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Landscape of malaria bednet programs

Key actors, funding, and challenges

Global Health and Development Department

February 2025 • Report

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Suggested citation: Leow, A., Hu, J., Elsey, J., & Hird, T. 2025. Landscape of malaria bednet programs: Key actors, funding, and challenges. Rethink Priorities.

https://rethinkpriorities.org/research-area/landscape-of-malaria-bednet-programs/

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We thank GiveWell for commissioning and funding this research report. The views expressed herein are not necessarily endorsed by GiveWell.

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Editorial note

This report was commissioned by GiveWell and produced by Rethink Priorities from January to February 2024. We updated and revised this report for publication. GiveWell does not necessarily endorse our conclusions.

The primary focus of the report is to provide an overview of the key actors involved in mosquito bednet programs and the funding landscape for such programs, at the time of writing. It's likely that some of this information is out of date, given ongoing uncertainty about funding for the President's Malaria Initiative.

In addition, we summarize expert opinions about emerging challenges and priorities in this field based on the perspectives shared in 10 interviews.

We don't intend this report to be Rethink Priorities' final word on malaria bednet programs, and we are open to revising our views as more information is uncovered.

Executive summary

Key actors in malaria bednet programs: Our research found that all countries within the scope of our report[1] distribute nets via mass campaigns (often with universal coverage, but sometimes with exclusions for lower-transmission areas) and almost always additionally distribute to pregnant women and to children under one year of age via antenatal care (ANC) and Expanded Programme on Immunization (EPI) channels. An overview of malaria bednet programs across the 14 countries can be found here. There are funding gaps in almost all countries, which we have captured here. Only three countries are engaged in school-based distribution, with pilots in two other countries. The highest volume channel for ITN distribution across the targeted countries is via mass campaigns (on average, 65.9% of nets in a three-year cycle), followed by ANC (14.0%), then EPI (13.5%), then schools (5.3%).

The Global Fund (GF) and the US President's Malaria Initiative (PMI) fund most bednet programs, and they work with the same procurement and logistics actors in most countries: the GF Pooled Procurement Mechanism (PPM), the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM), and the IDA Foundation. However, some of these actors will change in the next 18 months because long-term contracts are coming to a close. The Against Malaria Foundation (AMF) also works closely with both GF and PMI.

We captured other key actors involved in malaria bednet programs here. Based on our desk research and expert input, it seems that these additional actors are mostly involved with in-country logistics (from the first administrative level, such as a provincial capital) and implementation/distribution. As a rule of thumb, non-governmental organizations are more likely to be involved with mass campaigns and school-based distribution rather than ANC and EPI distribution. While we do not expect to have captured all actors involved in all programs, we are reasonably confident that we have identified the key non-governmental organizations that have significant experience with bednet programs and work across multiple countries: Catholic Relief Services, Population Services International, and World Vision.

GiveWell asked us to look more closely at three countries.

- Nigeria: we note that many of the net and operational costs for 2025 and 2026 were unfunded. Lower provision of nets to the mass campaign may negatively affect continuous distribution channels because historically these have utilized leftover nets from mass campaigns. The GF Funding Request states intentions for co-financing to support continuous distribution, but this funding is not confirmed. In more positive news, we heard that a World Bank and Islamic Development Bank initiative is going ahead after significant delays (see World Bank, 2020). Catholic Relief Services has been an important actor, but one expert suggested that many responsibilities are transferring back to the Nigerian states.
- Mozambique: the mass campaign appears to be mostly funded (with a gap only for nets for the provincial capitals). As far as we can tell, the distribution of nets is not integrated with EPI, which is unusual compared to other high-burden countries. Based on expert input, we believe that implementation in Mozambique is supported by a stable set of key non-governmental actors, including World Vision, but these actors may face capacity constraints.

[1] The scope of this research was set by GiveWell, who commissioned this report. The 14 countries we considered were Burkina Faso, Cameroon, the Democratic Republic of the Congo (DRC), Guinea, Mozambique, Nigeria, Uganda, Ghana, Mali, Niger, Tanzania, Chad, South Sudan, and Togo.

- Uganda: our impression is that bednet programs are primarily run by the government, with minimal involvement in logistics and implementation by other actors. There are stated gaps of at least 40% (and up to 100%) for all continuous distribution channels.

Funding for malaria bednet programs: We estimate that roughly 55% of all spending on bednet programs is from the Global Fund, and PMI funds a further 20%. This analysis is imperfect, but experts agree that these are the major funders. AMF and UNICEF are also important (~10% of funding each). The relative breakdown of bednet funding has generally been stable over the last 15 years, but notable trends include 1) the continual growth of AMF's share of total bednet spending and 2) a reduction of the share made up by minor funders outside the top four. Due to data limitations, we could not calculate the funding breakdown per country or analyze the relative spending on bednet programs versus malaria or health budgets.

From published materials, we learned that bednet funders have publicly signaled an overall intention to 1) shift money toward next-generation Dual AI nets (e.g., through the Global Fund's Revolving Facility; see Global Fund, 2023d) in response to rising insecticide resistance; 2) increasingly prioritize areas of highest burden; 3) increase their emphasis on subnational tailoring; and 4) increase their emphasis on monitoring the durability of nets, among other trends.

- We were able to substantiate the first two strategic objectives with data. Among the top bednet funders, Dual AI nets procurement has increased from 6% in 2020 to 18% in 2023. Analysis of Global Fund data shows that the share of vector control funding directed toward 10 "high-burden, high-impact" countries has steadily increased, from 48% (2017-2019) to 69% (2023-2025).
- Experts confirmed that funders are increasing their emphasis on subnational tailoring (the process of targeting specific interventions to specific locations within a country) and are allocating more funds toward subnational modeling and analysis. Many experts also spoke about concerns regarding net durability, which we discuss below.

In addition to these overall trends, we learned that, in certain countries (including the DRC, Mozambique, and Malawi), there is a movement toward shorter mass campaign cycles due to concerns about net durability. We also learned that PMI has stated that it will pause or reduce continuous net distribution in the DRC and Cameroon due to budgetary constraints in 2024.

Expert-identified challenges and priorities: We conducted 10 interviews during this project, and in each, we asked experts an open-ended question about their views on emerging challenges, priorities, and net technologies. Our aim was to solicit responses from people with a range of roles and perspectives within this field, which we could then synthesize into a high-level view for GiveWell. We spoke to individuals at (or formerly at) key organizations in the malaria community: multilaterals, technical assistance providers, implementers, net manufacturers, and research institutions. We did not interview individuals at the Global Fund, PMI, or BMGF, as agreed with GiveWell. We also did not reach out directly to national malaria control programs.

In Table 1, we provide an overview of the challenges and the related priorities and trends that experts identified. This table also includes our low-confidence assessment of potential implications for net programs and next steps for GiveWell, based on a mix of explicitly stated expert views and first principles thinking by our team. Our "Top 5" suggestions to GiveWell are:

1. Calculate the cost-effectiveness of funding more continuous distribution as a way to reduce gaps in coverage between mass campaigns, and/or ask CHAI to share their

progress on this. It seems plausible that continuous distributions could be a cost-effective and tractable way to distribute more nets.
2. Conduct additional expert interviews targeted towards a better understanding of the malaria community's position on "universal" vs. "optimal" coverage for bednet programs, which could then inform GiveWell's position on this question. These interviews could impact GiveWell's view of net gaps.
3. Investigate whether the increasing complexity of malaria programs due to subnational tailoring and prioritization increases the cost-effectiveness of two kinds of grants above GiveWell's bar: 1) grants for technical assistance and 2) grants for collecting and/or improving data collection to facilitate intervention targeting and mitigation of malaria outbreaks.
4. Talk to funders to better understand their projections for the spread of *Anopheles stephensi*, their containment strategies, and to what extent they have committed funding. These conversations could have implications for funds available to bednet programs.
5. Investigate the possibility of resistance to chlorfenapyr. Evidence of resistance could reduce confidence in chlorfenapyr nets as a long-term solution.

We are aware of two developments in net technologies in the near future:

- A new net that combines bifenthrin (a kind of pyrethroid that has not yet been used on bednets) with chlorfenapyr is currently under assessment for prequalification by the WHO. Assuming the assessment process takes a year, it could be listed by 2025.
- A new net that combines Tenebenal and a pyrethroid is in the "pre-development" stage. Several experts suggested that this bednet may be ready for testing in 2026, and prequalified by 2027 at the earliest.

We did not have time to thoroughly investigate these new active ingredients to determine what impact they could have on net programming. We recommend that GiveWell briefly discuss bifenthrin and Tenebenal with an expert, particularly regarding the likelihood of cross-resistance.

In our conversations with experts, they also discussed some developments in other technologies. The two that seem most likely to have short-term implications for nets programming are spatial repellents (which may receive an evidence recommendation this year) and vaccines. Multiple experts suggested that determining how best to co-deploy these tools (and subsequently funding this co-deployment) was a priority. We believe this is an additional area that GiveWell should explore.

Table 1: Summary of challenges, priorities, and implications for net programs and GiveWell

Challenge	Expert-identified priorities and trends	Implications for net programs	Potential next steps for GiveWell
Insecticide resistance *This was a "given" with almost all experts, but two entomologists queried the strength of the evidence base and suggested there's too much focus on this issue in the malaria community.*	Trend: increasing distribution of Dual AI nets, particularly chlorfenapyr nets	Increased possibility of delays for all net types Increased net costs and potentially funding gaps Concentration of volume among fewer net manufacturers	Investigate the concerns raised by entomologists Expect to increase net costs in CEA Investigate whether there is documented resistance to chlorfenapyr Consider the evidence for long-term resistance management and incorporation into CEA
	Trend: funders, especially PMI, are shifting away from IRS	Potentially increased demand for dual AI/PBO nets	Understand what type of nets are being deployed in areas IRS is removed Investigate whether removal of IRS in certain areas could lead to malaria rebounds
	Priority: remove barriers to innovation	Unlikely to have new net types in the next three to four years	Consider whether there are tractable, neglected opportunities to intervene
Net durability *Multiple experts cited concerns about durability, and some suggested that the actual lifespan of a net is 1.5-2 years.*	Priority: determine how to address coverage gaps in between mass campaigns	Reducing intervals between campaigns in some countries Potentially more volume through continuous distribution	Consider whether to update the "Adjustment for net coverage years lost due to residual nets from previous distributions" parameter in the CEA Consider calculating the cost-effectiveness of continuous distribution and/or ask CHAI to share their current understanding of cost-effectiveness
	Priority: measure and reward durability to shape the bednet market	If durability data becomes more available and pricing based on durability is implemented, then there may be changes to the mix of nets purchased	Consider/update net durability parameter Consider the potential for impactful data collection and/or market shaping Potentially expect more variation in net costs
	Priority: develop strategies to manage	Pressure to manage plastic waste might increase appetite for other solutions	Investigate what options exist for responsible management of used nets

	LLINs after use	Efforts to manage used nets may require new or different activities	Incorporate other costs of nets, such as plastic waste, into the CEA
Limited funding *Resource constraints, and the subsequent need for trade-offs and prioritization, were highlighted by many.*	Trend: subnational tailoring and prioritization	If universal coverage is no longer the aim: smaller volumes could increase prices If tailoring of specific nets to specific areas continues/intensifies: increasing costs and potential for delays due to higher complexity and smaller volumes could increase prices If urban coverage is reduced: average non-net costs may increase	Determine what GW considers the optimal coverage for bednets Plan to dedicate more time to understanding complex national strategies to better understand net gaps and calculate fungibility Consider the impact of increasing complexity on the cost-effectiveness of technical assistance grants Consider effects on net and non-net costs
	Priority: collect data to support initial prioritization and monitor outcomes to mitigate the risk of malaria outbreaks	If data becomes available: more complex analysis and subnational targeting If monitoring takes place: potentially more subnational prioritization due to lower risks	Consider whether (improving) data collection could be a cost-effective grant
Changing bite patterns and novel species *In the short term, experts seem more concerned about* Anopheles stephensi *than about behavioral resistance.*	-	Behavioral adaptation could render nets (and tools such as IRS) less effective over time Vector control measures targeting multiple types of behavior may be required, placing more funding stress on nets	Consider including behavioral adaptation and regional species prevalence into CEA Better understand funders' projections for Anopheles stephensi, as well as their strategies and committed funding
Net retention/use *We were surprised that only two experts mentioned this issue. One suggested this lack of mention reflects an established gap in public health thinking about bednet programs.*	Priority: consider procuring nets that match user preferences, even if more expensive	If pursued, this strategy would increase the complexity of manufacturing and procurement, and may increase complexity of implementation	Consider a shallow investigation of cost-effectiveness, comparing expected usage increases to projected costs
	Priority: increase social and behavior change activities	Unknown	Consider a shallow investigation of cost-effectiveness, comparing expected usage increases to projected costs

Abbreviations

AMF	Against Malaria Foundation
ANC	antenatal care
CAMEG	Central Purchase of Generic Essential Drugs and Medical Consumables
CHAI	Clinton Health Access Initiative
CRS	Catholic Relief Services
DRC	Democratic Republic of the Congo
Dual AI	dual active ingredient
EPI	Expanded Programme on Immunization
GC	Grantmaking Cycle (more)
GF	The Global Fund to Fight AIDS, Tuberculosis and Malaria
GFDS	Global Fund Data Service (more)
GHSC-PSM	Global Health Supply Chain Program-Procurement and Supply Management
GW	GiveWell
HBHI	"high burden, high impact" (more)
HIV/AIDS	human immunodeficiency virus/acquired immunodeficiency syndrome
IDA	International Dispensary Association
IDPs	internally displaced persons
IG2	Interceptor® G2 (more)
IMA	IMA (Interchurch Medical Assistance) World Health
IMPACT	Immunization Plus and Malaria Progress by Accelerating Coverage and Transforming Services
IRS	indoor residual spraying
ITN	insecticide-treated net
IVCC	Innovative Vector Control Consortium

JMS	Joint Medical Store
LLIN	long-lasting insecticidal net
MOES	Ministry of Education and Sports
MOH	Ministry of Health
MOP	Malaria Operational Plan (more)
NMCD	National Malaria Control Division
NMCP	National Malaria Control Program
NMEP	National Malaria Elimination Program
NMP	Net Mapping Project (more)
PAAR	Prioritized Above Allocation Request (more)
PBO	piperonyl butoxide
PMI	The US President's Malaria Initiative
PPM	Pooled Procurement Mechanism (more)
PR	principal recipient (more)
PSI	Population Services International
RBM	Roll Back Malaria
SANRU	Soins de Santé Primaires en Milieu Rural
SBC	social and behavior change
SMC	seasonal malaria chemoprevention
SNP	school nets program
SSA	sub-Saharan Africa
TA	technical assistance
TB	tuberculosis
USAID	United States Agency for International Development
UNDP	United Nations Development Programme

UNICEF	United Nations Children's Fund
WFP	World Food Programme
WHO	World Health Organization
WV	World Vision

Key actors in malaria bednet programs

Malaria bednet programs are complex undertakings that involve a variety of actors. In this report, we aim to clarify the roles that different actors play, with a focus on 14 African countries of particular interest to GiveWell.

In many countries, The Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund or GF) and The US President's Malaria Initiative (PMI) are the main funders. Programs funded in this way tend to have a similar set of actors and relationships. We describe these "default" actors in the first subsection. Following this description, we present country-specific information on net needs and non-default actors.

The scope of this report is broad. We cover all distribution channels for bednets, the most common of which are:

- Mass/universal campaign: a concerted effort to distribute nets that takes place at intervals (generally every three years) and targets all or almost all households
- Antenatal care (ANC): a continuous distribution channel integrated with antenatal visits, whereby pregnant women receive a net during their first ANC visit
- Expanded Programme on Immunization (EPI): a continuous distribution channel integrated with scheduled vaccinations, whereby children up to the age of five (but often up to one year old) receive a net
- School-based: a continuous distribution channel whereby children of particular ages or school grades (which can vary by country) receive a net at school

We also cover all stages of the bednet programs from planning to implementation. For simplicity, we've delineated these activities into discrete stages: planning, procurement, logistics, and distribution/implementation (see Table 2). These categories are purposefully high-level, such that they should apply to all distribution channels.

Table 2: Description of activities in bednet programs

Stage	Description of activities
Planning	Calculating net quantities Allocating funds Deciding on net types
Procurement	Contracting with net manufacturer(s) to buy a quantity of nets at a given price, to be ready by a certain date
Logistics	International: organizing quality control inspections, shipping (from manufacturer to country), and/or customs Domestic: organizing in-country storage/warehousing and transport of nets (e.g., by train, truck)
Distribution/implementation	Organizing specific details, e.g., when, where, who (similar to microplanning; see Health Campaign Effectiveness Coalition, n.d.) Physically handing out bednets to recipients

Common actors and relationships: Programs are coordinated by the NMCP and involve multiple actors across procurement, logistics, distribution/implementation, and technical assistance

The National Malaria Control Program (NMCP)[2] is important throughout the process and is most closely involved in planning, logistics, and distribution.

In most countries, **GF and PMI are the key funders of bednet programs (see more). Programs funded in this way tend to have a similar set of actors and relationships.** We describe the involvement of GF and PMI below, ordering the activities roughly in order from most to least standardized.

Procurement:
Procurement is often centralized, with some exceptions that are generally outside of the 14 countries of interest. In addition to the actors listed below, the Against Malaria Foundation (AMF) also procures nets directly.

- **Global Fund: Countries procure through the Pooled Procurement Mechanism (PPM)** using an online platform called Wambo (see Global Fund, n.d.-b, for general information; see Global Fund, n.d.-a, for net-specific information).
    - One expert shared that for some GF-funded programs, particularly in "challenging environments," nets may be purchased by the **United Nations Children's Fund (UNICEF) Supply Division** rather than through the PPM. Our low confidence conclusion from desk research is that South Sudan is the only country within our scope that falls into this category.
- **PMI: In 2021/22, procurement was done via the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM)**, which is contracted to **Chemonics International**. However, the relevant organization may be changing shortly (or may have already changed), according to our understanding of recent news articles and USAID web pages.[3]
- We understand from an expert that some non-governmental organizations directly procure nets but that the prices of these nets must be aligned with the Global Fund PPM.
- Other actors very rarely purchase nets directly from the manufacturers we spoke to.[4] Exceptions may include national agencies (such as Kenya and Ethiopia) and humanitarian NGOs such as MSF, Red Cross, and UNHCR.

Logistics:
In general, the actors that manage what we describe as "international" logistics (i.e., from manufacturer to port) are the same for all countries within the scope of this report.

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[2] In French-speaking countries, this is called the PNLP, and in some English-speaking countries, this program is differently named (e.g., National Malaria Control Division, National Malaria Elimination Program). We use NMCP here as a catch-all term.
[3] To use the DRC as an example, in the 2021 funding table, it is clear that GHSC-PSM procures nets. However, 2022 and 2023 documents indicate that nets will be purchased by "TBD - Supply Chain Central Mechanism," and in 2024, the "Working Capital Fund, Commodity Procurement" is listed as the relevant mechanism. Some brief searching suggests this may reflect the fact that Chemonics International's contract to fulfill GHSC-PSM was extended several times to November 2024 (Igoe et al., 2023). From this point, it seems like a new set of organizations will implement GHSC-PSM as part of a 10-year $2.2bn contract. On January 8, 2024, USAID posted that the awards have been made to Bixal Solutions, Chemonics International, DAI Global, LLC; Guidehouse, LLP, JSI Research and Training Institute; Management Sciences for Health, and Panagora Group (USAID, n.d.).
[4] This reflects the net mapping data that we analyze further here.

- **Global Fund: The International Dispensary Association (IDA) manages logistics for nets purchased through PPM**; see IDA Foundation (n.d.). We understand from an expert that this contract is due to be rebid in the near future, so this may change shortly.
- **PMI: Our lower confidence impression is that GHSC-PSM manages LLIN logistics** by default, though they may, in turn, subcontract to other actors, including the private sector. See this 2017 example for school distributions in Ghana in USAID (2017).
    - As mentioned above, it appears that PMI's current way of managing logistics will change in the next ~18 months.

There is more variation across countries with regard to in-country logistics after nets arrive at the port. Our impression from speaking with an expert is that **in most countries, IDA or GHSC-PSM will deliver to the first administrative level** (i.e., capital of a province/state/region), **at which point another actor will take over.** Countries prefer this to delivery to a single central warehouse, and getting IDA and GHSC-PSM to deliver to this level saves money and time versus government tendering (especially in larger countries).

- There are exceptions to this generalization. For example, in Uganda, government agencies manage most, if not all, in-country logistics, whereas in Cameroon, the government conducts last-mile logistics from the third administrative level (aire de sante, or "health area").

The same expert shared that the responsibility for logistics from the first administrative level to last-mile varied from country to country, and there was no rule of thumb for this variation. **The best indicator for whether in-country logistics will be done by the government or by a non-governmental organization is where there is a non-governmental Global Fund principal recipient (PR).**[5]

- For ANC and EPI continuous distribution, nets are generally warehoused at a more central location, and resupplied to specific health centers based on need. These logistics are managed by the government.

Distribution/implementation:
The key actors for this stage vary by distribution channel. For mass campaigns, the key actor will depend on the setup of the Global Fund or PMI grant. ANC/EPI continuous distribution is usually government-run. School distribution is primarily conducted by non-governmental partners and generally involves the Ministry of Education, not the Ministry of Health.

Technical assistance:
Additionally, other actors may provide technical assistance (TA) at any stage in the process:

- Experts highlighted that TA can range from support to set high-level strategic direction and determine the scope of bednet programs (i.e., planning) to more focused support specifically for digitization, campaign management, or logistics.
- The Roll Back Malaria partnership (RBM) compiled a dashboard of country support in 2022 and 2023, showing TA by partner and country (RBM Partnership to Malaria, n.d.). At the time of writing, this dashboard focuses primarily on support for GF Funding Requests for the 2024-26 cycle, so this list is likely incomplete.

[5] In each country, Global Fund grants are initially disbursed to a PR, which may be a government ministry, non-governmental organization, or private company. PRs are selected to handle the financial and managerial capacities of the grant and sign a grant agreement with GF. In one country, there may be multiple PRs. As an expert notes, the specific setup in each country often dictates how activities are carried out and by whom. For many activities, PRs then disburse funds to implementers that are designated sub-recipients (SRs) or even sub-sub-recipients. See more on this topic here.

- The lead partners often mentioned in the dashboard are the Alliance for Malaria Prevention, African Malaria Leaders Alliance, CHAI, PATH MACEPA, RBM, and WHO.
    - We understand from experts that in PMI-funded areas, Abt Associates provides technical assistance through the Evolve project (formerly the VectorLink project). Additionally, some other non-governmental organizations may also offer technical assistance, such as CRS, Population Services International (PSI), SANRU ("Soins de Santé Primaires en Milieu Rural," which translates to "Primary Health Care in Rural Areas"), and Society for Family Health (SFH).

Country-specific detail

For country-specific detail, we focused primarily on documentation from the two largest funders in antimalarial programs across the designated regions: GF and PMI.

Data Sources + Process

- PMI provides country-specific Malaria Operational Plans (MOPs), which detail planned antimalarial activities that will be covered by PMI funding each financial year. Similarly, GF makes available country-specific requests for funding, which outline planned activities to be carried out for the upcoming grant cycle. The most recent of these documents, usually the 2024 MOPs and funding requests for 2024-2026, were used to gather information about planned and recently implemented ITN activities in each country of interest, including key distribution channels (e.g., mass campaigns, antenatal care) and the scope of their coverage.[6]
- Where possible, we extracted information about specific organizations or actors that were noted as being involved in the procurement, logistics, or distribution of ITNs in these countries. Upon identifying a specific actor, we conducted some additional online searching to obtain more detailed information about the activities these actors had engaged in.
- We supplemented our search of PMI and GF documents with broader web searching to try to identify specific actors who may have been involved in the process, from the procurement to distribution of ITNs in each country. These searches were in the form of a Google search for different distribution channels, along with the country name and terms such as bednets or LLIN (distribution channels were also searched in French for countries in which French is a major language).
- In addition, we asked experts about three countries of particular interest to GiveWell: Nigeria, Uganda, and Mozambique.

Based on our research, we have:

1. Populated a spreadsheet of key actors in malaria net programs, which provides an **overview of the distribution channels in use in each country and, where identified, specific non-default actors** that appear to be involved with procurement, logistics, and distribution.
    - We also present this information in prose in Appendix A.
    - In the next section, we provide a high-level overview of our findings.
2. Synthesized information about reported net needs for each country across different distribution channels. Our analysis can be seen here and in Appendix B.
3. Captured information about reported funding gaps in each country; here.

[6] Copies of the specific resources that we used are available here and are not cited individually in the bibliography. PMI MOPs are found on their website here, and Global Fund documentation is available from the Data Explorer here.

As a caveat, we think it is likely that our desk research may have missed relevant actors and may not accurately reflect funding gaps because:

- Our primary sources from GF and PMI often do not name specific actors (which may reflect that subcontractors/SRs have not been identified at the time of writing).
- We're conducting this exercise at the very beginning of the new GF cycle and at a time of change for PMI.
- The information we have found in 20-30 minutes online is likely to be incomplete. We expect that additional time spent searching will not be particularly fruitful, except perhaps for large countries such as Nigeria and the DRC.

Implementing actors across countries: Many actors are country-specific, but in multiple cases we identified involvement by organizations such as CRS, PSI, and World Vision

In terms of distribution channels, all countries distribute bednets via mass campaigns, typically every three years. Most countries additionally engage in continuous distribution via antenatal care and/or EPI. School-based distribution is less utilized than other channels.

Information regarding specific actors involved in implementing ITN activities was harder to find than information about the general scope of activities. **We generally did not see the same actors repeatedly coming up across the countries in scope, though we identified some larger organizations that operate in multiple countries:**

- **Catholic Relief Services** has been involved in bednet programs in Nigeria (current), Gambia (confirmed activities in 2022; Mbye, 2022), Niger (confirmed activities in 2020; CRS, n.d.; and principal recipient for GF in the most recent grant cycle), and Guinea (confirmed activities in 2019; Global Fund, 2023b; and a joint principal recipient of the most recent GF cycle). An expert agreed that CRS was probably the most widely involved of non-default organizations, though the organization was in the process of establishing what its level of involvement should be going forward, to avoid being overstretched.
    - Note that a Global Fund investigation found that nets were diverted during the 2019 Guinea campaign in CRS zones (Global Fund, 2023b).
    - An expert noted that CRS had done good work in Nigeria and seemed to have a broadly positive view of its performance.
- **Population Services International** notes distributing 450 million ITNs since 1997 and helping governments distribute 25 million since 2018 (PSI, n.d.-a). Countries covered by distribution from PSI include Kenya (in the mid to late 2000s; National Social Marketing Centre, n.d.), distribution of school-based and health center ITNs in Tanzania (PSI, n.d.-e), helping identify solutions for routine distribution in Niger (PSI, n.d.-c), as well as distribution in Mali (PSI, n.d.-b)—these appear to be more recent, with Tanzanian and Malian operations at least up until 2020. PSI was also involved with the PMI VectorLink LLIN durability testing (PSI, n.d.-d) and in other vector control activities such as chemoprevention. An expert seconded that PSI has been operational in many countries but had possibly been less directly involved with ITNs recently.
    - Note that a Global Fund audit reported non-compliant expenditures and potential losses of $7.4 million during the period that PSI was the PR for DRC (Global Fund, 2020).
- **United Nations Development Programme (UNDP)/World Food Programme (WFP).** An expert highlighted the involvement of the UNDP across multiple countries (Haiti, Burundi, Chad, and Cameroon). In cases where UNDP was the PR, the WFP was often involved in distributing bednets.

- **World Vision International (WV).** WV has been involved with bednets in Mozambique and in other countries. An expert noted that WV is a relatively minor player in the bednets space, but also that it might get involved in procurement.

As a general point, an expert also noted that **the use of non-governmental PRs is decreasing due to funding constraints.** It is now more common for the government to act as the PR to avoid overhead costs, and, as such, organizations like CRS that may previously have led on multiple aspects of malaria bednet programs are less involved.

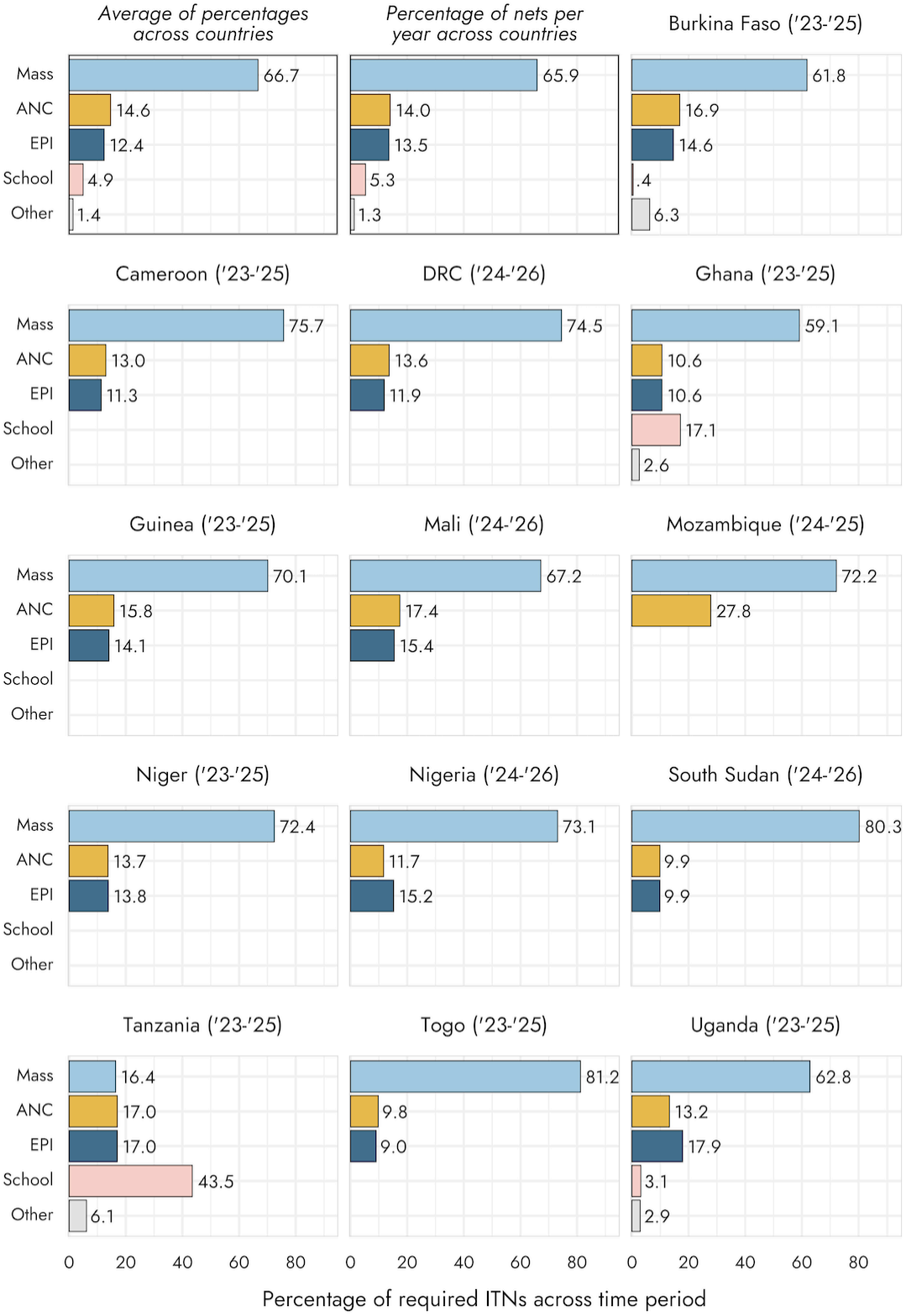
Number of nets via different channels: Mass campaigns deliver a majority of bednets in most countries of interest, with ANC, EPI, school-based, and other modes accounting for the remaining volume distributed

To better enable an approximate sense of how many nets are distributed through different channels across different countries, we've compiled the most recently available information on *needs* for ITNs. **These net need figures do not strictly reflect how many nets will be distributed**. Rather, they reflect a projected need and intended amount to distribute across the funding cycle, **primarily according to PMI documentation**. In some cases, not all of the desired nets will be funded or the exact amounts successfully procured and distributed. In addition, we are not fully confident that PMI documentation always includes bednet activities implemented by other funders. As a result, **we think these numbers give a good overall impression of the landscape but would not rely on the precise numbers** for each country if high precision were required.

Summary tables are presented in this spreadsheet. The proportions of nets per channel overall and per channel per country are displayed in Figure 1. Plots depicting yearly raw numbers and percentages can be found in the Appendix section "Yearly bednet need breakdowns."

We also include this breakdown (in square brackets for each distribution channel) in the country-specific narrative summaries below.

Figure 1: Percentage of nets via each distribution channel across countries and overall



Average of percentages across countries takes the average of each of the channel percentages across the countries. *Percentage of nets per year across countries* pools the number of nets per year per channel, and then estimates the overall percentage per channel. Numbers for Mozambique are based on a 2yr average, as 2023 numbers were missing. *Source: PMI ITN Gap Tables, GF for DRC, South Sudan, and Nigeria.*

Note. Original sources are the PMI MOP ITN Gap Tables and GF Funding Requests. Recent information for Chad was not available.

Funding for malaria bednet programs

The funding landscape for malaria bednet programs comprises several actors whose absolute and relative contributions have varied over time. In this section, we aimed to provide GiveWell with a broad overview of the major funders for bednets and how their nets funding has changed over time in terms of volume, geographic spread, and objectives, based on analysis of publicly available data.

Bednet donors in countries of interest: GF, PMI, AMF, and UNICEF are the most significant bednet donors

[Confidence: High confidence that the major donors for sub-Saharan Africa are the major donors for the 14 countries of interest to GiveWell as a group. Medium confidence for any individual high-priority country, given it could be disproportionately funded or not funded by a particular funder.]

Data limitations: We rely on publicly available data on bednet deliveries for sub-Saharan Africa to estimate funding

Funding data are not publicly available for all malaria bednet program costs, so we extrapolate from data on net deliveries (methodology described here). These data come from the Alliance for Malaria Prevention's Net Mapping Project (Alliance for Malaria Prevention, n.d.-b).

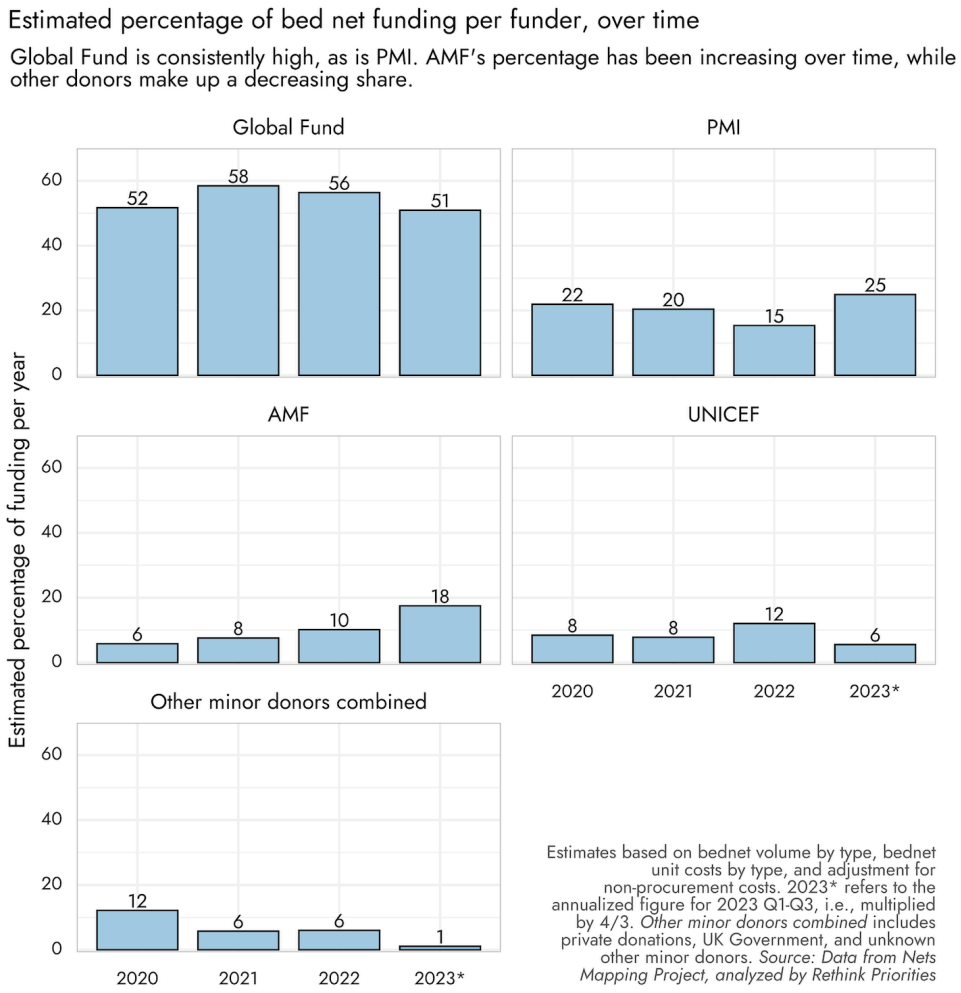
Country-level data are not published by NMP, so we use data for sub-Saharan Africa (SSA). We expect that our findings for SSA broadly reflect the landscape for the 14 countries of interest to GiveWell, which are all in SSA.

Funding concentration: The four largest funders account for almost all bednet funding in sub-Saharan Africa

The top funder of bednets in SSA is the Global Fund, which consistently accounts for more than half of funding (55% over the period 2020-2023*). **The next three major funders in SSA are PMI** (20%), **AMF** (10%), **and UNICEF** (9%). See Figure 2.

- *Note:* 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

*Figure 2: Estimated percentage of bednet funding per funder, 2020-2023**

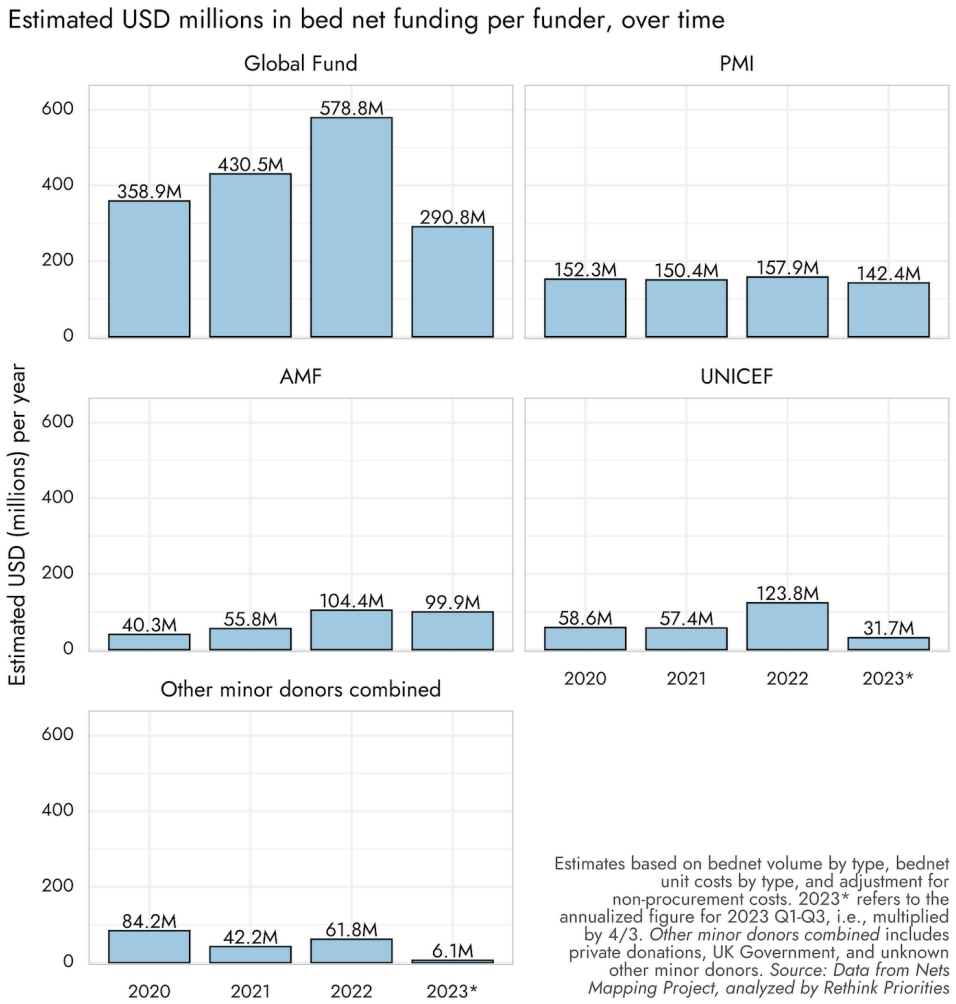


Note. Own calculation based on bednet volume by type, bednet unit costs by type, and adjustment for non-procurement costs. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

Evolution of the funding landscape: Funding has generally held stable over the last 15 years, but AMF's share has grown while that of minor funders has declined

The bednet funding landscape in SSA has been generally stable over time. GF and PMI have consistently been the top two funders since 2009. Over the period 2020-2023*, we estimate that GF spending was $415 million per year on average, while PMI spending was $151 million per year on average. However, major changes include significant absolute and relative growth of AMF's contribution since 2009-2019 and a significant absolute and relative reduction in the share made up by other funders over the same period (see also Figure 3, Figure 4, and Figure 5).

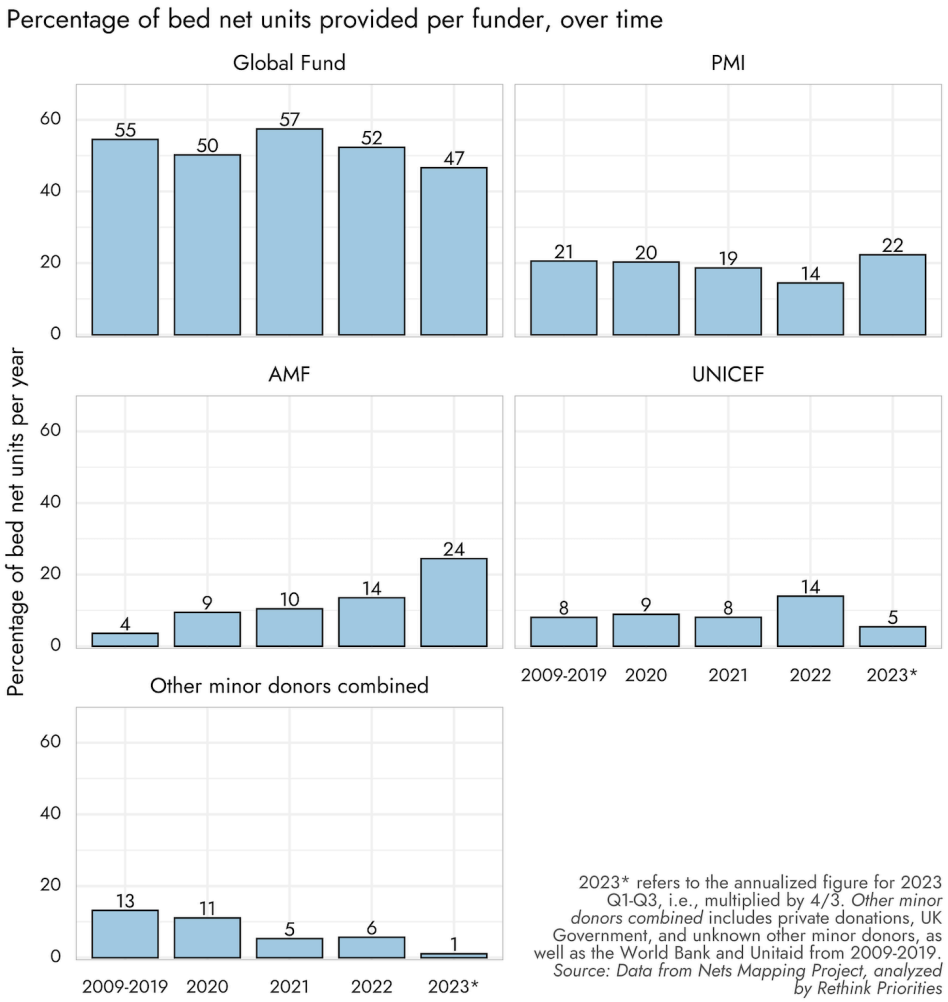
*Figure 3: Estimated USD millions in bednet funding per funder, 2020-2023**



Note. Own calculation based on bednet volume by type, bednet unit costs by type, and adjustment for non-procurement costs. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

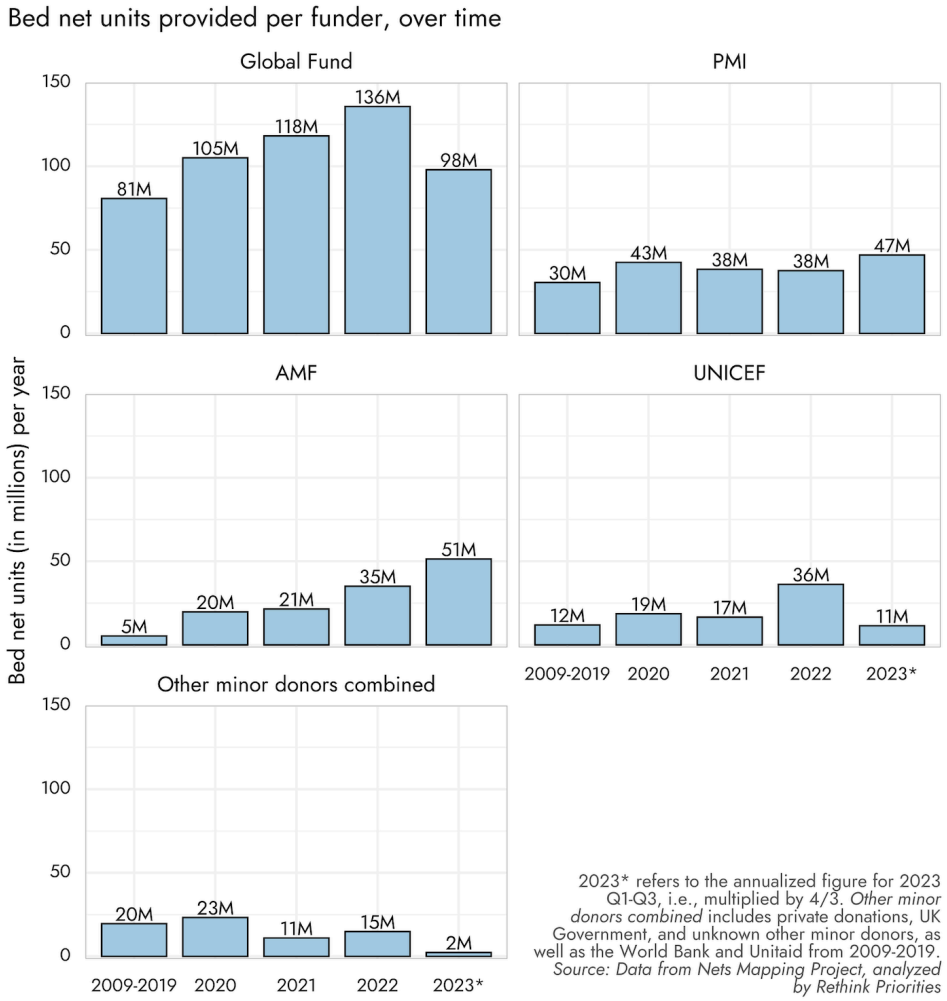
- *Bednet spending ($) over the period 2020-2023**: See Figure 2 and Figure 3
  - **AMF's share of bednet spending grew every year during this period**, going from $40 million (5.8% of total bednet spending) to $100 million (17.5% of total bednet spending), overtaking UNICEF to become the #3 funder of bednets.
  - **The "Other donor" category accounted for a relatively large portion of spending until 2023***. Over the 2020-2022 period, this category accounted for $52 million per year on average (6.4% of total bednet spending), but in 2023*, it only registered spending $3.3 million (0.6% of total bednet spending).
    - We did not look further into why this might be. One possibility is that most "Other donor" donations occur during Q4 and are not captured by the "2023*" figure, which is extrapolated from Q1-Q3.

*Figure 4: Percentage of bednet units provided per funder, 2020-2023**



Note. Data from NMP; analyzed here. The source does not disaggregate 2009-2019. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

*Figure 5: Bednet units provided per funder, 2020-2023**



Note. Data from NMP; analyzed here. The source does not disaggregate 2009-2019. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

- *Bednet deliveries (nets) over the period 2009-2023**: See Figure 4 and Figure 5
  - **Over this longer time window and in terms of bednet units,[7] AMF's share growth appears even more dramatic**, going from 5.3 million nets per year on average during 2009-2019 (3.6% of total nets) to 51 million nets in 2023* (25% of all nets).[8] Based on NMP data for 2023 Q1-Q3, AMF was on track to surpass PMI to purchase the second-most bednets in 2023.
  - Movements in the relative contribution of private and named minor donors:
    - **Private donors saw significant growth from the 2009-2019 period to recent years**. From 2009 to 2019, they accounted for just 180,000 nets per year on average (0.1% of all nets). From 2020 to 2023*, they delivered 2.5 million nets per year on average (1.15% of all nets).
    - **The UK government, World Bank, and Unitaid previously accounted for a somewhat significant share in 2009-2019, but they now deliver very few or zero nets.** From 2009 to 2019, they collectively delivered 9.4 million nets per year on average (6.4% of all nets). From 2020 to 2023*,

[7] We did not attempt to estimate spending in 2009-2019 because NMP does not disaggregate data from this period. (Moreover, it could be difficult to source accurate bednet unit cost data for this longer period.)
[8] AMF accounts for relatively more nets than dollars because it does not pay for non-procurement costs, whereas we presume that all other funders do.

World Bank and Unitaid delivered zero nets, and the UK government delivered an average of 110,000 nets per year (0.05% of all nets).

- An expert said that the UK government's exit from bednet procurement might be explained by broader foreign aid budget cuts by the UK, while Unitaid's later net grants (made jointly with GF), which amounted to $66 million for the New Nets Project, ending in 2022, could have been attributed solely to GF—but we did not confirm this with NMP.

It is unlikely that the "Other donor" category is concealing an unnamed large funder. We emailed an NMP representative to check whether that could be the case. They did not directly answer our question but said, "The other category is made up of a lot of various donors." We confirmed at least six minor donors in this category for 2023.

Box 1: About the data analysis

Relevant sheets:

- All funders—nets
- All funders—$

What data are available:

- **How many nets each funder provides (by type, region), 2009-2023** (AMP, n.d.-b)[9]
- **Bednet unit costs (by type), 2020-2023** (e.g., Global Fund, 2023a)[10]
- **The proportion of total bednet spending that procurement tends to make up** (GiveWell, 2023)

What analyses we've managed to do:

- **How much does each funder spend on nets for sub-Saharan Africa, 2020-2023?**
  - Step 1: Multiply nets by unit costs for each type to obtain bednet procurement costs (BPC)
  - Step 2: Multiply BPC by inflator to account for non-procurement costs to obtain total bednet costs
    - The inflator is calculated as 1/0.64 = 1.5625[11]
    - The exception is AMF, which does not pay non-procurement costs
- **Two sense checks showing that Step 1 works reasonably well:**
  - Global Fund reports that $329 million worth of nets were procured through its platform in 2022 (Global Fund, 2023c, slide 10), a figure that is similar to our 2022 estimate of $370 million (excluding non-procurement costs).
  - UNICEF reports that it procured $81.5 million worth of nets in 2021 (Briedova & Markova, 2022, slide 3), which is similar to our 2022 estimate of $79 million (excluding non-procurement costs).

Major assumptions:

- **Non-procurement costs are constant across funders other than AMF.**
  - This is a strong assumption, but we think it is unlikely to change our top-level conclusion that GF and PMI are the major funders of bednet programs.

[9] Year: 2009-2019 not disaggregated, 2023 until Q3
Region: sub-Saharan Africa vs. rest of world, not disaggregated by country

[10] Year: no data for 2009-2019
Type: Dual AI unit costs not available before 2023

[11] This number comes from taking the median value (among eight countries) of GiveWell's estimate of the "Percentage of total costs covered by AMF" in its CEA. See here for how we use this calculation in our spreadsheet.

- **During 2020-2022, for which there are no bednet unit cost data for Dual AI nets, we use the 2023 ratio of Dual AI net price to PBO net price to estimate Dual AI net unit costs.**
    - This is also a strong assumption, but it is unlikely to change our top-level conclusions because Dual AI nets made up only a small share of nets before 2023 (13% of GF-procured nets and 8% of all nets in 2022, and less before 2022).
- **We exclude the non-net costs for AMF nets instead of attributing them to GF or PMI.**
    - As we lacked specific data on how AMF's non-net costs should be reallocated proportionally between GF and PMI, we elected to exclude those costs in our estimates.

More detailed analyses

[Confidence: Medium overall. Low-medium confidence in data figures from the Global Fund Data Service as well as any time-series patterns that can be discerned from them (low confidence for individual countries, medium confidence for countries in aggregate). Medium-high confidence in other data analyses in this section, such as the PMI analyses.]

Trends over time: Data limitations prevented us from tracking medium-term trends

A note on GF data limitations

First, we were not able to draw out robust time-series patterns from data downloaded from the Global Fund Data Service (GFDS) because:

- **The data only go back as far as the 2017-2019 funding cycle**, meaning that there are very few data points (either two or three) for each country.
- **We have low confidence in the figures for the 2023-2025 cycle** (the most recent cycle for which there are data). Given that the 2023-2025 figures for the DRC are clearly lower than suggested by another source and 1/10 of the total for the previous cycle, we think that the data upload process for 2023-2025 is incomplete as of January 2024. (Based on comparing two data downloads on different dates, we can confirm that as of January 2024, the dataset was being actively updated.[12]) Thus, we think it is plausible that the 2023-2025 figures represent underestimates for other countries too. Moreover, Chad and Mali have no allocations published for the 2023-2025 cycle.

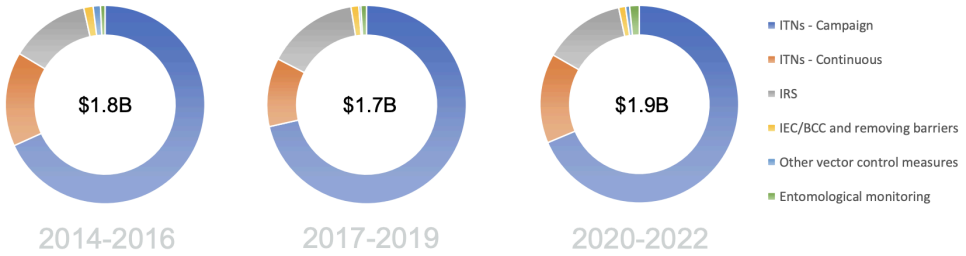
Second, we changed our approach to presenting country-level trends in GF bednet spending during this project due to further data limitations.

- **We could not estimate specific bednet funding by country/funding cycle** using data downloaded from GFDS, as budget items were not labeled as bednet-specific. However, we were able to make the following calculations per the steps described here:
    - Vector control funding per country/funding cycle
    - Malaria-related funding per country/funding cycle
    - All health-related funding per country/funding cycle
- **We initially thought we might be able to draw out some rough trends if we assumed that 80% of vector control funding went toward bednet funding**, given a GF slide deck that showed ~80% of all GF vector control funding globally went toward bednets and this

[12] E.g., on first download in early January 2024, the dataset contained no malaria funding items for the DRC (2023-2025), but a second download in late January 2024 contained some such items.

trend was consistent across cycles (Htin Kyaw Thu & Kolaczinski, 2022, slide 4; reproduced as Figure 6 below).
    - For context, "vector control" is a broad category of interventions that includes bednets and IRS.

Figure 6: Breakdown of GF vector control funding



Note. From Htin Kyaw Thu and Kolaczinski (2022, slide 4).

- **However, we were concerned about variation at the country-level, so we conducted a sense-check that made clear that our assumption that 80% of vector control funding went toward bednets for every country was not tenable.**[13]
- **Consequently, we cannot present trends in GF bednet funding. Instead, below, we simply report vector control funding**—which in some cases will closely match bednet funding.

Gross funding of vector control ($)

GF's vector control funding ($) by country over the past three grant cycles is shown in Table 3. However, we do not attempt to draw out GF country-level funding trends in this section for the reasons outlined above.

Table 3: Global Fund vector control funding

	2017-2019	2020-2022	2023-2025[14]	Grand Total
Africa	$23,736,445	$20,261,007		$43,997,453
Burkina Faso	$43,237,918	$64,701,800	$87,858,190	$195,797,908
Cameroon	$43,991,482	$59,164,454	$51,177,936	$154,333,872
Chad	$33,496,757	$30,251,976		$63,748,732
Congo (Democratic Republic)	$176,537,812	$215,158,368	$25,106,434[15]	$416,802,614
Ghana	$78,293,371	$70,295,534	$63,113,359	$211,702,264
Guinea	$17,757,289	$23,266,060	$26,004,157	$67,027,506

[13] Due to the proprietary nature of the data used in our sense check, details are not disclosed in this public report.
[14] Data are incomplete and these figures may be too low.
[15] We attribute this difference to data incompleteness.

Mali	$23,675,298	$36,988,973		$60,664,271
Mozambique	$108,992,662	$123,673,150	$103,068,820	$335,734,632
Niger	$42,722,683	$47,376,674	$53,092,133	$143,191,490
Nigeria	$161,080,932	$176,828,339	$167,858,939	$505,768,209
South Sudan	$24,240,266	$21,633,615	$21,977,750	$67,851,631
Tanzania (mainland)	$69,709,736	$80,336,301	$98,318,290	$248,364,327
Togo	$12,618,723	$19,829,637	$22,641,961	$55,090,321
Uganda	$76,308,752	$122,681,752	$137,953,784	$336,944,287
Zanzibar	$1,906,281	$2,669,736	$1,051,796	$5,627,814

Note. "Africa" refers to multi-country recipient "Multicountry Southern Africa," a group that includes the DRC, Mozambique, Tanzania, and 11 others (not in this table).

We deprioritized looking into PMI given that time-series funding data were dispersed across a large number of documents (see the MOP funding tables here). We also deprioritized looking into UNICEF given the lack of publicly available data.

Vector control or bednet funding relative to other malaria funding (%)

[Given that we have not been able to specifically determine bednet spending for GF, we expect this section and the following section will be less useful for GiveWell's calculations of fungibility. Note that the below analysis is based on data from GFDS. Consequently, we have low confidence in our analysis of GF funding.]

Our analysis of GF's vector control funding as a proportion of overall malaria funding (Table 4) shows some variation over time. However, we do not draw out time-series patterns in this section due to data limitations as outlined above.

Global Fund's vector control spending almost always accounts for 30%-55% (unweighted average: 41%) of these countries' malaria spending (Table 4).

- At the higher end are countries like Cameroon and Mozambique, where vector control has generally accounted for 50% or more of total malaria spending. At the lower end is Guinea, where around 30% is the norm.
- The discrepancy between countries' malaria spending may reflect variation in country strategies for malaria treatment and prevention, including different compositions of tools used in vector control.

Table 4: Global Fund vector control funding as a proportion of malaria funding (%)

	2017-2019	2020-2022	2023-2025	Grand Total
Africa	57.69%	55.57%		56.69%
Burkina Faso	33.11%	22.76%	55.24%	34.11%

Cameroon	59.89%	52.98%	46.67%	52.36%
Chad	52.92%	25.80%		35.31%
Congo (Democratic Republic)	42.45%	35.19%	52.54%	38.77%
Ghana	53.36%	50.08%	51.40%	51.65%
Guinea	30.27%	27.48%	31.90%	29.81%
Mali	38.14%	45.05%		42.08%
Mozambique	59.93%	57.04%	54.16%	57.00%
Niger	48.84%	36.67%	47.46%	43.58%
Nigeria	52.18%	43.81%	42.30%	45.60%
South Sudan	47.42%	39.74%	41.26%	42.72%
Tanzania (mainland)	38.08%	25.68%	49.20%	35.70%
Togo	35.30%	32.94%	35.56%	34.52%
Uganda	40.10%	44.93%	54.69%	47.09%
Zanzibar	35.59%	32.66%	18.44%	29.26%

Note. "Africa" refers to multi-country recipient "Multicountry Southern Africa," a group that includes the DRC, Mozambique, Tanzania, and 11 others (not in this table).

PMI's bednet spending accounts for a much more variable but generally lower (unweighted average: 17%) proportion of the countries' total malaria spending, compared to GF, according to our analysis of FY 2024 budgets for the countries of interest (Table 5).

- We have higher confidence in this estimate than in our GF estimate, as we can directly identify spending on bednets in PMI documentation, but we expect that 17% is an underestimate as we cannot include all related operational costs.
- The greater variability suggests that PMI's malaria strategies could be more variable by country compared to GF's strategies.
- As we only analyze the data for 2024, and as mass campaigns are often implemented on three-year cycles, country-level data are unlikely to be representative of PMI's longer-term funding strategy. However, we note that:
    - The 10%-30% range contains almost half (6/13) of the countries of interest.
    - Only in Nigeria and Tanzania are a relatively large (35% and 44%) portion of the total budget allocated toward bednets.
    - **In four countries, bednets make up a negligible portion (<3%) of the total budget allocated in 2024**. These are Cameroon, Ghana, Mozambique, and Niger. For these countries, we checked their FY 2023 and FY 2022 funding tables to see if their FY 2024 bednet budgets were anomalously low compared to previous years (see this spreadsheet). We found:

- Of these four countries, **only Ghana previously had typical (i.e., much higher) proportions of budget allocated to bednets** (28% in FY 2023; 23% in FY 2022). PMI's FY 2024 MOP for Ghana does not provide a clear explanation of why its funding for bednets has apparently dropped so dramatically. We considered that 2024's being a mass campaign year might be relevant, but the MOP states that GF and PMI share procurement and distribution responsibilities for mass campaigns (p. 16).
- **Cameroon also previously had higher—albeit still lower than typical—proportions of budget allocated to bednets** (7% in FY 2023; 6% in FY 2022). PMI's FY 2024 MOP for Cameroon justifies this drop as follows: "There will be no purchase of ITNs for routine distribution due to funding limitations and the planned 2025 mass campaign" (p. 14).
- **Mozambique and Niger have consistently had similar proportions** of budget allocated to bednets (0%-2%).

Table 5: PMI bednets funding as a proportion of malaria funding in FY 2024

	Total budget	Bednet budget ($)	Bednet budget (%)
Burkina Faso	$24,000,000	$2,887,500	12.03%
Cameroon	$22,000,000	$400,000	1.82%
Congo, DR	$48,000,000	$9,692,184	20.19%
Ghana	$27,000,000	$600,000	2.22%
Guinea	$15,000,000	$3,964,223	26.43%
Mali	$24,000,000	$5,659,971	23.58%
Mozambique	$27,500,000	$0	0.00%
Niger	$18,000,000	$528,943	2.94%
Nigeria	$68,000,000	$23,428,009	34.45%
Tanzania	$39,000,000	$17,232,750	44.19%
Togo	$11,000,000	$1,561,400	14.19%
Uganda	$31,000,000	$8,023,400	25.88%

Note. The Tanzania figure includes Zanzibar. The bednet budgets are likely underestimated given the presence of other budget line items that may cut across multiple operations including bednets, such as warehousing costs.

Vector control or bednet funding relative to other health funding (%)

[Note that the below analysis is based on data from GFDS. Consequently, we have low confidence in our analysis of GF funding.]

As with the previous section, we do not draw out time-series patterns in this section due to data limitations as outlined above.

Global Fund's vector control spending almost always accounts for 13%-30% of all health spending (Table 6).

- Niger is at the top end consistently, while Tanzania, Mozambique, Guinea, and Cameroon are at the lower end. This metric probably just indicates the relative importance of the malaria portfolio to the HIV/AIDS or TB portfolios, given the GF remit only covers these three diseases.

Table 6: Global Fund vector control funding as a proportion of health funding (%)

	2017-2019	2020-2022	2023-2025	Grand Total
Africa	31.75%	34.28%		32.87%
Burkina Faso	23.70%	18.59%	41.35%	26.36%
Cameroon	20.80%	15.18%	17.34%	17.22%
Chad	29.35%	17.00%		21.82%
Congo (Democratic Republic)	28.57%	20.39%	19.73%	23.15%
Ghana	32.88%	19.80%	25.44%	25.17%
Guinea	16.54%	13.02%	17.91%	15.54%
Mali	18.01%	16.66%	0.00%	13.36%
Mozambique	18.68%	13.09%	14.26%	14.91%
Niger	33.82%	26.27%	37.44%	31.93%
Nigeria	25.43%	14.36%	17.73%	17.99%
South Sudan	23.52%	11.64%	15.27%	15.67%
Tanzania (mainland)	11.64%	10.55%	16.20%	12.63%
Togo	16.48%	13.08%	20.20%	16.19%
Uganda	14.10%	15.19%	22.98%	17.29%
Zanzibar	16.40%	16.14%	9.72%	14.44%

Note. "Africa" refers to multi-country recipient "Multicountry Southern Africa," a group that includes the DRC, Mozambique, Tanzania, and 11 others (not in this table). Thus, figures for members of this group are less than actual allocations.

The question of how bednet or vector control funding compares to other health funding is not additionally relevant for PMI, as it works exclusively on malaria. See above.

Box 2: About the data analysis

Relevant sheets:

- Global Fund
- PMI

What data are available:

- **Grant agreements of GF, 2017-2026** (Global Fund Data Service)
  - **Malaria vector control funding from GF for each country, 2017-2026** (filter by ComponentName = "Malaria"; ActivityAreaName = "Vector Control")
  - **Malaria funding from GF for each country** (filter by ComponentName = "Malaria")
  - **All funding from GF for each country** (no filter)
- **PMI malaria operational plan budget for each country/fiscal year** (here)
  - **We specifically looked at bednet funding** (calculated based on our read of budget items) **from PMI in FY 2024**

What analyses we've managed to do:

- **Dividing vector control (GF) and bednet (PMI) funding by total malaria and total health funding**

Other relevant data that this analysis ignores:

- **Proprietary data that show discrepancies with the Global Fund Data Service figures**

Geographical trends: The share of bednets going to SSA seems stable, and HBHI countries could be receiving an increasing share of funding

Regional and national allocation

Close to 100% of PMI- and AMF-procured bednets go to sub-Saharan Africa, while roughly 90% of Global Fund- and UNICEF-procured bednets go to SSA (Table 7)**. These macroregional breakdowns—based on data from NMP—seem to have remained roughly stable over time.** However, in 2023 (extrapolated from Q1-Q3 data), there was a decrease in the proportion of bednets procured for SSA by Global Fund and UNICEF (85% and 80%). This relative decrease in SSA nets was driven by an absolute decrease in nets distributed to SSA from both GF and UNICEF and an absolute increase in nets distributed to the rest of the world. It is possible that this finding simply reflects incomplete data for 2023, so we do not place too much weight on it.[16] Data are not available at the country level.

[16] Experts noted that it would be best to speak to those organizations directly to find out.

*Table 7: Regional breakdown of nets procured by funder, 2009-2023**

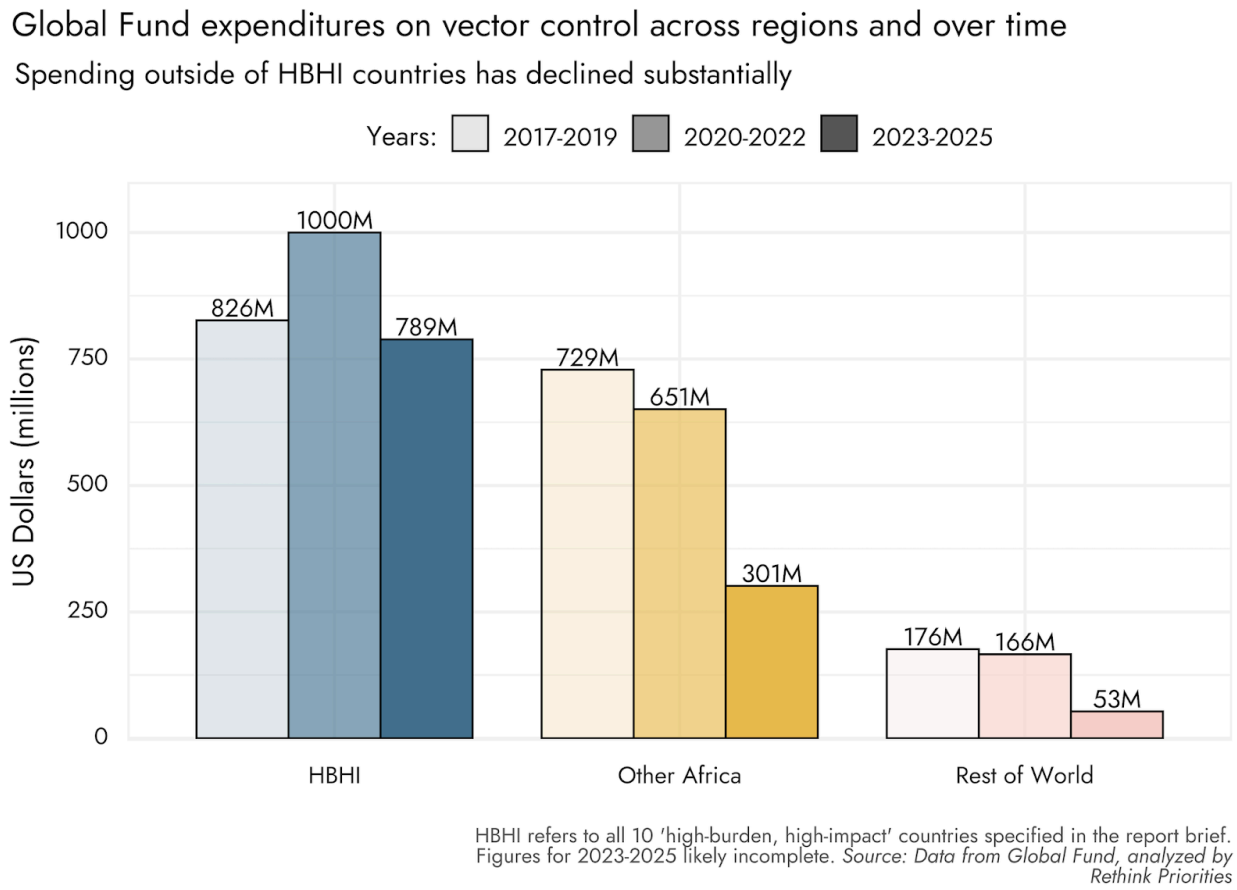
	Region	2009-2019	2020	2021	2022	2023*	Grand Total
Global Fund	ROW	9%	7%	7%	9%	15%	9%
	SSA	91%	93%	93%	91%	85%	91%
PMI	ROW	1%	3%	1%	1%	0%	1%
	SSA	99%	97%	99%	99%	100%	99%
AMF	ROW	3%	5%	0%	0%	0%	1%
	SSA	97%	95%	100%	100%	100%	99%
UNICEF	ROW	6%	11%	15%	5%	20%	10%
	SSA	94%	89%	85%	95%	80%	90%

Note. Data from NMP. SSA: sub-Saharan Africa; ROW: rest of world. Source does not disaggregate 2009-2019. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

High-burden, high-impact countries make up a greater proportion of total bednet spending by GF than before, although the absolute amount of bednet spending they receive seems to have remained stable (Figure 7)**.** Other regions may have seen a relative and absolute decrease in bednet funding over the last three funding cycles. We are highly uncertain about trends in absolute spending, given the incompleteness of data for the latest funding cycle, but we think the shown change in relative allocations is probably reflective of actual trends for two reasons:

1. **Expert views:** Experts referred to a strained funding landscape that has prompted "tough choices" and greater prioritization, including geographical prioritization. That said, experts did not directly say that relatively more funding was going toward HBHI countries, and geographical prioritization could have referred to targeting the highest-priority districts within countries.
2. **Data availability**: We aren't aware of specific reasons why budgetary data for HBHI countries would be systematically available earlier than for other countries, so we think the proportions shown in Figure 7 for the 2023-2025 cycle should be representative of the full sample.

Figure 7. Global Fund expenditures on vector control across regions over time



Note. Analysis of data from Global Fund.[17] HBHI refers to all 10 "high-burden, high-impact" countries specified in the report brief.[18] Figures for 2023-2025 are likely incomplete.

PMI could be particularly eager to prioritize the highest-burden countries for bednet distribution. (PMI's programs have covered fewer countries than GF's to begin with.) We did not look at time series data across countries but instead drew this conclusion primarily based on published documents and expert interviews.

1. **Published documents**: PMI's 2021-2026 strategy explicitly calls for "targeted strategic shifts" that include "strategically prioritiz[ing] countries with the highest burden of malaria and deaths" (PMI, 2021, p. 5).
2. **Expert views**: One expert said PMI has generally been more willing to experiment with new strategies for malaria control than GF. However, another expert said PMI might be questioning its investments in bednets altogether lately, and that there is uncertainty over its future malaria control strategy.

We did not look into trends in geographical coverage by country or country grouping for UNICEF, given a lack of public data.

[17] See our GitHub repository for this analysis, which was done using an R script from data on grant agreements from the Global Fund Data Service from the "Data Set" tab under the "Grant Agreement Implementation Period Detailed Budgets" item downloaded on January 25, 2024. Analyzed data can also be found in this spreadsheet.
[18] Burkina Faso, Cameroon, Congo (Democratic Republic), Ghana, Mali, Mozambique, Niger, Nigeria, Uganda, Tanzania (mainland and Zanzibar).

Subnational tailoring

GF and PMI both claim to be increasing their emphasis on subnational tailoring, i.e., helping countries set malaria strategies and funding priorities at the subnational level. Experts agreed that this is happening, one of whom highlighted that funding is being allocated to the modeling and analysis required to generate these tailored plans.

- **GF:** An emphasis on subnational tailoring is included under its larger 2023-2028 strategic aim to "maximize health equity" (Global Fund, 2021). For example, Nigeria's funding request for the 2023-2025 allocation period cites the "subnational stratification for tailoring of interventions prioritized on the basis of epidemiology, geography, access to health care, vulnerability … in 13 states" as evidence of alignment with the health equity objective (p. 127).[19]
- **PMI:** The importance of subnational tailoring in bednet distribution falls under its larger 2021-2026 goal to "Reach the unreached" (PMI, 2021, p. 3). It has set the goal of "ensuring strategic deployment of integrated vector control interventions subnationally" (PMI, 2023, slide 13) and includes subnational elimination among its strategic objectives.

One expert described subnational tailoring as a process to identify the perfect mix of interventions and called for more subnational tailoring of operational strategies as well. A different expert explained that subnational tailoring is necessary due to the combination of resource limitations and diverse ecological settings with countries and that countries are funded to do relevant modeling and impact analysis of subnational tailoring. An expert also noted that given funding constraints, prioritization and trade-offs quickly follow any tailoring exercise. We discuss the prioritization trend in more detail later in the report (here).

Trends in strategies and objectives: Funders are adopting novel bednet technologies, adjusting distribution channels amid funding and durability constraints, and improving coverage measurement

Adoption of new net types

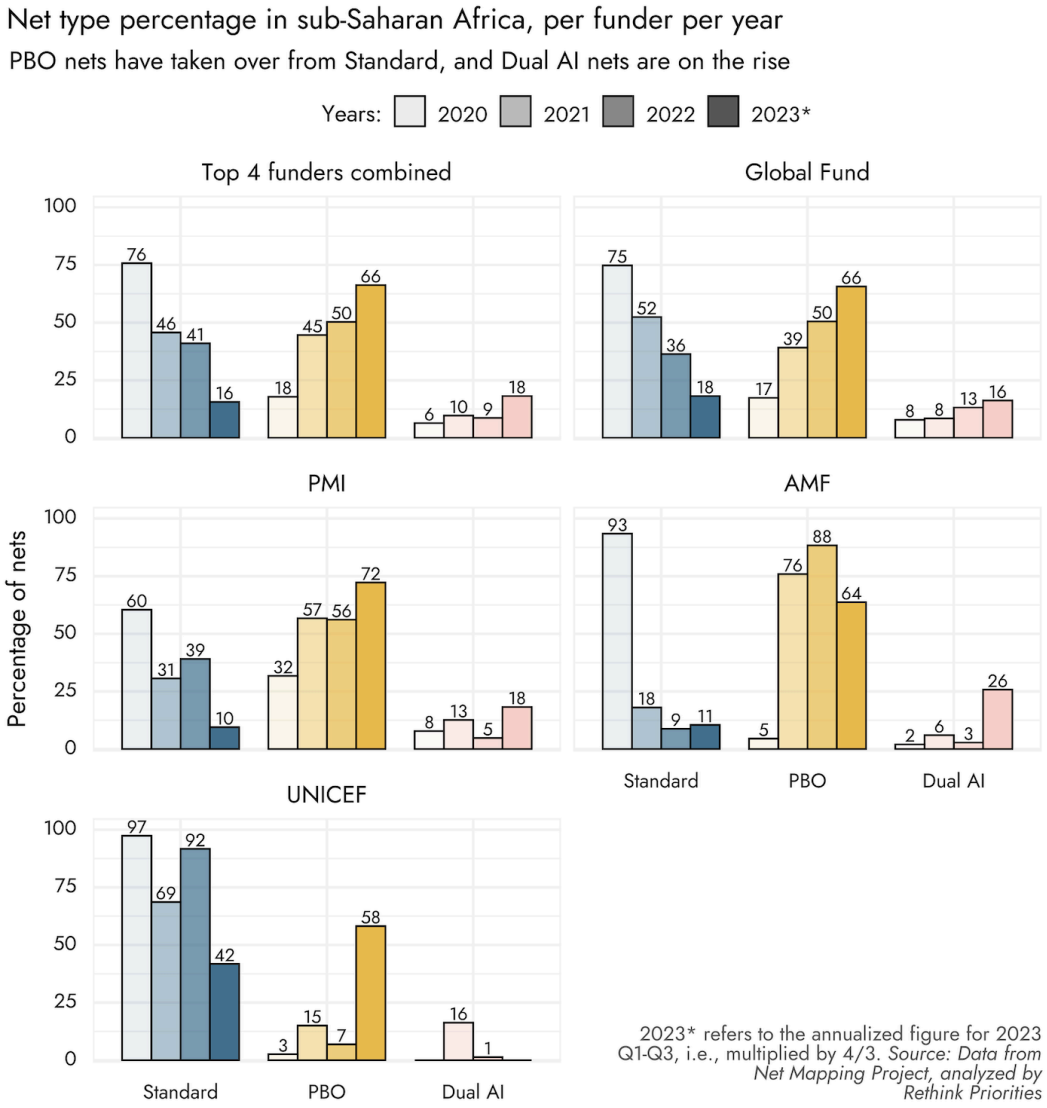
Major bednet funders are moving toward next-generation Dual AI nets in response to rising insecticide resistance. There has also been an increase in PBO net usage over time, but these do not appear to be the first priority moving forward (see Figure 8). A transition away from standard pyrethroid and PBO nets toward Dual AI nets has been declared as an objective in strategy documents we reviewed, is evidenced by data from NMP, and was mentioned by multiple experts. We discuss expert views on the adoption of new nets in more detail later in the report (here).

- The data show that, for most funders, Dual AI net use has increased to constitute a larger share of total procurement over the 2020-2023* period. We expect Dual AI nets to constitute an even larger share in dollars spent on bednets, given they have the highest unit costs among all three net types (Global Fund, 2023a):
    - For GF, the proportion and absolute number of Dual AI nets has grown continually and doubled over the 2020-2023* period from 8% to 16%.

[19] The request mentions reaching nomadic populations, internally displaced persons in the North East, and those who live >5 km from formal health facilities as a priority and says, "Considerations are given to these key, vulnerable and underserved populations in ITN mass campaigns" (p. 127). Examples of how these populations are reached include tailored messages delivered in local languages through different media and the adjustment of town announcers' schedules "to accommodate settlements where most residents leave home early and return late in the evenings" (p. 128).

- For other funders, the proportional and absolute growth in Dual AI nets was not monotonic, with a spike in 2021. AMF and PMI Dual AI net proportions have since recovered and reached 26% and 18%, respectively. UNICEF did not report procuring Dual AI nets in the first three quarters of 2023.[20] We did not hear from any experts we interviewed about these discontinuities, so we tentatively do not think they signal actual shifts in donor priorities.

*Figure 8: Proportion of procured bednets by type, sub-Saharan Africa, 2020-2023**



Note. Data from NMP, analyzed by Rethink Priorities here. 2023* refers to the annualized figure for 2023 Q1-Q3, i.e., multiplied by 4/3.

GF launched the Revolving Facility in 2023 as a new market-shaping mechanism for procuring Dual AI nets at lower costs (Global Fund, 2023d). The Revolving Facility involves volume guarantees and other supply chain optimizations that are intended to save costs across the supply chain. An expert said that GF's latest investment drive in Dual AI nets took place after WHO's March 2023 recommendation (see WHO, 2023b) of such nets in areas with widespread pyrethroid resistance. They said that they expect savings that "enable lower pricing

[20] UNICEF said in an October 2022 report that it "expects to see a shift in procurement towards a larger share of novel LLINs over the next three-five years" (UNICEF, 2022, p. 7).

to be offered to entire markets" to be derived in 2025-2026, implying that large increases in Dual AI net procurement could occur afterward.

Distribution channels and post-distribution monitoring

PMI has recently scaled back continuous distribution in some countries due to funding limitations. We read PMI's FY 2024 MOPs for the countries of interest (the 12 in which it operates) and found it had scaled back continuous distribution for two countries: the DRC and Cameroon. However, we did not read malaria operational plans from before FY 2024 or seek to understand long-term trends, given time limitations.

1. In the DRC, "PMI will reduce the number of ITNs for continuous distribution and will pause the funding to cover the operational cost for mass distribution due to budgetary limits" (p. 14).
2. In Cameroon, "There will be no purchase of ITNs for routine distribution due to funding limitations and the planned 2025 mass campaign" (p. 14).

Net durability is a concern among funders and experts that has begun prompting many countries to consider a shift toward more frequent mass campaigns. While funders tend to treat the issue of net durability as a potential problem requiring further investigation in the strategy documents we reviewed,[21] several experts spoke with greater certainty that durability is a real and growing concern (see discussion below). **Several countries' mass campaigns have moved—or are actively exploring moving—toward shorter cycles due to these concerns.** For example, PMI mass campaigns have shortened from every three years to every 30 months in the DRC following a net durability monitoring study (PMI DR Congo FY 2024 MOP, p. 15), while experts said they were aware that Mozambique and Malawi are also in discussions to increase the frequency of mass campaigns. They added, "Everyone is sort of toying with the idea," suggesting that more countries could join this list. However, they said that the logistical intensity of mass campaigns makes operationalizing increased-frequency campaigns "hard to imagine."

Ways to measure bednet coverage are improving. Experts said that GF has historically measured bednet coverage via USAID's Demographic and Health Surveys (DHS), typically administered every five years. Bednet coverage is also measured through the Malaria Indicator Survey (MIS), though still only every two to three years (e.g., Ghana's most recent estimates of coverage come from the 2022 DHS, 2019 MIS, and 2016 MIS; DHS, n.d.). They also said that while bednet coverage is still mostly measured through such surveys, there is increasing investment in routine measurement systems and data repositories that will allow coverage information to be "immediately available."

[21] For example, PMI mentions several net durability monitoring studies that it has funded or is funding in its MOPs (e.g., DRC, p. 15; Mali, p. 19; Guinea, p. 20; Cameroon, p. 7). In FY 2024, the DRC appears to be the only country where PMI shortened distribution cycles while explicitly citing durability study results (DRC FY 2024 MOP, p. 15).

Challenges, priorities, and implications for malaria bednet programs

This section summarizes the outputs from 10 interviews, in which we asked experts an open-ended question about the key challenges and priorities in the bednet space. Our aim was to solicit responses from people with a range of roles and perspectives within this field, which we could then synthesize into a high-level view for GiveWell. In some interviews, we also asked explicitly about new technologies, where we thought the expert might have relevant expertise.

We spoke to individuals at (or formerly at) key organizations in the malaria community: multilaterals, technical assistance providers, implementers, net manufacturers, and research institutions. Notably, we did not approach funders such as GF, PMI, and the Gates Foundation; these views will be incorporated at a later stage by GiveWell's malaria team. We also did not directly contact any implementing organizations or NMCPs.

In each section below, we discuss expert opinions about priorities and trends in response to specific challenges. We present these views anonymously,[22] and we roughly order these sections based on the number of experts who brought up the issue, from most to least. We are aware that this ordering does not necessarily reflect the true importance of each topic, but we cannot provide an objective ranking based on our own views without a deeper scientific look (which was out of scope for our research). Throughout, we also include low-confidence statements about implications for net programs and for GiveWell, based on a mix of explicitly stated expert views and first principles thinking by our team.

Challenge: Insecticide resistance

Insecticide resistance came up in every expert interview and GiveWell has written about it extensively. The threat of insecticide resistance seemed to be taken as given by many experts.

Two academic experts presented some points to counter this consensus narrative. One indicated that the presence of some degree of resistance is clear but raised questions about **whether these tests overestimate insecticide resistance for infectious mosquitoes**.[23] They argued that even attenuated effects of insecticides might be enough to reduce transmission, and it is important to keep in mind other concerns about the strength or concentration of insecticides and the quality of nets to retain their potency. The second similarly noted that nets, of course, also provide a physical barrier, and perhaps something like a third of their efficacy could be related to this physical component. Both experts expressed that it was natural that net manufacturers would be happy to focus specifically on net technology as a key factor

[22] With their permission, we shared experts' views directly with GiveWell. In this publication, however, we provide summary overviews of expert opinion without direct attribution. We do so primarily because we feel this is the most impactful use of our time (trading off capacity to conduct new research against time spent rigorously anonymizing views).

[23] In detail, there are two points. The first is that the age of mosquitoes is an important factor in insecticide resistance, and it is not being appropriately factored into testing. WHO bioassays, which are often used to measure resistance, are conducted using larvae that are hatched in control conditions and tested three to five days after birth. (See WHO, 2022, for the Standard Operating Procedure). However, the expert pointed out that the mosquitoes that spread malaria will all be at least 10 days old because it takes 10 days for the malaria parasite to become infectious. Hence, WHO bioassays may not measure resistance in the right population of mosquitoes. They suggested that this may lead to overestimation of insecticide resistance: much like older humans may have less efficient liver enzymes to filter toxins, older mosquitoes may be more susceptible to insecticides. We think this is potentially worth investigating further. Their second point is that lab-based tests may overestimate resistance if mosquitoes do not actually come into contact with the net surface; this was a particular concern mentioned for tunnel tests.

for improving malaria outcomes as it is in their commercial interest to do so. **Neither expert denied that resistance was important, but they highlighted it certainly was not everything.** They did not want other important areas of improvement (e.g., other dimensions of nets such as physical and chemical durability and social behavioral change to increase proper usage) or alternative approaches to be neglected due to a narrow focus on insecticide resistance.

Potential next steps for GiveWell:

- Consider investigating the concerns raised by these academics

Expert-identified trend: Increasing distribution of Dual AI nets, particularly chlorfenapyr nets

As mentioned above (see here), procurement data show clearly that funders are buying more Dual AI nets. As far as we can tell, **this trend is likely to continue, with some forecasts from CHAI and IVCC (Ursu, 2022, slide 3) suggesting that ~50% of all nets will be Dual AI by 2029.**[24] Based on a Global Fund update in October 2023, the price per net is expected to be "on average **15-20% (US$0.40 - US$0.50) higher and could reach US$1 per net in some cases**" (Global Fund, 2023e).

The experts we spoke to mainly discussed Dual AI nets that are being made with a pyrethroid plus chlorfenapyr. Chlorfenapyr nets are in demand because they remain effective in areas with insecticide resistance,[25] which is particularly important when mosquitoes have target site resistance, which PBO nets do not address. **Experts we spoke to were excited about the ability of chlorfenapyr nets to handle resistance but also expressed concerns about the possibility that resistance might develop in the long term.** We remain uncertain about the relationship between chlorfenapyr nets and resistance, as experts shared differing views.

- One expert suggested that they think resistance is somewhat unlikely to develop given the mode of action.[26]
- Another interviewee was aware of documented resistance to chlorfenapyr.[27]
- A third suggested that chlorfenapyr nets may also be a longer-term resistance management strategy, as Messenger et al. (2023) indicate that they do not increase pyrethroid resistance, in contrast to standard, pyriproxyfen and PBO nets. We have not read this paper.

There are two chlorfenapyr nets currently available in the market: the Interceptor G2 from BASF and the PermaNet Dual from Vestergaard. We have some concerns that demand for chlorfenapyr nets will outstrip supply, leading to delays. The October 2023 Global Fund update suggested **longer lead times than for other nets, "of around an additional two months or more"** (Global Fund, 2023e).

In terms of wider market dynamics, it seems possible that if demand for standard and PBO nets decreases, volumes may be too low to sustain manufacturers that only produce these nets. It is unclear whether more manufacturers are currently developing chlorfenapyr nets. According to the WHO Prequalification Pipeline, **at the time of writing there were no new chlorfenapyr nets under assessment** (WHO, n.d.-b).

[24] In 2023, data suggest this proportion was 18%, as described here.
[25] Evidence for the relative effectiveness of dual AI, PBO, and standard nets comes from the first two years of a trial in Tanzania: Mosha et al. (2022). We note that the findings from the third year have just been published, though we have not read them: Mosha et al. (2024).
[26] Chlorfenapyr is metabolized by P450 enzymes and then affects the mitochondria. Our understanding is that the lack of a "target site" is what makes resistance less likely to develop.
[27] A quick search suggests that Tchouakui et al. (2023) may raise some concerns about resistance, but we note that we have not read this paper.

Implications for bednet programs:

- Possible delays if there is a lack of production capacity—particularly for chlorfenapyr nets (given only two manufacturers), but also standard/PBO nets if some manufacturers shut down
    - Uncertainty: to what extent procurers/funders are coordinating to avoid this
- Increasing average cost of net, leading to funding gaps in programs
    - Uncertainty: whether prices will be lower than expected due to volume guarantees
- Increasing centralization in the hands of a few major manufacturers may reduce competition over the long term (and therefore increase prices or prevent new players from entering the market) or make the supply chain more vulnerable to unexpected shocks
    - Uncertainty: how much volume already is concentrated with Vestergaard/BASF, and how quickly other manufacturers might develop chlorfenapyr nets

Potential next steps for GiveWell:

- Expect to increase net costs in CEA
- Investigate whether there is documented resistance to chlorfenapyr
- Consider taking long-term resistance management into account in the CEA if the evidence base is strong enough
    - The inclusion of these data could reflect the counterfactual difficulty/cost of future interventions if standard nets had been used instead. They could potentially be added as a "Supplemental intervention-level adjustment."

Expert-identified trend: Funders, especially PMI, are shifting away from IRS

Multiple experts mentioned to us that there has been a general shift away from indoor residual spraying (IRS). Several **linked this trend to the introduction of net options that are effective against resistance**: IRS was previously used to manage insecticide resistance because there are non-pyrethroid options, but this is no longer necessary.

- All experts noted the logistical challenges of IRS as a deterrent to its use. Higher costs and the disruption for households were also mentioned as downsides.
- One expert noted that **the move away from IRS is a particular trend for PMI's funding**, suggesting that they are trying to explore other options to reduce their commitment to IRS, such as partial spraying and housing modifications such as eaves tubes.

One expert was **concerned that the removal of IRS, even if nets are deployed, could lead to large increases in malaria.** They shared some slides (NgenIRS, n.d.) showing the results from an IVCC trial[28] that measured the impact of withdrawing IRS where standard nets are still in use, and the comparative impact of IRS + standard nets vs Dual AI nets. We have not engaged with these results enough to form any view on whether this is the case.

Implications for bednet programs:

- If Dual AI/PBO nets are increasingly being used to manage resistance in areas that formerly received IRS, this would increase overall demand for Dual AI/PBO nets.

Implications for GiveWell:

[28] The slides are available for download on IVCC's NgenIRS webpage under "NgenIRS Evidence: English Slides."

- Understand whether NMCPs are deploying Dual AI, PBO, or standard nets in areas that formerly received IRS
- Investigate the question of whether the removal of IRS in certain areas could lead to malaria rebounds

Expert-identified priority: Remove barriers to innovation

Multiple experts expressed concerns that barriers to innovation make it difficult for the industry to develop new nets. They highlighted the **length and expense of the regulatory process** as a barrier while also acknowledging the important role that WHO Prequalification plays in making sure products are safe. Experts described that the process involves evaluation by three different groups and two multi-year RCTs that cost millions of dollars.[29] Experts highlighted that developing Dual AI nets was a process that took more than a decade, and required significant financing from the New Nets Project.

In our conversations, in general, we did not dig into exactly how these barriers could be removed. One expert highlighted the need for a close partnership between the WHO Vector Control Advisory Group (VCAG) and WHO Prequalification, who co-develop the guidelines for approval processes. This expert felt that overall timelines could be shortened by considering other study designs (such as non-inferiority testing) and opportunities to conduct tests in parallel. Another expert mentioned that incentives to the private sector could encourage innovation.

Implications for bednet programs:

- It is unlikely that there will be any new types of nets (e.g., new insecticides) in the next three to four years (more here)

Implications for GiveWell:

- Consider whether there are tractable, neglected opportunities to encourage innovation[30]

Challenge: Net durability

As described above (here), many experts raised concerns about the durability of nets. Experts highlighted increasing evidence that ITNs do not actually last for the full three years they are expected to and named durability a "key thing to pay attention to." Several mentioned a lifespan of one and a half to two years.

In this section, we use durability as a catch-all term to refer to both physical durability (i.e., does the net have holes or tears) and retention of the active ingredients in the net. In most interviews, the experts did not distinguish between the two.

Expert-identified priority: Determine how to address coverage gaps in between mass campaigns

If nets only last one and a half to two years and mass campaigns stay on a three-year cycle, then this discrepancy could result in significant coverage gaps. While experts mentioned examples of national programs that are moving toward more frequent campaigns as a result (e.g., DRC),

[29] These groups are the Vector Control Advisory Group (VCAG), WHO Global Malaria Program, and WHO Prequalification.
[30] Our impression is that this is a topic that already has many involved players (e.g., the Gates Foundation, IVCC, Unitaid, MedAccess, i2i). It is possible that there are still funding gaps, but a low-confidence guess would be that this is not neglected.

they expressed skepticism regarding (significantly) increasing the frequency of campaigns given their logistical complexity (see also earlier discussion).

Several experts questioned **whether continuous distribution could address coverage gaps**.

- ANC/EPI distribution: One expert said that they are optimistic that distributing bednets to young children at their U1 health check-ups could help plug gaps between mass campaigns, as doing so would deliver the most effective (i.e., brand new) bednets to the most vulnerable population groups. Relying only on mass campaigns, they said, meant that "children could end up not having a net for the first year of their life."
    - **Another expert mentioned that they believe the return on investment of continuous distribution is likely high** but hard to show due to a combination of poor data quality and a focus on modeling for transmission rather than mortality.
    - We understand that the incubator program at CHAI is doing some modeling for different distribution channels.
- School-based distribution: One expert also suggested that if nets are only lasting a year, then a three-year campaign "does not make sense" and "maybe you need more school distribution." Annual school distribution programs could be a way to "ensure sustained access."[31]

Implications for bednet programs:

- Reducing intervals between campaigns in some countries (mentioned above)
    - Uncertainty: how many countries have proceeded beyond discussions about shorter intervals to implementation
- Potentially more volume through continuous distribution
    - Uncertainty: whether these volumes are reduced in the mass campaigns as a result or whether there is additional net need

Implications for GiveWell:

- Consider whether expert views expressed in recent interviews provide an update to the "Adjustment for net coverage years lost due to residual nets from previous distributions" parameter in the CEA
- Consider calculating the cost-effectiveness of continuous distribution and/or ask CHAI to share their progress

Expert-identified priority: Measure and reward durability to shape the bednet market

Several experts suggested that the market needs to change the way it procures to reflect variations in net durability between manufacturers. An expert described the current procurement system as focused mostly on achieving the lowest price, with some additional considerations for spreading volume across manufacturers. They suggested that rewarding companies with more durable nets would start a "virtuous cycle" in which competitors were incentivized, and this created a market for longer-lasting nets, though these changes wouldn't happen overnight. Another expert similarly stated that it is worth paying for a net that lasts longer, and suggested that, in particular, the Global Fund needs to take the lead on this.

[31] Relatedly, an expert suggested there has been a shift in the malaria burden from children under five (and especially those under one) to school-age children as a result of "great gains from recent efforts." We have not checked whether this phenomenon can be seen in malaria data. The Funding Request for Uganda (notes here) does refer to this shift as justification for its school-based distribution in some regions.

In a 2022 market and supply update, UNICEF claimed that "there is to date insufficient robust evidence and durability data gathered on products to inform procurement decisions in UNICEF's recent tenders" (UNICEF, 2022, p. 8). Therefore, collecting data is likely an important first step toward this kind of market shaping, and several recent efforts seem to point in this direction.

An expert highlighted the **"resistance to damage" scores as an important building block** for taking forward this priority. Wheldrake et al. (2021) describe scores developed by the Nonwovens Innovation & Research Institute (NIRI) and Tropical Health LLP. Their research suggests that it may be possible to predict how durable nets will be in the field based on measurements from four lab-based textile tests conducted on unused nets.[32]

The new WHO (2023a) guideline for the prequalification assessment of ITNs, which was updated in December 2023, appears to reference this finding. Specifically, the document states: "The aggregation of four key characteristics (bursting strength, resistance to hole formation, abrasion test, snag strength) has been shown to predict the physical durability of ITNs in operational use conditions" (p. 12). These **updated guidelines now incorporate textile tests into the net specification**. We understand from experts that **manufacturers are required to get all nets tested against the new requirements** at an independent facility and submit the results to WHO Prequalification **before the end of the year**.

We do not know whether the WHO Prequalification team intends to use these data to create resistance to damage scores or whether they intend to make these data publicly available. However, we note that WHO Prequalification does publish some data in the Public Assessment Report for each net.

In addition to this initiative, there are other efforts to measure durability in the field, such as PMI durability monitoring.

Implications for bednet programs:

- If more data on durability becomes available and differential pricing based on durability is implemented, then there may be changes to the mix of nets purchased

Potential next steps for GiveWell:

- Consider/update the net durability parameter calculated here
  - In the short term: in one expert's view, GiveWell's estimate for this parameter remains too high
  - In the medium term: if/when data from textile tests becomes available, consider updating the durability calculations to be specific to each net (rather than a blended result)
- Consider the potential for impactful data collection and/or market shaping
  - Uncertainty: what the most valuable/impactful data would be
- Potentially, expect more variation in net costs in the CEA over time
  - Uncertainty: how committed procurers such as Global Fund and PMI are to implementing durability-based pricing

[32] The correlation is evidenced in Kilian et al. (2021). We have not reviewed this paper in depth. Our impression from speaking to an expert is that while these scores have been in discussion for many years, this evidence was a new development, as previously, the correlation had not been proven.

Expert-identified priority: Develop strategies to manage LLINs after use

Concerns about how to manage used nets were shared by multiple experts. An expert shared that the three billionth net was distributed in October 2023, and it **only took four years to distribute one billion nets**. We would expect that if bednet volumes increase to maintain coverage levels in the face of durability challenges, this will exacerbate the issue of how to manage end-of-life nets.

An expert spoke about an emphasis in the malaria community to reduce packaging and consider options for recycling and biodegradable nets. They suggested that **pressure to reduce plastic waste might prompt the malaria community to shift towards lower-waste solutions.**

The malaria community does not yet appear to have decided on a strategy to solve this problem. An expert highlighted that the disposal of nets is more complicated because of the presence of pyrethroids: it is necessary to reach high temperatures to break down the chemicals, and there are a limited number of incinerators in Africa. Another expert shared that they think any solution will involve significant private sector engagement.

Experts raised the example of a trial for net recycling that was conducted in Nigeria[33] and speculated that used nets might usefully be incorporated into the eaves of houses.

Implications for bednet programs:

- Pressure to manage plastic waste might increase appetite for other solutions
    - Uncertainty: which other solutions are preferable, and how cost-effective they are/how quickly they can scale
- Efforts to manage used nets may require new or different activities, e.g., additional logistics by actors to collect and dispose of nets

Potential next steps for GiveWell:

- Potentially investigate what options exist for responsible management of used nets
- Incorporate other costs of nets, such as plastic waste, into the CEA

Challenge: Limited funding

Several experts highlighted funding as a concern, exacerbated by both **decreased funding for vector control and increasing need.**

- Factors contributing to lower funding for bednets: flat contributions from GF and PMI, inflation reducing purchasing power, and increasing competition for malaria funding from other, new interventions. Several experts also mentioned uncertainty over future US contributions to the Global Fund and the renewal of PMI's funding.
- Factors contributing to increased need: population growth, more expensive nets to manage resistance, the increasing cost of raw materials for nets, and the potential that new and/or larger areas need to be covered due to climate change and invasive species. Some experts also mentioned increased supply chain costs, which are affecting all commodities, not only bednets or vector control more broadly.

CHAI suggested recent years are the tightest funding squeeze yet.

[33] For more detail about this project, see AMP (n.d.-a). Our impression is that this approach was not successful: despite setting up 25 collection points for a week, the project only collected 241 nets.

Expert-identified trend: Subnational tailoring and prioritization

As described above (see here), funders' strategies reflect an increasing shift towards subnational tailoring: identifying the ideal mix of interventions at the subnational level. However, experts described that, in reality, funding constraints make the ideal mix of interventions unaffordable, leading to trade-offs.

Multiple experts highlighted that the **first malaria intervention that will always be prioritized is case management to prevent deaths.** One of the experts suggested that peripheral healthcare provision and community health workers may be prioritized next, but there are divided opinions about to what extent. After allocating parts of their budgets to these activities, countries make trade-offs between different kinds of interventions (e.g., seasonal malaria chemoprevention vs. IRS) with the remaining funds. They may also need to prioritize further within interventions (e.g., buying more expensive Dual AI nets for some areas with higher resistance/burden and standard nets elsewhere).

Multiple experts also mentioned that they think the **modeling and guidance for how to tailor and prioritize between and within interventions could be improved**. They suggested that Tom Churcher at Imperial College, who has developed the Malaria Intervention Tool (MINT), would be worth talking to about this.

This process of prioritization under resource constraints can, and does, lead to some areas not receiving bednets.[34] An expert suggested that there is still a somewhat **open question in the malaria community about whether removing nets from some geographic areas is the "right way to make ends meet."** In particular, they highlighted the contrast with guidance from the WHO to aim for "universal coverage," i.e., the goal of reaching every person with a net. Another expert suggested that maybe the malaria community is still "trying to wrap its head around" the idea of moving away from universal coverage, with the GF remaining more committed to universal coverage than PMI.

However, the WHO (2023c) guidelines for malaria suggest that the WHO now recommends that countries aim to achieve "optimal" coverage rather than universal coverage. This approach suggests deployment of bednets "at a level that provides the best value for money while reflecting programmatic realities", and urges consideration of "other alternatives as part of the intervention package, ranging from chemoprevention to supplementary vector control, instead of pursuing the idealistic goal of providing full population coverage" (pp. 41-42). We are unsure whether this means that all actors are, in fact, supportive of optimal rather than universal coverage—rather than it being an "open question".

Multiple experts suggested that there are areas where you can safely not provide bednets, particularly **in areas with *historically* low to no endemicity (below 1% prevalence or a bit higher) removing nets is unproblematic. However, if transmission has been *suppressed* to these levels, then interventions must be sustained to avoid malaria rebounding.** Another expert stressed that in the DRC and Nigeria, the trade-offs currently being made have gone beyond these considerations; they described a scenario in which the **Global Fund and PMI are aware that the wrong actions are being forced by funding constraints.**

Our investigation of PMI MOPs and Global Fund Funding Requests suggests that if countries are reducing the scope of their mass campaigns, they are generally removing nets from urban

[34] The extent to which this is occurring in the 14 countries in the scope of this report can be seen in this spreadsheet.

areas (e.g., national or regional capitals). We asked an expert about this approach, who said they think this is generally accepted by technical partners and donors but can be difficult politically. However, they also highlighted that the spread of *Anopheles stephensi* may increase the need for vector control in urban areas, though nets may not be the right tool (more discussion below).

Implications for bednet programs:

- If there is a widespread shift away from universal (i.e., 100%) coverage, then overall net volumes may decrease with effects on price and the wider market
    - Uncertainty: whether there is consensus on what the "optimal" level is in each country and how well-evidenced this is
- If tailoring of different nets for specific areas continues and increases over time:
    - Smaller volumes of nets from each supplier could lead to higher prices (e.g., no volume discounts)
        - Uncertainty: whether this affects all procurers equally, e.g., Global Fund may be less affected due to the pooled procurement mechanism
    - More complex operations for NMCP to coordinate, leading to increased costs
        - Relatedly, this may increase the value of technical assistance
    - More delays or staggered distribution due to variable lead times for different nets
- If there are fewer nets in urban areas, most of the population to be covered by a mass campaign may be located in hard-to-reach areas, thereby changing (likely increasing) the non-net costs per net
    - Uncertainty: the difference in non-net costs for rural and urban areas, and what impact removing urban areas has on the average cost

Implications for GiveWell:

- Further investigate the malaria community's position on universal vs. optimal coverage and determine what GW considers the optimal coverage level to be
- Potentially plan to dedicate more time to understanding national strategies, as increasing complexity may make it more difficult to understand the net gap and fungibility of a GiveWell grant
- Consider the impact of increasing complexity on the cost-effectiveness of funding technical assistance for malaria programs
- Consider whether net and non-net costs will increase

Expert-identified priority: Collect data to support initial prioritization and monitor outcomes to mitigate the risk of malaria outbreaks

Multiple experts highlighted that in order to do subnational tailoring and prioritization well, programs need high-quality data. They suggested that while strides have been made, **further improvements are needed—particularly on the entomological side** in terms of measuring species distribution and insecticide resistance.

One expert additionally highlighted that there is a **gap with regard to monitoring.** They stressed the need to put in place monitoring activities to better understand the impacts of trade-offs—**particularly where net distribution is removed or reduced. They expect that this is necessary to avoid malaria outbreaks**, though it may be expensive. Some suggested forms of monitoring include:

- Entomological monitoring of vector density (as more mosquitoes lead to more biting and more malaria)
- Epidemiological monitoring

- Behavioral monitoring of what people do differently to protect themselves without nets, e.g., increasing their use of antimalarials

Implications for bednet programs:

- Making high-quality data available would allow for more complex analysis and subnational tailoring, with the aim of higher cost-effectiveness
    - Uncertainty: what are the limitations on analysis and implementation, what specific data are needed?
- Monitoring data could potentially facilitate more subnational prioritization with lower risks
    - Uncertainty: would this ultimately be more cost-effective?

Implications for GiveWell:

- Consider whether (improving) data collection could be a cost-effective grant, particularly in the context of:
    - High likelihood that data will be used for subnational tailoring, which could increase the impact of interventions
    - Some likelihood that data will be used to identify and avoid potential malaria outbreaks

Challenge: Changing bite patterns and novel species

Insecticide-treated nets are geared towards targeting transmission via mosquitos that bite at night and indoors, but this is not the only way mosquitoes bite. Different species display different typical behaviors, and there may be changes within species due to selection effects (i.e., behavioral resistance).

Only a few of our expert interviewees raised concerns about the development of behavioral resistance *within* species and concomitant changes in biting behavior as a possible issue, although several noted more general concerns about biting patterns owing to novel species. Two experts discussed behavioral resistance extensively. Both noted **behavioral resistance is to be expected, given the selective pressure that bednets place on mosquitos**. One noted that researchers have a lot of data on behavior/biting patterns, and there have been reviews of the topic, although we have not investigated this literature. **While the expert did not doubt that behavioral resistance exists, they questioned how much of an effect it would have on transmission**, in part because these patterns of behavior are not *completely* novel.

The other expert emphasized that **mosquitoes are usually not exclusively indoor/outdoor or daytime/nighttime biters**. Even a relatively low probability of nighttime biting would likely, over the mosquito's life cycle, cause it to be exposed to a net at some point, often before infecting someone.

This expert noted that **biting patterns were not just a threat to nets but also to IRS** (or indeed any vector control method that targets a specific type of behavior). They felt that the WHO had undervalued this aspect of resistance, instead focusing on insecticide resistance and adding multiple active ingredients to nets. When asked how long they thought it would be before this was a very serious issue, they suggested that **nets probably still had 10 years before this was a major problem** and that nets would always remain part of the solution for fighting malaria. This discussion led to the consideration of other approaches to target outdoor

mosquitoes—attractive toxic sugar baits—covered in the section on advances in other technologies below.

One expert also noted biting patterns and behavioral resistance as threats to both nets and IRS. They informed us that the **IVCC had made a call this year for novel solutions to tackle outdoor biting, with a hope to replace nets and IRS**.

Concerns about the spread of the invasive species, *Anopheles stephensi*, were mentioned in six out of 10 of our interviews. The main feature of this species that experts highlighted is that it is more comfortable in urban settings. Only two explicitly mentioned the challenge of outdoor biting. We did not ask experts about the **best way to manage this invasive species**, but based on previous research we conducted for GiveWell, it seems that **Global Fund and PMI have so far been employing larviciding** (see Rethink Priorities' research brief on larval source management; Tsai et al., 2024).

As a side note, an expert also mentioned that they think the spread of *Anopheles stephensi* in urban areas could have implications for drug resistance, as increased risk could encourage urban residents to go out and purchase antimalarials, which does not have direct implications for net programming but may have broader effects on malaria burden.

Implications for bednet programs:

- Behavioral adaptation could render tools such as nets, which target specific behavioral patterns, less effective over time
    - Uncertainty: what is the expected evolution of adaptation?
- Vector control measures targeting multiple types of behavior might ultimately be required, but this would place more stress on funding for bednets, specifically
    - Relatedly, if *Anopheles stephensi* continues to spread, there will very likely be further pressure on funding

Implications for GiveWell:

- Consider including behavioral adaptation and regional species prevalence as factors affecting efficacy in the CEA
- Better understand funders' projections for the spread of *Anopheles stephensi* and their strategies (and funding) to manage this threat

Challenge: Net retention/use

Few experts mentioned net usage rates as a challenge unprompted. One expert stood out among interviewees as the most concerned about low net usage rates and was disappointed by coverage rates of 60%-70%.[35] They were a proponent of a consumer design approach that emphasizes adoption, which they contrasted with a public health approach that emphasizes access. They characterized some of IVCC's work as trying to take a consumer's lifestyle, user experience, and aesthetic preferences into account when designing, promoting, and distributing net products. Separately, they said that factors like low net usage (and low net durability) can mean that bednets are not necessarily the best vector control method in certain areas—instead, they suggested that IRS, which does not require a nightly decision on usage, could be more effective where net usage is low. Other experts either did not mention net usage as an area of concern or mentioned it only in passing.

[35] By contrast, a different expert described 70% coverage as "excellent."

As we found this lack of discussion striking, **we prompted two other experts about whether net usage is a challenge.**

- One said that they would classify it as an "adoption/access barrier"—though at the user level rather than the country level—and acknowledged that there was **room for improvement**. Compared with the concerned expert, they seemed more focused on social and behavior change/health education as a way to improve net usage.
- **Another said that net access/availability was a greater concern than usage,** but more could be done to better target households in urban areas (which have a less robust culture of bednet use than rural populations). Similarly to the other prompted expert, this expert mentioned social and behavior change programs as a way to drive up net usage. They separately suggested that low net longevity could possibly accelerate the repurposing or misuse of nets.

Expert-identified priority: Procure nets that match user preferences, even if more expensive

The concerned expert proposed incorporating more user-centered designs to boost net usage rates, though they acknowledged this would come with cost and thus volume trade-offs, as current net designs allow for lower-cost manufacturing. Specific optimizations they thought would improve net usage rates included:

- More breathable nets that reduce heat retention and improve sleep experience
- Brightly colored nets that better resist dirt, are more attractive to users, and may be more culturally acceptable to sleep under than white nets[36]
- Conically shaped nets that physically better fit some people's sleeping environments[37]

We asked the concerned expert how much improvement in net usage they would expect to see as a result of alignment with user preferences, but they did not provide a concrete answer.

Implications for bednet programs:

- If this strategy was pursued, it would increase the complexity of manufacturing and procurement (and may increase the complexity of implementation)
    - Uncertainty: exactly how feasible it is for procurers and manufacturers to make these changes, what cost increases should be expected

Potential next steps for GiveWell:

- Consider a shallow investigation of cost-effectiveness: what increase in usage is expected from making the suggested changes, and what would the additional costs be?

Expert-identified priority: Increase social and behavior change activities

Multiple experts mentioned social and behavior change activities as existing investments that combat low net usage. One expert said that Unitaid's New Nets Project included implementation pilots that found bednet efficacy to be sensitive to usage rates. Although Unitaid has not made improving net usage rates (through health education) a "main theme" of its investments, this expert said that it usually includes health education as one component of broader grants. Another expert mentioned that funding for social and behavior change communication is often cut but may be increasingly important in the context of more complex subnational interventions.

Implications for bednet programs:

[36] Due to white nets' resemblance to funeral shrouds in Islamic culture.
[37] We did not ask manufacturers about the feasibility of these changes. Our understanding is that non-white nets are manufactured and distributed in certain countries (sometimes at a higher price).

- Unknown, though it is possible that more prioritization could lead to changes in how bednet programs are implemented

Potential next steps for GiveWell:

- Consider evaluating the cost-effectiveness of social and behavior change programs

Advances in net and other anti-malarial technologies

Advances in net technologies: two new active ingredients may be introduced in the next one to three years, with unclear implications for net programming

Our main takeaway from discussions is that **experts do not expect significantly different types of nets to be available in the near future.** Experts said that they did not think there was anything "dramatically different on the horizon," and, at present, manufacturers are more focused on "mimicking" BASF to produce chlorfenapyr nets.

We are aware of **two nets incorporating new active ingredients that may be available in the next few years**.

- The PRONet Duo is currently under assessment by WHO Prequalification (WHO, n.d.-a).[38] This net combines bifenthrin (a kind of pyrethroid that has not previously been used on bednets, to the best of our knowledge) with chlorfenapyr. Our best guess is that the assessment will take a year or more, such that the net may be listed in 2025.
    - We did not have time to look into bifenthrin, and we do not know how this insecticide compares to other pyrethroids. As a result, we are unsure of how programming may be impacted when this net is introduced, potentially as soon as next year.
    - We suggest that GiveWell discusses this new net with an expert, particularly regarding the possibility of cross-resistance between bifenthrin and other pyrethroids.
- According to the IVCC 2022-2023 Annual Report (IVCC, 2023, p. 15), a new net that combines Tenebenal and a pyrethroid is in the "pre-development" stage. The net manufacturers involved in its development are Disease Control Technologies and Vestergaard. In conversation, several experts suggested that this bednet may be ready for testing in 2026, and prequalified by 2027 at the earliest. They also shared that timelines for the development of new nets are often delayed.
    - Given there are likely three years before this net is deployed, we do not think it will have immediate impacts on net programming. It may, however, be worth briefly asking an expert about how Tenebenal compares to chlorfenapyr.

Experts indicated that they think **there is a need for non-pyrethroid nets**, ideally with more than one insecticide. The fact that all PBO nets currently available are PBO + pyrethroid options exacerbates the need, as such nets are less useful for resistance management.

Additionally, some experts noted the possibility of creating ultra-durable nets, saying that, even with resistance, the barrier effect could be valuable. They specifically highlighted a kevlar-like material that cannot be cut with a knife, Dyneema. However, they noted further concerns about waste management for these nets. We are not aware of whether this net is actually in production.

[38] For an overview of the WHO Prequalification process, see our previous research: Leow et al. (2023).

In our desk research, we also identified that researchers at the Liverpool School of Tropical Medicine have been working alongside Vestergaard to trial a new net design called the "barrier bednet" (see also Liverpool School of Tropical Medicine, 2019). We have not looked into this new design in detail and did not discuss it with any experts.

Implications for bednet programs: unclear

Implications for GiveWell:

- Discuss bifenthrin and Tenebenal with an expert
- Potentially investigate benefits of, and progress on, barrier bednets

Advances in other technologies: Technologies such as spatial repellents, ATSBs, and modified built environments could impact net programming

The brief did not explicitly ask for a discussion of non-net technologies. However, the availability of other technologies is likely to impact net programming, particularly as other tools may be more appropriate to deal with some of the challenges highlighted above, such as outdoor biting. As a result, we provide short summaries of expert opinion on more recent developments for a number of interventions.

Spatial repellents

Spatial repellents, also called spatial emanators, are airborne chemicals that drive away mosquitoes and create a protected space within which hosts are shielded from mosquito bites and disease transmission. These chemicals can be pyrethroid-based or alternatively formulated (e.g., transfluthrin; see also Norris & Coats, 2017), and they undergo controlled, long-lasting release into the air from a sheet of plastic that can be placed where protection is needed. Spatial repellency forms part of the "push" component within a "push-pull" strategy to deter mosquitoes from areas with humans and attract them to other locations (see also IVCC, n.d.).[39] Experts discussed spatial repellents as a promising future tool for long-term outdoor protection. Experts said they considered spatial repellents to be promising tools to address entomological/epidemiological changes like the shift toward outdoor biting, citing data from Cambodia that has demonstrated its effectiveness outdoors. Experts also said that spatial repellents are highly durable, lasting up to 12 months. **One expert said that the use of spatial repellents could receive an evidence recommendation as early as this year.**[40]

Attractive Toxic Sugar Baits (ATSBs)

ATSBs take advantage of mosquitoes' need to consume sugar for survival and may be particularly useful against mosquitoes that less frequently go indoors. Bait stations include sugars and attractive scents (e.g., mixes of brown sugar and date syrup) but are also impregnated with insecticides or acids that are deadly to mosquitoes. ATSBs can form part of the "pull" component within a "push-pull" strategy, as discussed earlier. Experts had mixed opinions about their efficacy or viability as a programmatic intervention. One expert discussed a trial in Zambia for which the results were not as positive as had been hoped, failing to meet a 30% reduction in clinical malaria. Outcomes from other trial sites in Kenya and Mali are to be

[39] Repellents that "push" mosquitoes away from a location that is being protected, versus attractants or resources that "pull" mosquitoes toward a location away from the area that is being protected.
[40] Further reading (e.g., Achee et al., 2012) suggested that spatial repellents could be useful in delaying insecticide resistance given its generally sub-lethal effects on mosquitoes, but we did not have time to evaluate the evidence base for this.

unveiled later this year. This expert thought there remained some operational concerns and wondered what a programmatic approach for ATSBs would look like.

A different expert said ATSBs appeared to have great potential but also noted the discouraging results from the Zambia trial. This expert did not seem to believe that the discouraging Zambia results ruled out the potential of ATSBs. They went on to note that the efficacy of ATSBs may be highly dependent on the local context: in principle, they would be most effective against populations of mosquitoes that sugar feed frequently or in locations where there aren't so many natural sugar sources to compete. In one such location—Mali—they said results were more promising. Hence, ATSBs might be something of a "'bespoke" intervention for areas like Mali that are dry and without many green plants for feeding. However, they stated that ATSBs may be overlooked by other funders that favor interventions that can be rapidly developed and universally deployed.

A third expert noted ATSBs as potentially viable and useful for killing outdoor mosquitoes, although they did not raise specific evidence about this. They said ATSBs are still under evaluation, and the jury is out with respect to their being ready for WHO recommendation. Still, they indicated thinking it seemed like a promising general approach that could be improved with tweaks, though we did not have time in the meeting to delve further into this.

Additional brief internet searching suggests that effects on other insects might be of some concern (e.g., bees are also attracted to baits and negatively affected), but there are also ways to mitigate this, such as with a mesh of appropriate size to exclude certain insects from exposure.

Vaccines

Only two experts spoke about developments related to vaccines, though many mentioned them as a new consideration (and funding pressure). One of them suggested that the Global Fund is less committed to rolling these out than PMI, and may therefore be less enthusiastic about funding implementation and training for the rollout. The other expert stressed that they do not think it s possible yet to make meaningful comparisons with other tools, given the data that is available for vaccines.[41] As a result, they're concerned that the language being used to describe the vaccine (e.g., "highly efficacious") may incorrectly give policymakers the impression that they are more impactful than existing interventions.

Built environment/home modification

Experts, including those who have been involved in investigating the relationship between built environments and anti-malarial programs, suggested that changes to the lighting, windows, ventilation, and screening can dramatically reduce the chances that mosquitos actually enter a home. They also mentioned some possible home modifications, such as modifying the eaves of houses. Eaves are holes in the walls of houses that allow hot air to escape, but this hot and human-scented air is attractive to mosquitos, which enter the holes and can then infect people inside. One specific technology to tackle this is eave tubing (see, e.g., In2Care, n.d.), which is inserted into these holes and creates a mesh barrier. Insecticides can be placed on the mesh, and in principle, more and different insecticides could be used than with nets because they are unlikely to directly contact humans or animals (besides insects). Experts noted that some such modifications could be expensive, however.

[41] In particular, they noted that the data that we have for vaccines and other interventions is not standardized in terms of impact measurements, duration of assessment, or target groups. They think there is a need to model the impact of vaccines in a cohort.

These experts similarly noted the possible expense of high levels of home modification and emphasized the opportunity to integrate such design features into new building/infrastructure that is expected in Africa. In particular, they noted that as much as 60%-70% of the sub-Saharan African population is expected to reside in cities within the next few decades. This shift may introduce new vector control issues but also opportunities. They stressed we should not miss the opportunity to ensure vector control is integrated into this built environment. For example, ensuring proper sanitation and drainage to reduce breeding grounds in standing water. These design features can be expensive upfront but do not need to be repeated if done well.

Other technologies: Larviciding was generally not raised, except in passing. Experts mentioned genetically modified mosquitoes but said they were probably not relevant for short timelines, though these are the best hope in the long term. Experts also mentioned genetically modified mosquitoes, as well as ivermectin.

Priority: Understanding how to co-deploy nets and other technologies to maximize impact

Our impression from our calls is that some experts think there is potential to maximize impact by determining how best to co-deploy different interventions. For example, one expert said that preliminary data suggest that deploying complementary tools could be very effective but is funding-constrained.[42]

The only specific combination mentioned in our calls, however, was bednets and vaccines. Experts suggested that vaccines might pair well with chlorfenapyr nets, given that chlorfenapyr not only attacks the mosquito but also attacks the malaria parasite.

- Relatedly, an expert suggested that if the R21 vaccine was going to be deployed as part of EPI (for ease) rather than as a geographically stratified intervention, then those in lower transmission areas might be adequately covered by the vaccine and not require bednets.

Our impression is that the ideal combination of tools remains an open question, and it may be interesting for GiveWell to learn more about this topic.

Implications for bednet programs:

- [In the longer term] Depending on which tools are best suited to co-deployment, this may influence which distribution channels are used

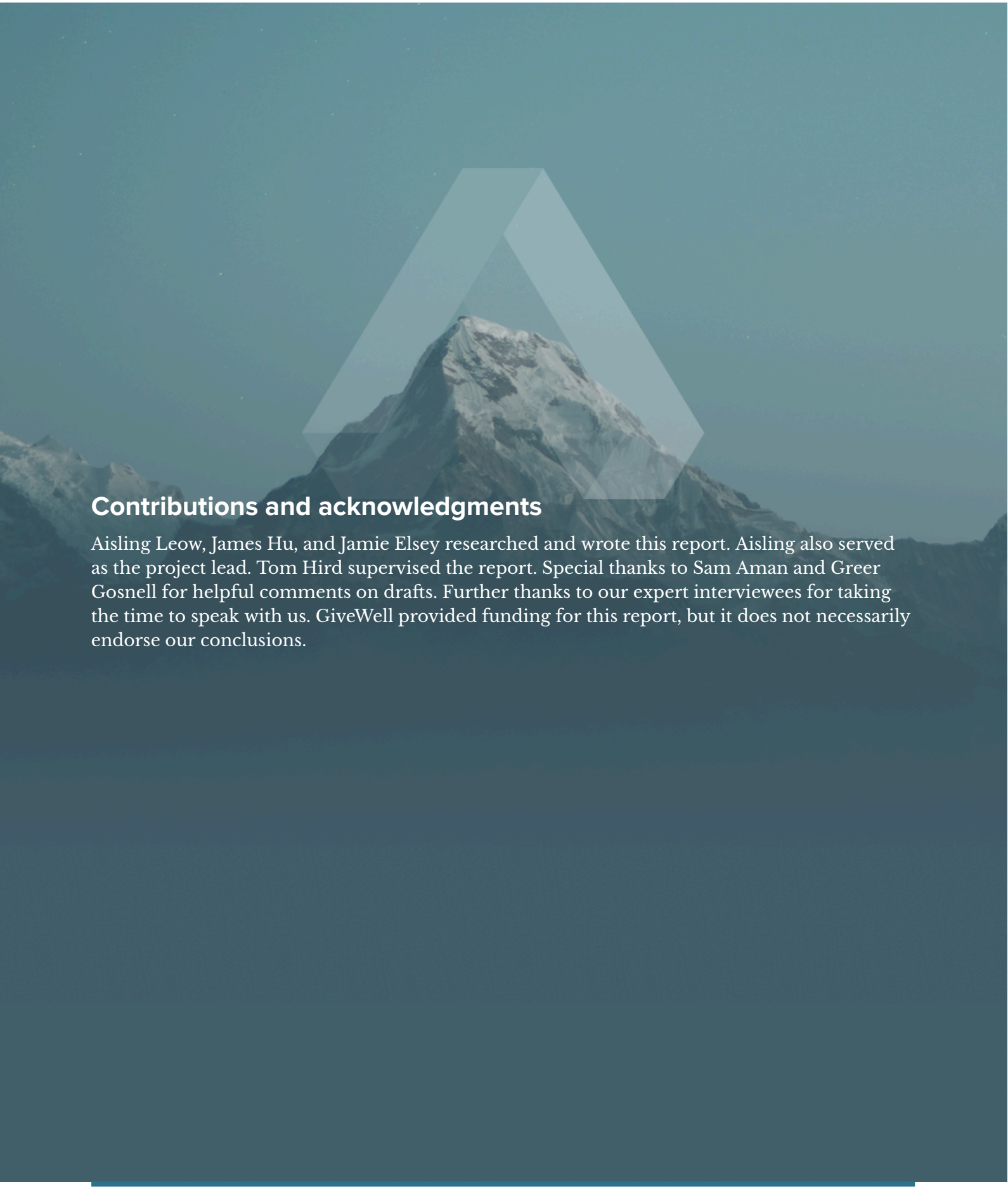
Potential next steps for GiveWell:

- Gather more expert views and data (e.g., follow up to see what preliminary data the expert was referring to) to determine which tools are most promising for co-deployment with nets
    - If data are limited, GiveWell could consider funding research on the efficacy of co-deploying multiple tools

[42] They did not mention specific tools in our call.

What we would do with more time

- Create a list of Global Fund Principal Recipients for malaria grants in priority countries.
    - These principal recipients are identified in the Global Fund Data Explorer, though it is not immediately clear whether this list is complete. The downloaded data from this source do not include the PR. We were able to identify the PR from the title in ⅞ of the grants, but further data capture would need to be manual.
- Look at country-level data for bednet funding volumes.
    - We mention in the section on funding that we often look at data for SSA, given data limitations. However, it may be possible to calculate bednet funding volumes for the countries of interest in a few ways. One way is to request data directly from NMP; another is to manually compile figures from the published MOPs for the countries of interest over the past couple of years (specifically, the gap analyses in the appendices).
- Look into the background of key implementing organizations, such as CRS, PSI, and World Vision.
- Investigate activities related to bednets, such as social behavioral change geared towards improving uptake or more appropriate use.
    - Relatedly, with more time, we would ensure that our overview of actors included organizations conducting social and behavior change activities and funding dedicated to these programs. At present, this type of program is a gap in our research.
- Explicitly ask experts if they believe that the cumulative effect of challenges is so great that bednets have reached the end of their usefulness, and/or purposefully interview more experts who have expressed negative views about bednets.
- Research the uncertainties that we highlight throughout the section on challenges and priorities, which we highlight in relation to specific, potential implications for bednet programs.



Contributions and acknowledgments

Aisling Leow, James Hu, and Jamie Elsey researched and wrote this report. Aisling also served as the project lead. Tom Hird supervised the report. Special thanks to Sam Aman and Greer Gosnell for helpful comments on drafts. Further thanks to our expert interviewees for taking the time to speak with us. GiveWell provided funding for this report, but it does not necessarily endorse our conclusions.

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Appendices

Appendix A: Individual country profiles

Our methodology for compiling this information on each country is described above.

Burkina Faso

In Burkina Faso, the following distribution channels are used:

- Mass campaigns occur every three years (due in 2025) and are primarily funded by GF, with <10% of nets purchased by PMI. Security concerns disrupted and postponed elements of the last campaign. [61.8% of nets]
- ANC ITNs are funded by both GF and PMI, targeting pregnant women, but activities for 2026 are in PAAR. [16.9%]
- Children under one are targeted through EPI but may also receive a net upon discharge from the maternity ward. Nets are funded by both GF and PMI, but activities for 2026 are in PAAR. [14.6%]
- PMI suggests a small number of nets are needed for school distribution, but this is not mentioned in the GF Funding Request. [0.4%]
- Additionally, the PMI MOP includes roughly 0.5m nets per year for community and hospital continuous distribution. The GF Funding Request also mentions some elements of community distribution to internally displaced persons but does not mention hospital-based programs. [6.3%]

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- Additionally, PMI mentions that Central Purchase of Generic Essential Drugs and Medical Consumables (CAMEG)—a non-profit organization that manages the procurement and distribution of essential medicines in Burkina Faso—may support storage and distribution.

Cameroon

In Cameroon, the following distribution channels are used:

- Mass campaigns occur every three years on a phased basis (due in 'semester 2' of 2025 for Adamawa, North and Far North, East, West, and Coastal regions, secondly in 'semester 1' of 2026 in Central, South, South-West, and North-West regions). GF is the primary funder for five regions, and the government funds one region.
    - PMI document notes that the mass campaign in 2025 will be AMF-procured nets.
- ANC ITNs are funded by both GF and PMI, targeting pregnant women. [13.0%]
- EPI distribution is funded by both GF and PMI, targeting children receiving their first vaccination dose for Measles and Rubella. [11.3%]
- School-based distribution is not listed as a main distribution channel, but GF is involved in piloting a small-scale (70,450 ITNs) primary school distribution in Littoral.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- Additionally, GF notes the World Food Program as a key humanitarian sub-recipient—they may be responsible for most transport to targeted facilities. An expert confirmed WFP involvement in Cameroon, with WFP responsible for warehousing and distribution to district and Aire de Santé (Health Center) levels, with the health ministry often taking over last mile distribution.

- Plan International has been involved at least in the small-scale distribution of ITNs as part of relief packages given to several thousand internally displaced persons.

Chad

In Chad, the following distribution channels are used:

- Only GF, not PMI, are involved with Chad.
- Mass campaigns occur every three years, covering all the 'eligible' health regions (19 of 23), representing 97.6% of the population. Distribution takes place in stages, although the exact process is not clear.
- ANC ITNs are funded by GF, targeting pregnant women in all ANC healthcare facilities.
- EPI distribution is funded by GF, targeting children less than one year old in all health facilities.
    - Both ANC and EPI each have a PAAR gap of ~1.5 million nets for 2024-2026.
- School-based distribution does not appear to occur.
- We do not have as clear net numbers for Chad as for other countries, though mass distribution predominates as with other countries.

The default actors associated with GF likely remain important: PPM for procurement; IDA and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, the World Food Programme and United Nations Development Programme have jointly been involved in the distribution of ITNs and appear to still be involved.

Democratic Republic of the Congo

In the DRC, the following distribution channels are used:

- Mass campaigns occur on a rolling basis, where several provinces are scheduled each year. Specific provinces are generally funded by either GF or PMI, though PMI's 2024 MOP indicates that at the time of writing, they were uncommitted to this support but rather "strongly exploring the possibility."[43] For the period 2024-2026, the DRC proposes to move to 30-month intervals. [74.5% of nets]
- ANC ITNs are funded by both GF and PMI, targeting pregnant women. [13.6%]
- EPI distribution is funded by both GF and PMI and targets children who come to a preschool consultation. [11.9%]
- School-based distribution was discontinued from 2024 onwards, a move that PMI describes as linked to the decrease in campaign intervals from 36 to 30 months.

The default actors likely remain important: IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- However, the GF Funding Request suggests AMF will procure all nets for 2024-2026.
- In addition, there are two key implementing organizations (primarily focused on in-country logistics and distribution): IMA World Health (IMA) and Soins de Santé Primaires en Milieu Rural (SANRU).
- PSI has been involved with bednet programs in the past, though we note potential losses of $7.4 million during their tenure as GF PR, as reported in this GF audit report.

Ghana

In Ghana, the following distribution channels are used:

[43] The public documents that we have reviewed do not explain what the withdrawal of PMI support would mean for vector control in the DRC. We expect that direct conversations with PMI and/or the NMCP would be necessary to understand PMI's ultimate commitment and the state of funding in the DRC.

- Mass campaigns occur every three years (due in 2024) and are jointly funded by GF and PMI. Some areas receiving IRS are excluded from the campaign. [59.1% of nets]
- ANC ITNs are funded by the Global Fund, targeting pregnant women. [10.6%]
- EPI distribution is funded by the Global Fund and targets children receiving their second dose of measles/rubella vaccines at child welfare clinics. [10.6%]
- School-based distribution is funded by PMI. This channel is not fully continuous: it occurs in years between mass distribution campaigns, focusing on children in primary classes two and six, in collaboration with the Ghana Education Service and NMEP. [17.1%]
- Ghana additionally aims to target 'special populations,' such as children at orphanages, HIV patients, and female head porters. [2.6%]

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, we identified that AngloGold Ashanti Malaria Control Ltd had some involvement with distribution between 2018 and 2020.
- We also note that GHSC-PSM has previously contracted third-party logistics firms to distribute to hard-to-reach areas.

Guinea

In Guinea, the following distribution channels are used:

- Mass campaigns occur every three years (due in 2025) and are funded by GF and PMI. For 2025, only Conakry will not be covered by the mass campaign. Two million nets are placed in PAAR. [70.1% of nets]
- ANC ITNs are funded by GF, PMI, and the government, targeting pregnant women. [15.8%]
- EPI distribution is funded by GF, PMI, and the government, targeting children younger than one year coming to health centers for vaccination. [14.1%]
- School-based distribution does not appear to be standard but may be aiming to expand into school and/or community-based distribution.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, CRS is listed as the PR of the GF funding request.
    - CRS appears to utilize Plan International and ChildFund Alliance as sub-recipients for distribution and 'social and behavioral change' activities around ITNs.
- AMF has also been involved in procurement, and it has contributed to the digitization of the campaign.

Mali

In Mali, the following distribution channels are used:

- Mass campaigns have been drawn out in the past due to lack of funding, but recent documents suggest the aim is to move to campaigns once every three years (i.e., 2023, then 2026). The campaign is funded by GF, and Bamako is excluded. [67.2% of nets]
    - Funding documents suggest Mali plans a replacement campaign one year after the mass campaign to replace ~8% of nets that will have worn out. The funding for this activity was placed in PAAR, and it is unclear whether it will happen.
- ANC ITNs are funded by PMI, targeting pregnant women. [17.4%]
- EPI distribution for children under one year old is funded by PMI. [15.4%]

    - For both ANC and EPI distribution, the government is committed to fund the procurement of ~300,000 nets (in total) per year.
- Mali additionally aims to distribute to homeless people and street children. Their funding request also mentions “LLINs for managing possible future malaria epidemics" from UN Central Emergency Response Fund.”

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- Catholic Relief Services is the PR for the current malaria grant (which runs to the end of 2024, unlike other GF grants) and manages the logistics and distribution of the mass campaign. Prior to CRS, the PR was PSI.
    - In conflict areas in the north of the country, NGOs are involved in the campaign. A list of NGOs operating in these areas can be found here, though it is unclear exactly which organizations manage bednet programs.
- Distribution to homeless people and street children is implemented by Le Groupe Walaha and Samu Social.

Mozambique

In Mozambique, the following distribution channels are used:

- PMI states that GF is responsible for funding procurement and distribution of all ITNs
- Universal Mass Campaigns are rolled out every 2.5-3 years, rolled out a few provinces at a time over a 12-month period. Through risk stratification, provincial capitals are less of a priority than rural areas—so distribution in provincial capitals went to PAAR. [Mass = 72.2% of nets]
- ANC ITNs are funded by GF, targeting pregnant women and infants at ANC visits. [27.8%]
- EPI distribution does not appear to occur.
- School-based distribution does not appear to occur.
- There is some distribution in response to natural disasters, such as after Tropical Cyclone Freddie.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, World Vision International is listed as a joint sub-recipient of the GF funding request and as the recipient who is primarily responsible for ITN procurement and distribution.
    - An expert noted Food for the Hungry as being subcontracted by World Vision and shared that there are others but did not specifically name them, including some involvement from Malaria Consortium, although we did not verify this independently. These actors have been relatively stable since 2016, but have some capacity limitations: rollout often has to proceed one state at a time to prevent them from being overstretched.
- An expert highlighted that there was a lot of room for improvement in the supply chain of Mozambique—switches between which actors are responsible for nets occur at a different level to most other countries, and there is often ‘a mess.’

Niger

In Niger, the following distribution channels are used:

- Mass campaigns occur every three years, next in 2024. GF is more responsible for mass campaign procurement, and PMI for continuous. Historically, it is a rolling mass campaign, but in 2024, they are aiming for all in one year. [72.4% of nets]
- ANC ITNs are funded by both GF and PMI, targeting pregnant women at their first ANC visit. 21 and seven districts are covered by PMI and GF, respectively. [13.7%]
- EPI distribution is funded by GF and PMI, targeting children receiving their first measles vaccination. 21 and seven districts are covered by PMI and GF, respectively. [13.8%]
    - Both ANC and EPI each have a PAAR gap of ~1.5 million nets for 2024-2026.
- School-based distribution does not appear to be standard but may be aiming to expand into school and/or community-based distribution.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, Catholic Relief Services is listed as the Principal Recipient of the GF funding request and appears to be involved in ITN procurement, logistics, and distribution.

Nigeria

In Nigeria, the following distribution channels are used:

- Mass campaigns occur on a rolling basis, where several states are scheduled each year. Specific states are funded by either GF or PMI. In GF states, activities for 2026 are in PAAR.[44] [73.1% of nets]
    - An expert suggested that only 70% of the net need is being procured for each state. We have not tried to confirm this in GF or PMI documentation.
    - Other states have experienced significant delays in mass campaigns due to a lack of funding. An expert confirmed that the Immunization Plus and Malaria Progress by Accelerating Coverage and Transforming Services (IMPACT) project—an initiative of the Bank/Islamic Development Bank—appears to be going ahead after a long wait. The GF Funding Request suggests ITNs will be purchased for the 12 states covered by IMPACT, but it doesn't state how they will be distributed.
- ANC and EPI channels are used in GF and PMI states, targeting pregnant women and young children. [11.7% and 15.2% respectively]
    - In PMI states, the MOP suggests that continuous distribution channels are supplied using leftover nets from the mass campaign. The GF notes that in the previous cycle, there were no leftover nets following campaigns due to a switch to door-to-door distribution during the pandemic.
    - In GF states, the Funding Request indicates that nets for continuous distribution will be 50% co-financed by domestic sources. We note that in the previous cycle, domestic funding was expected but not raised. Costs of storage and distribution costs for 2025 and 2026 are in PAAR.
    - An expert indicated that specific funding for routine channels in Nigeria will be more important going forward as it is less likely that there will be leftover nets from the campaign. We asked about the likelihood of co-financing being successful, and they said that although states are already making contributions to mass campaigns (often with delays), the odds that co-financing will happen for routine will vary by state.

[44] It is unclear whether operational costs for 2025 are also in PAAR, as the GF Funding Request contradicts itself through the document.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- AMF is also a relevant procurement actor for the mass campaign in PMI states.
- Local partners also appear to be important for distribution. We have identified several actors that have supported distribution in the past: C4C Global Services Ltd, Catholic Relief Services, and Society for Family Health.
    - An expert highlighted that CRS was brought in specifically to help after an investigation. There is a move to push CRS states back to working with the NMEP, and CRS was not intended to be there forever.
    - Malaria Consortium also implements a GiveWell-funded program in Nigeria.
    - An expert added that Malaria Consortium and Society for Family Health are sub-recipients of GF funding involved in GF states. In PMI states, Breakthrough Action has some involvement with bednets.
- An expert noted that logistics from the state level down are all handled by PSM/Chemonics (and their subcontractors), irrespective of the state. In their opinion, this process seems to work well, leading to one of the most optimized supply chains for bednet distribution.

South Sudan

In South Sudan, the following distribution channels are used:

- Mass campaigns have been drawn out in the past due to lack of funding, but recent documents suggest the aim is to move to campaigns once every three years (i.e., 2023, then 2026). The campaign is funded by GF and currently covers all states, but due to funding constraints, 65% of the net need (for five of 10 states) is in the PAAR for the 2026 campaign [80.3%].
- Both ANC and EPI ITNs are in the PAAR for the period 2024-2026 [9.9% of nets each].
    - It seems that UNICEF may conduct some small-scale, ad hoc distributions of nets to pregnant women and children as part of their humanitarian assistance.

The key actor in South Sudan is UNICEF, which is the principal recipient of the Global Fund grant. They conduct procurement, logistics, and distribution.

- In addition, AMF procured nets for seven states in the most recent mass campaign.
- Malaria Consortium has also conducted logistics and distribution for five states in the most recent campaign.

Tanzania

In Tanzania, the following distribution channels are used:

- Mainland Tanzania engages in ‘targeted mass replacement campaigns’ every three years, funded by PMI and GF—high and moderate risk strata in the country are primarily targeted, with distribution also in hotspots in lower-risk areas. [16.4%].
    - PMI funding for *Zanzibar* does not appear to involve mass campaigns but focuses on ANC, EPI, and community-based channels. GF funding for Zanzibar does note ‘targeted mass replacement.’
    - Across all channels, in 2025-2026, there are approximately 11.5 million nets PAAR.
- School Nets Program (SNP) distribution is a large share of mainland Tanzanian distribution. [43.5%]
- ANC ITNs are funded by both GF and PMI, targeting pregnant women at ANCs. [17.0%]

- EPI distribution is funded by GF and PMI, targeting children receiving their first measles vaccination. 21 and seven districts covered each by PMI and GF, respectively. [17.0%]

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- In addition, Population Services International (PSI) has been involved in a large volume of distribution, at least up until 2020.
- A private distribution/logistics company, Simba Logistics, has been involved in distribution—also at least up until 2020.
- John Hopkins has been involved with PMI and lists Viama and Tropical Health LLP as implementing partners for bednet-related activities.

Togo

In Togo, the following distribution channels are used:

- This was the first year of PMI funding, so PMI focused more on technical assistance and it needs to improve overall implementation.
- Mass campaigns occur every three years, next in 2026. Coverage appears to be throughout all regions, except where IRS is used. The PMI documentation notes both GF and AMF supporting mass campaigns. [81.2% of nets]
- ANC ITNs are funded by GF, targeting pregnant women at their first ANC visit. [9.8%]
- EPI distribution is funded by GF, targeting newborns at the time of their first vaccination. [9.0%]
    - Both ANC and EPI each have a PAAR gap of ~1.5 million nets for 2024-2026.
- School-based distribution does not appear to occur.

The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

Uganda

In Uganda, the following distribution channels are used:

- Mass campaigns occur every three years (due in 2026) and are primarily funded by GF (though a small contribution from PMI of $1M nets is noted by GF, though not PMI). 2M nets are in the PAAR. [62.8% of nets]
- ANC ITNs are funded by both GF (86 districts) and PMI (50 districts), targeting pregnant women. 60% of this program is in the PAAR. [13.2%]
- EPI distribution is funded by both GF (86 districts) and PMI (50 districts). Funding for distribution in 2025 and 2026 (40% of the total) is in the PAAR. [17.9%]
- School-based distribution has previously been implemented in 11 high-burden and high-transmission districts in two regions, amounting to ~800 schools. Continuation of this program and expansion to an additional region is in the PAAR. [3.1%]
- There is additional mention of specific efforts to 1) reach nomadic populations in Karamoja through integration with mobile outreach efforts, 2) provide nets for hospital beds, and 3) provide nets upon discharge for patients treated for severe malaria. The latter two activities are in the PAAR. [2.9%]

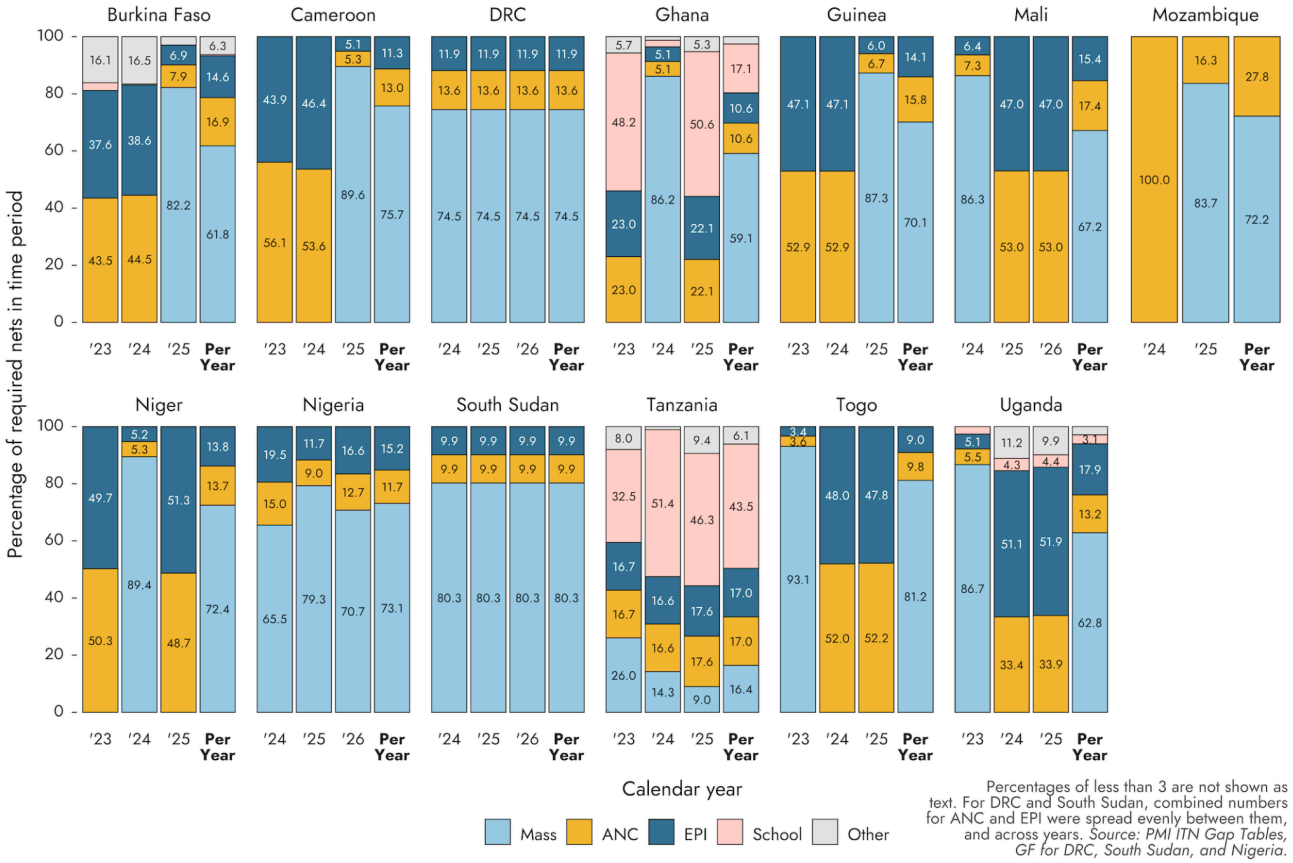
The default actors likely remain important: PPM and GHSC-PSM for procurement; IDA, GHSC-PSM, and NMCP for logistics; and NMCP/existing health infrastructure for distribution.

- AMF is also a relevant procurement actor for the mass campaign.

- The National Medical Stores (a governmental organization) handles in-country logistics for the mass campaign and GF-funded ANC (and likely EPI) channels.
    - Warehousing and distribution of PMI-funded nets for continuous distribution will be done by the Joint Medical Store (JMS), a private, not-for-profit warehouse.
- PACE and Malaria Consortium have been involved with bednet programs in the past.
- An expert noted that governmental actors are the most important in Uganda but that there were also a lot of organizations involved in (probably costly) oversight and tracking at each level of the supply chain.

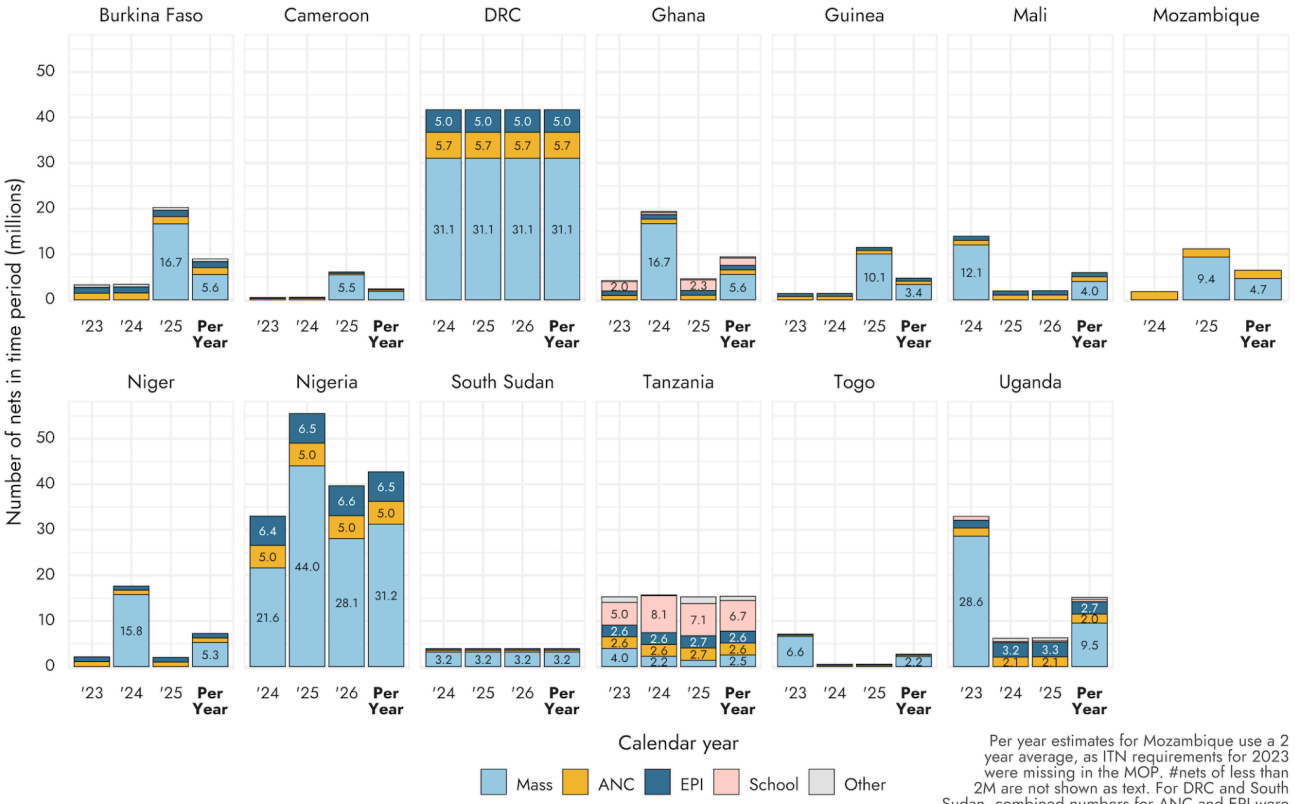
Appendix B: Yearly bednet need breakdowns

Figure B1: Breakdown (percentage) of yearly bednet need by country, 2023-2025



Percentages of less than 3 are not shown as text. For DRC and South Sudan, combined numbers for ANC and EPI were spread evenly between them, and across years. *Source: PMI ITN Gap Tables, GF for DRC, South Sudan, and Nigeria.*

Figure B2: Breakdown (net units) of yearly net need by country, 2023-2025



Per year estimates for Mozambique use a 2 year average, as ITN requirements for 2023 were missing in the MOP. #nets of less than 2M are not shown as text. For DRC and South Sudan, combined numbers for ANC and EPI were spread evenly between them, and across years. *Source: PMI ITN Gap Tables, GF for DRC, South Sudan, and Nigeria.*