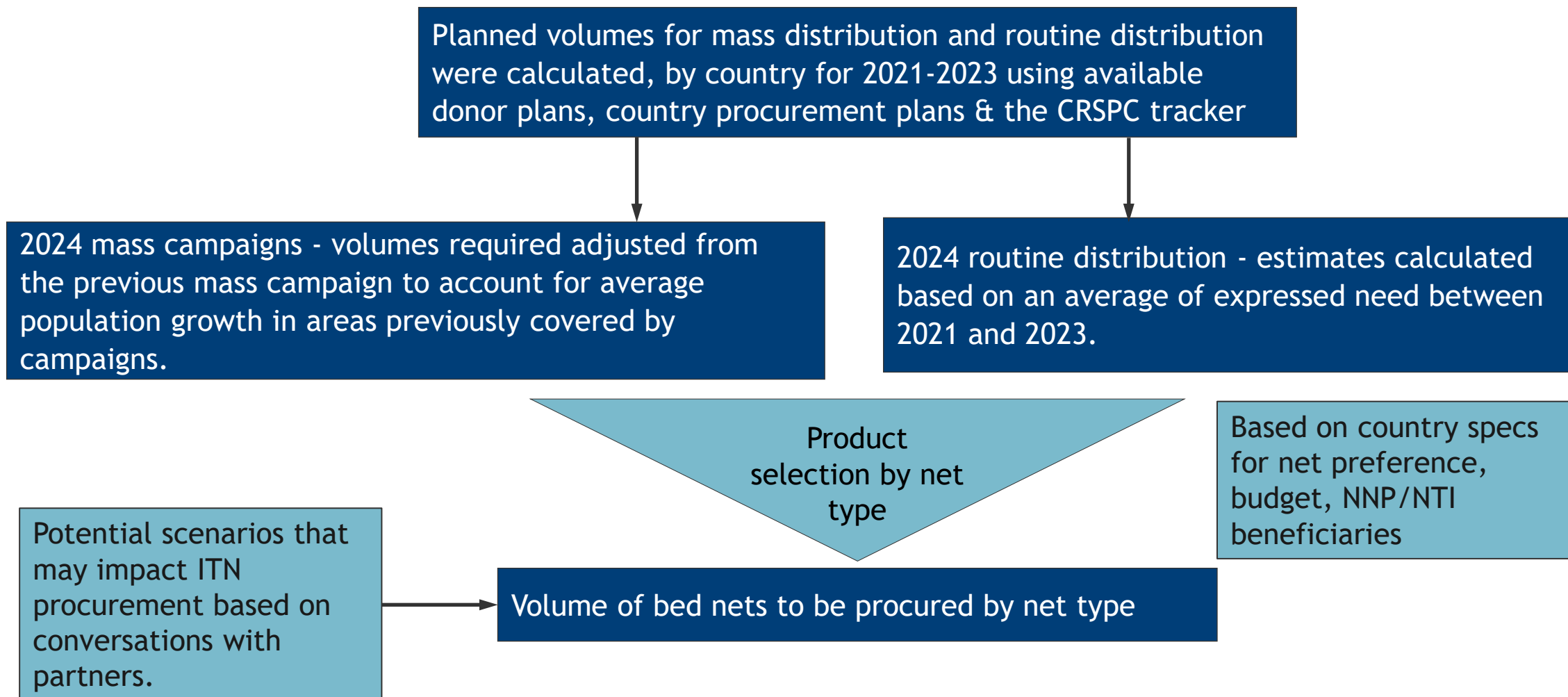
Covid-Related Freight Challenges: COVID-19 disrupted normal freight patterns and created a global shortage of shipping containers. This affected the ability of suppliers to ship nets and has compounded the longer lead times already in place for PBO nets, challenging planned mass distribution campaigns.

Short-term forecast for ITNs

Data sources

Data Source	Data Description	Date last accessed
GFATM – Price and Quality Reporting tool	Ex-manufacturer prices for ITNs and insecticides for IRS; Volume of WHO-PQ procurement through GFATM Pooled Procurement Mechanism (PPM); product market share and share by package strength	October 2021
GFATM Data Explorer/Data Services	Country funding requests, funding allocations, and programmatic gap analyses Monthly aggregates of all disbursements by GFATM	October 2021
NMCP	National Strategic Plans, Integrated Vector Management Plans, Insecticide Resistance Management Guidelines	September 2021
PMI	Historical procurement data, by country and product. Future procurement budgets and gap analysis from projected malaria operational plans	September 2021
RBM	Programmatic and Financial Gap Analysis	October 2021
UNICEF	Supply and price updates	October 2021
IVCC	Next Generation Indoor Residual Spray (NgenIRS) Project – data on volumes collation aggregated for manufacturers annually from 2016-2021	November 2021
CRSPC IRS tracker	Summary IRS tracker, used for validation and background analyses	October 2021
The AMP Net Mapping Project	Historical quantities of ITN global shipments by year and net type, broken down by country and donor	October 2021
CRSPC Mass Campaign Tracker	Net campaign tracker by country/subnational units, net type and year	November 2021

Future of the PBO net market: short-term forecast methodology overview

Planned volumes for mass distribution and routine distribution were calculated, by country for 2021-2023 using available donor plans, country procurement plans & the CRSPC tracker

2024 mass campaigns - volumes required adjusted from the previous mass campaign to account for average population growth in areas previously covered by campaigns.

2024 routine distribution - estimates calculated based on an average of expressed need between 2021 and 2023.

Product selection by net type

Based on country specs for net preference, budget, NNP/NTI beneficiaries

Potential scenarios that may impact ITN procurement based on conversations with partners.

Volume of bed nets to be procured by net type

Factors Influencing PBO Nets Volumes in the Short-term

BUDGET IMPACT

Global Fund replenishment for the 2024-2026 period

Funding from other donors that support ITN procurement
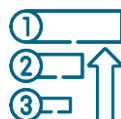
Country and donor funding priorities

PRICE IMPACT

Rising costs of plastic inputs

Rising costs of freight

Number of PBO nets on market

Number of dual AI nets on market
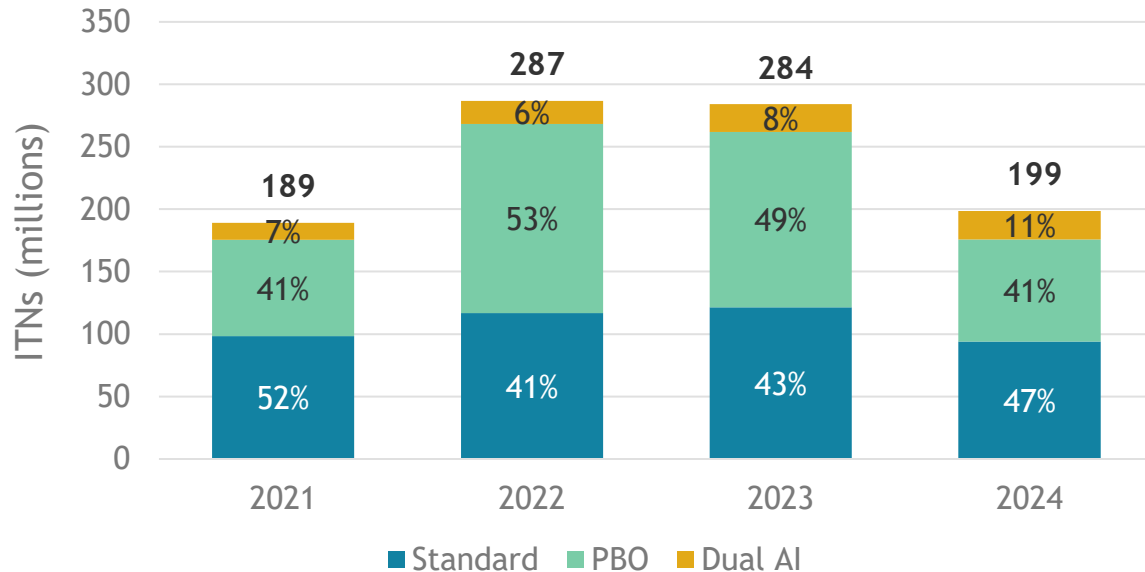
NTI exit price for dual AI nets

POLICY & RESISTANCE

New policy recommendations

Shifts in insecticide resistance

Short-term Procurement Projections for PBO Nets: Estimation based on current procurement trends

Forecast donor-funded ITN procurement

ITNs (millions)

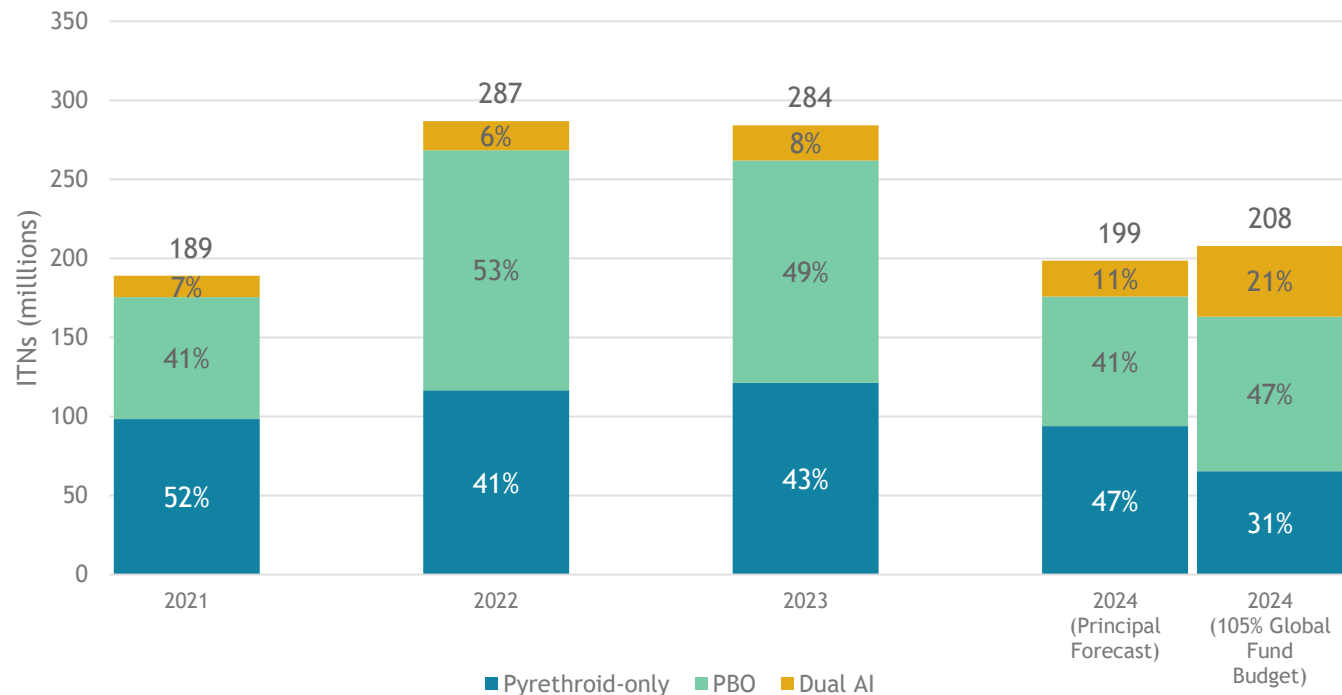|	2021	2022	2023	2024
Total	189	287	284	199
Dual AI	7%	6%	8%	11%
PBO	41%	53%	49%	41%
Standard	52%	41%	43%	47%

■ Standard ■ PBO ■ Dual AI

WAP (US$) for ITNs, ex works

Type	2019	2020	2021	2022	2023	2024
Standard	1.99	1.97	1.93	1.93	1.93	1.93
PBO	2.71	2.65	2.58	2.46	2.37	2.28
Dual AI	2.46	2.5	2.18*	2.18	2.18	2.38

Assumptions for all scenarios:

- Procurement years specified are based on the date at which products are shipped, which is assumed to be the same year as products are needed in country.

- Per WHO guidelines, net replacement cycle is usually 3 years and adherence to this guidance will continue through to the end of 2024. As such, market share trends for 2024 are most comparable to 2021 procurements

- Resistance is expected to continue at current trends.

- Current procurer perceptions of product performance does not change for each net type

- The impact of PBO and Dual AI recommendations in 2022 will depend on pricing and budget availability. Both recommendations are assumed to be moderate (strong enough to avoid a downwards effect but not so strong to influence a big shift in product type preferences).

Short-term Procurement Projections for PBO Nets: Budget replenishment scenario in 2024
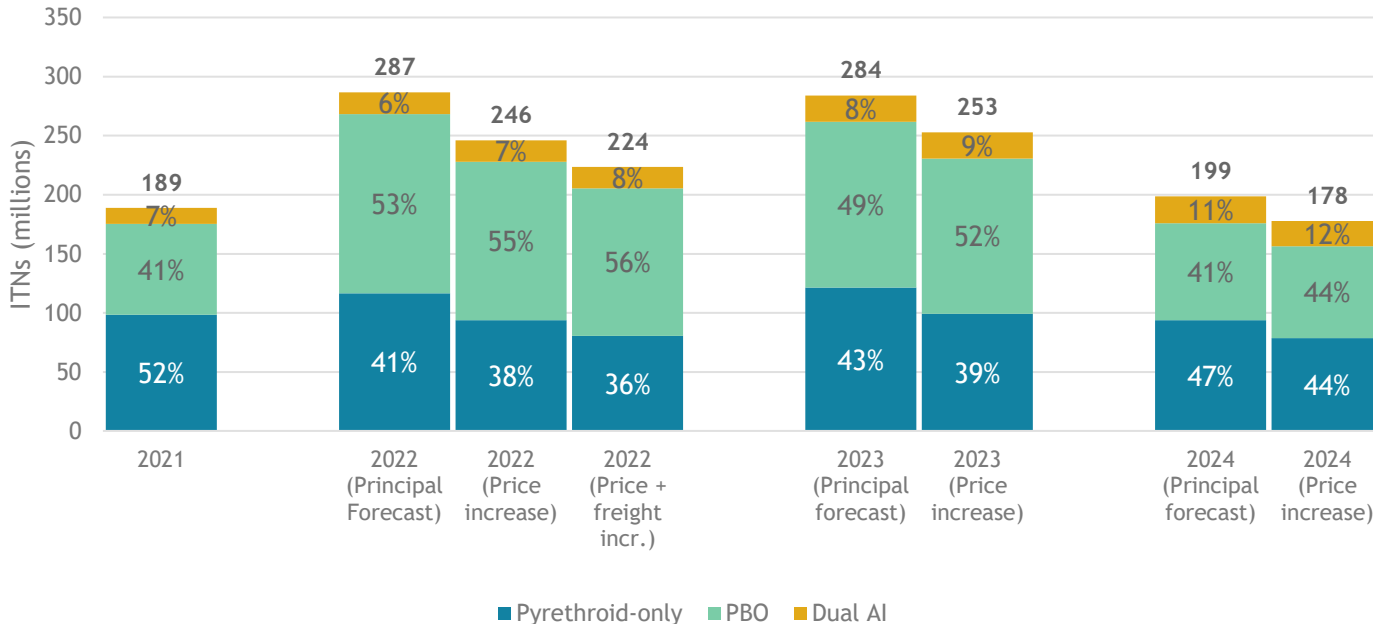

Global Fund 105% Budget Replenishment Scenario for 2024

ITNs (millions)

Year	Pyrethroid-only	PBO	Dual AI	Total
2021	52%	41%	7%	189
2022	41%	53%	6%	287
2023	43%	49%	8%	284
2024 (Principal Forecast)	47%	41%	11%	199
2024 (105% Global Fund Budget)	31%	47%	21%	208

Legend: ■ Pyrethroid-only ■ PBO ■ Dual AI

Assumptions for budget increase scenario:

- Baseline assumptions and ITN pricing projections remain the same as the principal forecast

- Countries use additional budget to increase proportion of nets that are PBO and/or Dual AI compared to standard nets, with preference for Dual AI.

- Countries not procuring standard nets will use additional budget to increase proportion of Dual AI nets being procured (assumes sufficient supply of Dual AIs).

Short-term Procurement Projections for PBO Nets: ITN Pricing Scenarios - Price Changes in 2022 - 2024

Projections of Principal ITN Forecast, Price Increase Scenario for 2022-2024, and Price + Freight Cost Scenario

Legend: ■ Pyrethroid-only ■ PBO ■ Dual AI

WAP for ITN (US$), ex works (price increase)

Type	2019	2020	2021	2022	2023	2024
Standard	1.99	1.97	1.93	2.22	2.22	2.22
PBO	2.71	2.65	2.58	2.87	2.59	2.50
Dual AI	2.46	2.49	2.18	2.48	2.48	2.50

Assumptions for price/cost change scenarios

- The price of standard nets increases 15% ($0.30) in 2022 driven by rising cost of raw materials and this absolute cost is applied to other net types.

- COVID-19 related increase in freight and container costs of 13% of the standard LLIN price in 2020 (a $0.25 increase on the total cost of freight) must be absorbed by ITN commodity budgets in 2022 only

- In order to maintain net types needed to manage resistance, countries will prioritize maintaining Dual AI nets, then PBO volumes

- Dual AI and PBO net prices are assumed to be equivalent in 2024, as NNP parameters for price difference have already been reached

# Key takeaways for the short-term ITN forecast

- Based on country requests and anticipated need, market share of PBO nets is expected to peak around 2022, with increased uptake of dual AI nets from 2022 to 2024.

- By 2024, supply constraints for Dual AI are no longer expected to be a limiting factor and demand is expected to increase in line with increasing resistance pressures.

- In the scenario of increased fund, countries are expected to accelerate switching to PBO and Dual AI nets in the next funding cycle. The rate of switching is expected to be highest for Dual AI nets, as countries implementing PBO only or PBO and Dual AI nets use additional funds to accelerate the switch towards Dual AI.

- In the scenario of a $0.30 increase in price across all types of nets, without a budget increase to accommodate this, total volumes of nets would be expected to decrease from 2022 to 2024

Long-term drivers of need and demand

Factors Influencing PBO Net Need and Demand in the Medium to Long-term

CATEGORY	FACTOR	EXPLANATION OF IMPACT ON PBO VOLUMES
Budget and Price Factors	Budget Changes	*Increase or decrease:* Budgetary constraints will likely restrict demand for PBO nets whereas additional funds allocation will fuel demand
	Price Changes	*Increase or decrease:* New PBO net manufacturers, prices of Dual AI nets, cost of deploying other vector control interventions like IRS will all impact the price and hence demand of PBO nets
Policy Factors	WHO GMP PBO recommendation	*Increase or no change:* A recommended increase in the settings where PBO nets should be used would increase projected need for PBO nets.
	WHO GMP dual AI recommendation	*Decrease or no change:* If there is a strong recommendation for dual AI scale-up, dual AI net use may decrease need and demand for PBO nets, depending on content of recommendation
	Universal coverage v. HBHI	*Increase, decrease or no change:* Donor and country prioritization of universal coverage v HBHI approaches will impact ITN types/volume.
	Changes in ITN campaign frequency	*Increase or no change:* Changes to frequency of ITN campaigns may lead to changes in volumes/types of ITNs due to budget considerations.
INSECTICIDE RESISTANCE	Prevalence of metabolic resistance to pyrethroids	*Increase:* More widespread metabolic resistance leads to greater possible areas where PBO nets could have significant impact
	Intensity of metabolic resistance to pyrethroids	*Increase or decrease:* Higher intensity metabolic resistance triggers switching from pyrethroid-only nets to PBO nets.
	Prevalence of other types of pyrethroid resistance	*Decrease:* Prevalence of non-metabolic resistance would suggest that PBO nets will have less impact, which would reduce need

When considering resistance projections only, Dual AI nets are expected to be the most appropriate type of net for most settings in the medium to long term
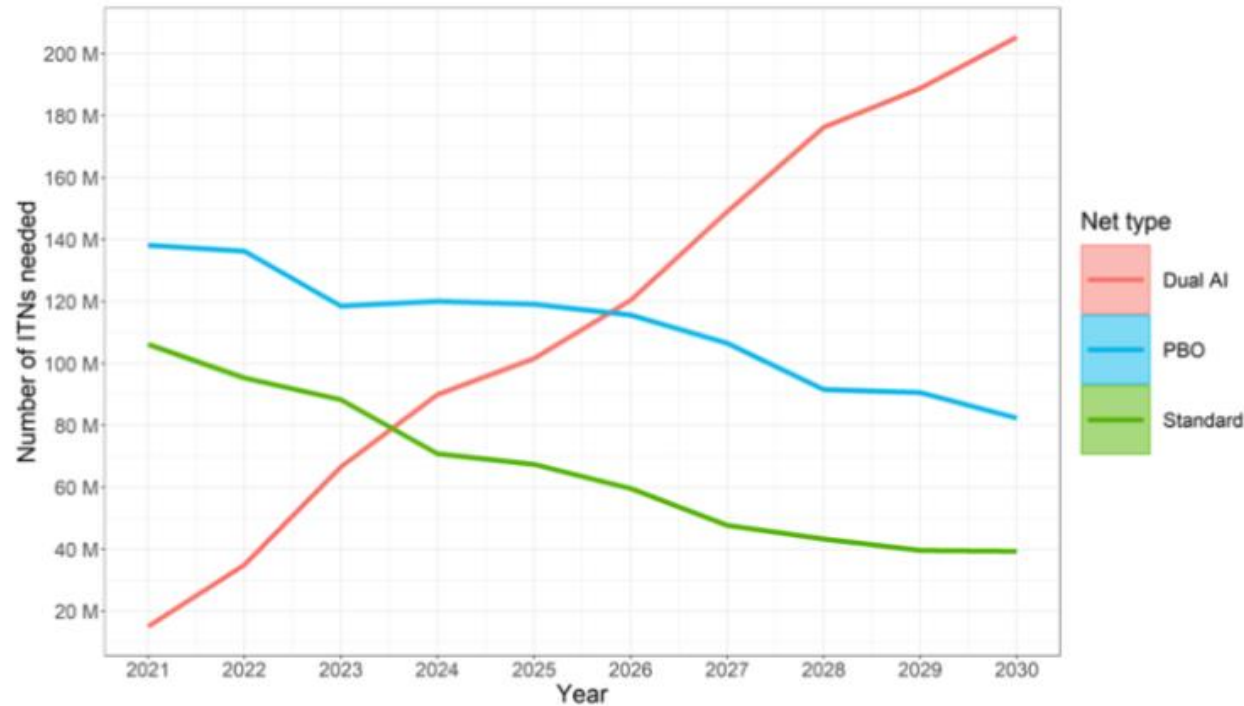
Long-term Forecast of Total ITN Need by Class in Sub-Saharan Africa, 2021-2030, Based on Modelled Progression of Resistance
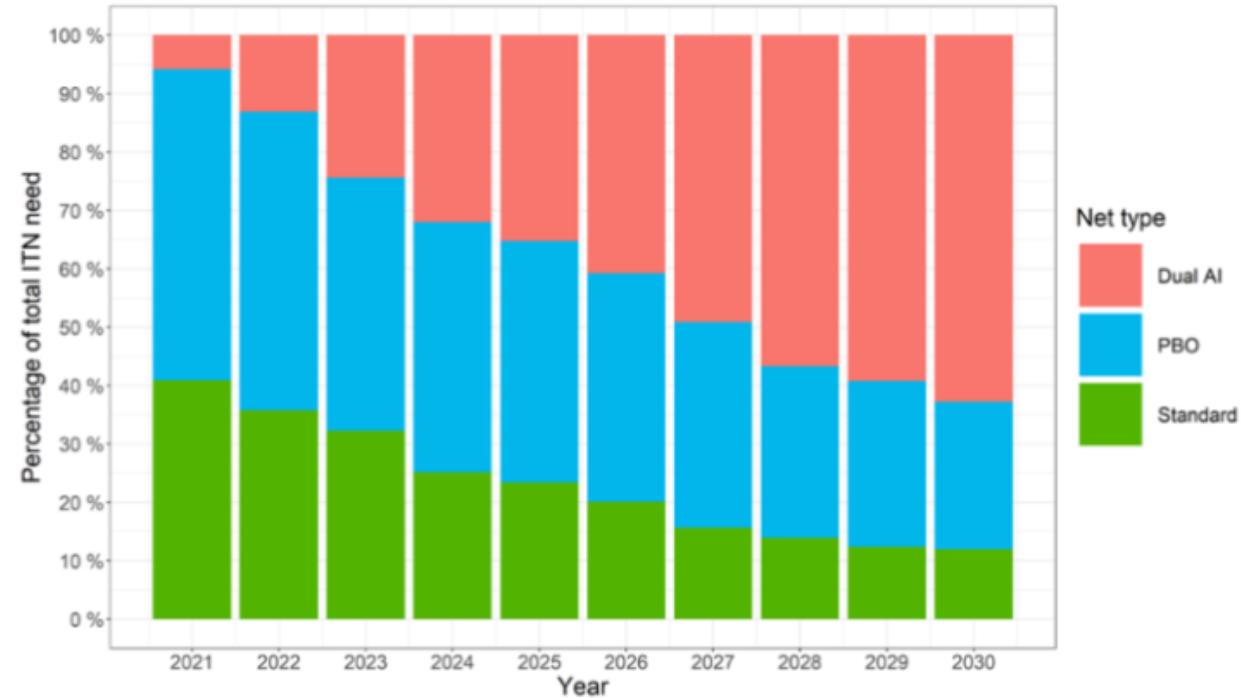
Long-term Forecast of Proportion of Total ITN Need by Class in Sub-Saharan Africa, 2021-2030, Based on Modelled Progression of Resistance

However, factors outlined in the previous slide will substantially influence demand for different types of nets in the medium to long term. Modelling of the interplay of these factors will be explored in the upcoming 2022 long-term forecast.

Acknowledgements

Acknowledgements

Closing

The full deep dive report, short term forecast outputs and methodology can be found on the CHAI forecasting dashboard on the RBM website:
https://endmalaria.org/dashboard/chai-forecasting-global-malaria-commodities

Please direct any questions/comments to: malaria.forecast@clintonhealthaccess.org

Thank you for listening!