



# GENDER AND MALARIA EVIDENCE REVIEW

February 2020

BILL & MELINDA  
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## EXECUTIVE SUMMARY

Malaria, a disease that affects an estimated 228 million people and causes over 400,000 deaths every year, mostly in sub-Saharan Africa and Asia, is a top priority of the Bill & Melinda Gates Foundation, which is committed to being catalytic in reducing the burden of malaria and accelerating progress toward eradication of the disease. While there is a vast scientific literature on the epidemiological, entomological, and social factors related to the risk of malaria infection and disease progression that informs the foundation and its partners in their work in the areas of surveillance, vector control, and antimalarial interventions, there is relatively little systematic evidence on the role that gender might play in developing effective responses to malaria. This report synthesizes the current state of research and knowledge about the ways in which gender mediates the adoption of preventive technologies and behaviors and access to treatment, as well as the potential for gender-intentional approaches to research, product development, and advocacy.

Taken together, the evidence reviewed strongly suggests that addressing gender inequalities in malaria endemic settings has the potential to accelerate burden reduction and disease elimination. In addition, there are areas of malaria programming that, if intentionally designed and implemented, have the potential to contribute to enhancing

gender equality as an objective in and of itself. Expanding and strengthening high-quality research on the relationship between gender and malaria will be critical to informing evidence-based gender integrated malaria strategies, funding priorities, and program design and implementation.

With respect to gender and malaria prevention, the report synthesizes research on bed net access and use and concludes that: (1) high bed net price sensitivity among the poor, compounded by women's limited economic and decision-making power in the household, makes free distribution key to reducing gender gaps in access; (2) antenatal clinics are an essential delivery channel for bed nets, and malaria programs could be strengthened by addressing known barriers to women's maternal health care utilization; (3) reliance on self-reported bed net use may overstate preferential allocation to the most vulnerable populations (including pregnant women and children under 5); direct observation is recommended for future surveillance programs; and (4) the shift to universal coverage policy has not been accompanied by effective communications targeted to adult men and boys, who may have greater occupational risk of exposure and therefore transmission to more vulnerable household members.

An examination of the linkages between women's empowerment and malaria burden reduction finds strong evidence that strengthening women's agency over resources and household-level decision-making authority can significantly decrease malaria incidence and prevalence. This suggests that investing in gender-targeted resource transfers—normally the purview of poverty reduction policy—could have important impacts on malaria.

Gender considerations are also highly relevant with respect to malaria case management and surveillance. Evidence from many endemic regions suggests that: (1) treatment-seeking for individuals exhibiting malarial symptoms is often a multi-step process involving complex intra-household negotiation; (2) women's financial autonomy and decision-making authority are positively associated with treatment-seeking for febrile children; (3) community-based case management can significantly reduce the costs associated with malaria treatment-seeking and ease the burden on women to seek permission and resources from spouses for formal care; (4) Malaria education programs that address symptom recognition and treatment protocols need to involve all relevant decision-makers—including husbands/fathers and elders—to help give credibility to women in the treatment-seeking process; (5) effective case management for pregnant women requires more attention to drug safety concerns on the part of women and spouses and other family members, and quality improvement interventions that reach all providers administering antimalarial drugs to increase adherence to World Health Organization (WHO) protocol; and (6) surveillance systems need to consistently collect and report age- and sex-disaggregated data.

The report also finds evidence on links between gender and malaria scientific research and development, including: (1) the international malaria research agenda can be strengthened by sex and gender analysis of differences in exposure risks, disease susceptibilities, prevention and treatment behaviors, and preferences in product development; (2) gender barriers to career development lead to the underrepresentation of women scientists in malariology, which in turn impacts the research agenda; and (3) clinical trial design and protocol can be made more effective, efficient, and equitable by addressing the gender-specific socioeconomic and cultural barriers that limit the recruitment and retention of women.

Finally, this report highlights the importance of integrating gender considerations into current malaria policy and advocacy efforts, and finds that: 1) there is an opportunity to strengthen global technical guidance on gender integration into national malaria planning, policy, and programming, and to develop accompanying toolkits to guide uptake of these recommendations; and 2) targeted advocacy and communication efforts can raise the profile of the links between gender and malaria in order to strengthen political will to integrate gender considerations into malaria policies and programs.

Filling research gaps and strengthening the evidence base for gender integration of malaria programs and policies is of utmost importance. In the areas of prevention, treatment, and surveillance, evidence is lacking for the reliable measurement of gender gaps in bed net use; there is also a need for impact assessments of antenatal clinics as delivery channels for bed nets and chemoprevention for pregnant women and of community-based case management on the reduction of gender barriers and gaps to receiving malaria prevention and treatment. Intersectoral research on the impact of women's economic empowerment on malaria burden reduction could yield important insights into the relationship between gender equality and malaria outcomes. In the area of biomedical research and development, there is a need for generating new evidence on gender differences in needs and preferences for new malaria product development, exploratory research to identify gender barriers to recruitment and retention in malaria clinical trials, as well as efforts to develop safe and effective malaria treatments for HIV-infected women.

Gender-intentional and transformative approaches have the potential to unlock improved malaria outcomes, and should therefore be of critical priority to future malaria prevention, treatment, and elimination efforts.



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## INTRODUCTION

Malaria, a disease that affects an estimated 228 million people and causes over 400,000 deaths every year, mostly in sub-Saharan Africa and Asia, is a top priority of the Bill & Melinda Gates Foundation, which is committed to being catalytic in reducing the burden of malaria and accelerating progress toward eradication of the disease.

While there is a vast scientific literature on the epidemiological, entomological, and social factors related to the risk of malaria infection and disease progression that informs the foundation and its partners in their work in the areas of surveillance, vector control, and antimalarial interventions, there is relatively little systematic evidence on the role that gender might play in developing effective responses to malaria. This report synthesizes the current state of research and knowledge about the ways in which gender mediates the adoption of preventive technologies and behaviors and access to treatment, as well as the potential for gender intentional and transformative approaches to research, implementation, product development, and advocacy. This report is not intended to determine the resource requirements nor feasibility for scale of the opportunities identified.

Taken together, the evidence strongly suggests that addressing gender inequalities in malaria endemic settings has the potential to accelerate burden reduction and disease elimination. In addition, there are areas of malaria programming that, if intentionally designed and implemented, have the potential to contribute to enhancing gender equality as an objective in and of itself. Expanding and strengthening high-quality research on the relationship between gender and malaria will be critical to informing evidence-based gender integrated malaria strategies, funding priorities, and program design and implementation.

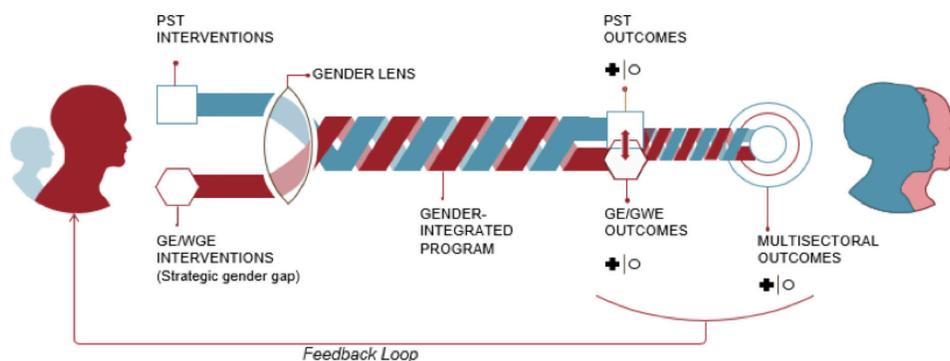
## 2. OBJECTIVES, METHODS, AND SCOPE

This review of evidence on the links between gender equality and malaria outcomes identifies opportunities for gender integration into malaria prevention and treatment delivery, research and development of new malaria drugs, diagnostics, and other tools, and strategies for malaria policy and advocacy.

This review is built on the Bill & Melinda Gates Foundation approach to gender integration, which states that applying a gender lens to sector-specific interventions has the potential to accelerate sector outcomes while at the same time making a positive contribution to advancing gender equality (Figure 1). In the case of malaria, this implies that identifying and

addressing gender barriers, gaps, and opportunities across malaria control and elimination efforts will both accelerate burden reduction and have an impact on reducing gender gaps in access to and agency over resources. Within this approach, gender gaps are defined in the foundation's Gender Equality Lexicon as a "disparity between women and men's and boys' and girls' condition or position in society based on gendered norms and expectations" (The Bill & Melinda Gates Foundation, 2018). Gender gaps in access and agency reflect the unequal distribution of opportunities, resources, or outcomes, and are usually revealed through the analysis of sex-disaggregated data that illustrate the extent of inequalities.

**Figure 1. Creating Synergy between sector and gender equality interventions**



The evidence reviewed in the first two sections, which is drawn from both the biomedical and social sciences, was primarily identified using the PubMed and EconLit databases and bibliographic backreferencing from those documents. Supplementary source material was obtained from the comprehensive bibliography of the Global Fund's Technical Brief on Malaria, Gender and Human Rights (GFATM 2019). From an initial list of more than 200 peer-reviewed articles, 49 were identified as relevant to the objectives of the report, which is intended as a targeted—as opposed to a systematic—review of the available evidence on gender and malaria. Inclusion criteria were quite broad, as much of the peer-reviewed research in this nascent field is descriptive and exploratory in nature, often with small sample sizes using qualitative methodologies. Research focused on the biological aspects of malaria in pregnancy were excluded, as were studies published prior to 1999 and those that failed to at least meet the "medium" quality of evidence criteria described in Appendix A. The advocacy and policy section of the review (Section 5) consisted of an analysis of publicly available reports and policies to identify the extent to which the evidence on the links between gender and malaria was incorporated in existing documents.

The report is organized as follows:

- Section 3 reviews the research on gender and malaria prevention and treatment, with particular attention to bed net access and use, the role that women's empowerment could play in reducing malaria burden in endemic regions, and gender barriers to treatment-seeking for children and pregnant women.
- Section 4 considers the evidence on gender in malaria research and development, including guidelines for sex and gender analysis in the context of human drug R&D, gender representation on scientific teams, and gender considerations in the design and implementation of clinical trials.
- Section 5 discusses current gaps in gender integration in malaria advocacy and policy approaches, and identifies opportunities to address these gaps.

At the conclusion of each section, evidence gaps/learning agendas and opportunities for action are identified.

## 3. GENDER AND MALARIA PREVENTION AND TREATMENT DELIVERY

The vast majority of the research literature on gender and malaria focuses on gender differences in disease prevention and treatment, with a particular emphasis on bed net access and use. A consistent finding across research sites and methods is that, while women are often informed about and express strong interest in malaria prevention and treatment technologies and practices, their health-seeking behaviors (on behalf of themselves and their children) are frequently limited by their low socioeconomic standing within their households and communities. In this section, we review the evidence in four key areas: (1) gender barriers to bed net access and use, (2) the challenges of delivering effective chemoprevention to pregnant women, (3) women's participation in vector control, (4) the relationship between women's empowerment and malaria burden reduction, and (5) gender issues in malaria case management and surveillance. The section concludes by identifying evidence gaps and opportunities for gender integration in malaria prevention, treatment, and surveillance.

### 3.1 Gender barriers to bed net access and use

Key findings from the extensive research literature on the prevention of malaria through the distribution and use of insecticide-treated bed nets (ITNs) include:

- High bed net price sensitivity among the poor, compounded by women's limited economic and decision-making power in the household, makes free bed net distribution key to overcoming gender barriers in access to bed nets.
- Antenatal clinics are an essential delivery channel for bed nets; malaria programs could be strengthened by addressing known barriers to women's maternal health care utilization.
- Reliance on self-reported bed net use may overstate preferential allocation to the most vulnerable populations (including pregnant women and children under 5); direct observation is recommended for future surveillance programs.
- The shift to universal coverage policy has not been accompanied by effective communications targeted to adult men and boys, who may have greater occupational risk of exposure and therefore transmission to more vulnerable household members.



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## High bed net price sensitivity among the poor, compounded by women’s limited economic and decision-making power in the household, makes free distribution key to reducing gender gaps in access to bed nets.

It is well-known that long-lasting insecticide-treated bed nets (LLINs) are a highly effective means of reducing the entomological inoculation rate. For example, a recent well-designed study in the Democratic Republic of Congo (DRC) finds that a LLIN distribution campaign led to a 41 percent decline in under-5 mortality risk among children living in rural areas with malaria ecology above the sample median (Dolan et al. 2019). Field experiments have also confirmed that low-income households exhibit extremely high price elasticities of demand for bed nets: in Kenya, uptake drops by 60 percentage points when the price of ITNs increases from zero to \$0.60 (i.e., from 100 percent to 90 percent subsidy) (Cohen and Dupas 2010), and in Madagascar, when price increases by \$0.55 (which represents 25 percent of the total market price), demand falls by 23.1 percentage points and effective coverage falls by 23.1 percentage points (Comfort and Krezanoski 2017).

Price sensitivity to this effective preventive health product is compounded by gender gaps in household economic and decision-making power. Even when women, who often bear primary responsibility for family health (especially providing unpaid caring labor), express strong preferences for bed nets as a malaria prevention method,<sup>1</sup> men’s control over financial resources renders them dependent on their husbands for cash and permission to purchase bed nets and other preventive health products (Rashed et al. 1999). In this context, where the economic dependence of women on their husbands constitutes an obstacle to bed net acquisition, creating opportunities for women to generate and have agency over independent income may translate into increased uptake of this important malaria prevention technology. Indeed, there is emerging evidence that suggests a positive correlation (and in some studies a causal relationship) between women’s independent control of income and decision-making related to household use of vector control measures (see Box 1 and section 3.4).

Charging a positive price for antimalarial bed nets may also influence the intrahousehold allocation and use of this preventive health product. Box 2 profiles an experimental study in Uganda which found that nets received for free were more likely to be used by young children, while purchased nets were used by those members of the household, often adults, perceived by participants to suffer from malaria most frequently (Hoffman 2009).

## Box 1. Female-headed households and vector control adoption

Do male-headed households exhibit different malaria preventive behaviors than female-headed households? Using cross-sectional survey data from over 2,700 households in Nyabondo and Malindi provinces in rural Kenya, researchers examined differential adoption of multiple integrated practices for prevention and control of malaria across male- and female-headed households (Diiro et al. 2016). Female-headed households—which may serve as a weak counterfactual for women’s independent control of income and decision-making with respect to preventive health investments—were statistically significantly more likely to use bed nets, purchase repellants, use traditional repellants, and engage in bush clearing (an ineffective vector control method that is commonly misperceived as useful), compared to male-headed households. These higher adoption rates among female-headed households are particularly notable given the fact that the households headed by women in this region are poorer and comprised of fewer adults and children, and female household heads have lower average levels of education and knowledge of malaria transmission. The same study found that participation in community activities, neighborhood effects, and knowledge of malaria cause and transmission were stronger predictors of the adoption of these preventive practices for female-headed vs. male-headed households.

1. For example, a small survey in Mozambique that elicited preferences for malaria prevention methods among a sample of pregnant women found that close to 69% of women selected ITNs as their first choice (compared to 14% for IPTp and 1.2% for IRS) (Boene et al. 2014).

## Box 2.

### The intrahousehold allocation of free and purchased mosquito nets in Uganda

A field experiment in an area of seasonal malaria transmission in western Uganda randomly assigned parents or guardians of young children to receive either a sufficient number of free insecticide-treated bed nets to cover all household members or their cash equivalent. Both treatment groups, which were equally comprised of male and females from dual-headed households as well as (mostly female) single heads of household, also received information about the particular malaria vulnerability of pregnant women and children under 5. Participants then had the opportunity to exchange nets for cash or cash for nets, in order to elicit willingness to pay. Usage of nets was observed during nighttime checks three weeks later.

As illustrated in the table below, children under the age of 5 were statistically significantly more likely to be covered by a bed net in the households that received the net for free in kind. Regression analysis confirms that the proportion of children in this youngest age category observed using a bed net was 22.6% higher in households that had received the nets in kind, relative to those who had received cash, and controlling for the education of the household head and the total number of children under 5. The strongest predictors of individual net use were sharing a bed with the experiment participant (for both the in-kind and cash groups), being a child under 5 of the participant (for the in-kind group only), and whether the individual “usually gets malaria every year” (for the cash group only). Targeting the transfer of nets or cash to female rather than male guardians did not affect the intrahousehold allocation of bed net use.

**Proportion Using Net, By Treatment, Age, and Gender Category**

	Whole Sample <sup>a</sup>			Obtained at least one net		
	Pooled sample (1)	Received cash (2)	Received nets (3)	Pooled sample (4)	Received cash (5)	Received nets (6)
Age 0-5	0.69	0.56	0.79***	0.76	0.69	0.80*
Age 6-14	0.64	0.59	0.68	0.67	0.66	0.68
Female 15-45	0.85	0.79	0.91*	0.92	0.91	0.92
Other adults	0.84	0.80	0.87	0.89	0.90	0.88
Age 60+	0.89	0.82	1.00	0.94	0.90	1.00
Total	0.73	0.65	0.79	0.78	0.76	0.80

Notes: Differences in means are tested using a probit model of net usage within each subgroup with a treatment dummy as the only independent variable. Standard errors clustered at the household level.

<sup>a</sup> assumes no change from baseline net usage in households that did not acquire any nets through the experiment

\*\*\* Significant at the 1 percent level

\*\* Significant at the 5 percent level

\* Significant at the 10 percent level

Source: Hoffman (2009)

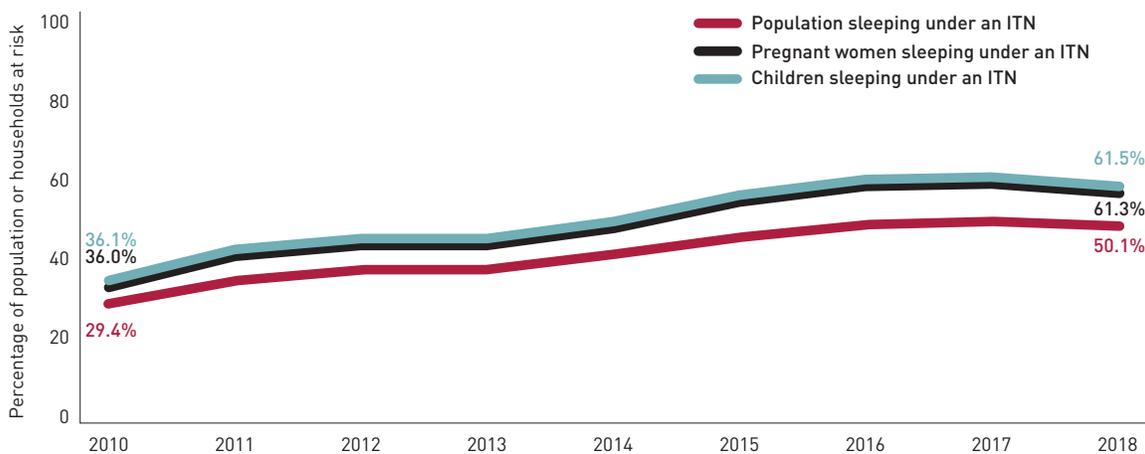
**Reliance on self-reported bed net use may overstate preferential allocation to the most vulnerable populations (including pregnant women and children under 5); direct observation is recommended for future surveillance programs.**

There is a large literature on the intra-household distribution of bed net use. Most studies using self-reported net coverage from the previous night (the standard measurement used

in Malaria Indicator Surveys and Demographic and Health Surveys) find that reproductive-age women (including those who are currently pregnant) and children under 5 are the most likely to sleep under a bed net. The most recent data from the World Health Organization suggest that 61 percent of pregnant women and children aged under 5 years in endemic regions of sub-Saharan Africa were using bed nets in 2018 (compared with 36 percent in 2010), while only 50 percent of the overall population did so (up from 29 percent in 2010) (Figure 2).

**Figure 2: Bed net coverage of pregnant women and children under 5**

Percentage of population at risk, pregnant women and children aged under 5 years<sup>a</sup> sleeping under an ITN, sub-Saharan Africa, 2010-2018 Source: ITN coverage model from MAP.<sup>b</sup>



ITN: insecticide-treated mosquito net; MAP: Malaria Atlas Project.

<sup>a</sup> Estimates for children aged under 5 years and pregnant women highly overlap and show the same values in the trend since 2010.

<sup>b</sup> <https://map.ox.ac.uk>

Source: WHO (2019)

The distribution of bed nets among household members depends in part on how many bed nets are owned. A recent cross-country analysis of insecticide-treated bed net use (Olafeju et al. 2018) found that a median of only 31 percent of households in 29 malaria endemic sub-Saharan African countries possessed an adequate number of ITNs for universal coverage (one per every two people). After adjusting for wealth quintile, residence, and region, among households with not enough ITNs in all countries, the odds of ITN use were consistently higher among children under 5 years and non-pregnant women 15–49 years. Meta-regressions showed that across all countries, the mean adjusted odds ratio (aOR) of ITN use among children under 5 years, pregnant and non-pregnant women aged 15–49 years, and people 50 years and above was significantly higher than among men aged 15–49 years. Among these household members, the relationship was attenuated when there were enough ITNs in the household (dropping 0.26–0.59 points) after adjusting for geographical zone, household ITN supply, population ITN access, and ITN use:access ratio.

This study demonstrates that having enough ITNs in the household increases level of use and decreases existing disparities between age and gender groups, and suggests that ITN distribution via mass campaigns and continuous distribution channels should be enhanced as needed to ensure that households have enough ITNs for all members, including men and school-aged children. In an environment where gender norms are difficult to transform, ensuring there is at least one bed net for every person in a household is an entry point to address unequal access to bed nets. Self-reported bed net use data, however, is likely to be subject to social desirability bias (the tendency of survey respondents to answer questions in a manner that will be viewed favorably by others). In other words, the way that people answer the questions posed in the MIS and DHS may reflect normative views of who should be sleeping under the nets (especially in situations where there are not sufficient nets for universal coverage), as opposed to actual use.

Innovative research in Uganda, for example, yields important insights into the gap between norms and practices around the intra-household allocation of bed nets, particularly when the number of owned nets is insufficient to cover all household members (Lam et al. 2014). Using a creative participatory exercise in which subjects arranged photographs of individuals of various ages and genders onto photos of distinct sleeping spaces (beds with spring mattresses and linens, foam rubber mattresses on the floor, and straw mats on the floor) and covered them with swatches of bed nets in varying conditions of use and disrepair), children under 5 and pregnant women were most often assigned the highest-quality beds and nets. The almost-universal justification given for this prioritization, consistent with the messaging of most malaria control programs, was the greater biological vulnerability of young children and pregnant women. However, measuring actual allocation behaviors with a sleeping space questionnaire demonstrated that 41 percent of children under 5 had slept without a net on the previous night, while almost 86 percent of household heads had been covered.

This discrepancy between social norms and observed behaviors is consistent with the allocation of health resources to those perceived as making greater economic contributions to the household. It also points to the sensitivity of bed net coverage (and intra-household distribution) data to measurement method; Krezanoski et al. (2018) find that self-reported ITN use is 8 percentage points higher than objectively measured (through direct observation) ITN use, representing a 13.6 percent overestimation relative to the proportion measured as adherent to ITN use by objective measures.

**The shift to universal malaria intervention coverage policy has not been accompanied by effective communications targeted to adult men and boys, who may have greater occupational risk of exposure and therefore transmission to more vulnerable household members.**

As the international malaria policy consensus has shifted from targeting bed nets to the most vulnerable populations of children under 5 and pregnant women to access and use of appropriate interventions by the entire population at risk, there is renewed attention to the intra-household distribution of bed net use. After decades of prioritizing distribution to select household members and developing and disseminating informational and communications materials and campaigns emphasizing allocation of bed nets to young children and pregnant women, households in endemic areas are now being encouraged to acquire, install, and use sufficient nets and/or other effective tools based on local conditions for everyone. The shift in WHO strategy from targeted bed net access for pregnant women and children under 5 to universal coverage (which for bed nets is defined as one net per two household members) has implications for gender-intentional marketing and distribution strategies. A widely cited study in Nigeria (Garley et al. 2013) found that while a universal free ITN distribution campaign in Kano State increased household ITN ownership more than 10-fold (from 6 percent to 71 percent), women were significantly more likely to use the nets, even after controlling for relevant covariates such as wealth and education.<sup>2</sup> This is important because men are more vulnerable to contracting malaria through occupational exposure, and men with untreated malaria infections are potential reservoirs for malaria transmission (ibid.). The study's authors suggest that one possible explanation for higher uptake of ITNs among females over males is related to the nature of messages about mosquito net usage: billboard images, radio advertisements, and television commercials promoting ITNs often portray women and young children using the nets but generally do not include men. They go on to recommend that gender-specific behavior change strategies help to promote gender equity in ITN use—and particularly use by adult men—as universal bed net campaigns roll out across countries worldwide to compensate for the historical campaigns that have primarily focused on women and children.

### **3.2 Challenges of Delivering Malaria Chemoprevention to Pregnant Women**

As is well-known, due to pregnant women's reduced immune response and sequestration and replication of the malaria parasite in the placenta, malaria infection in pregnant women is associated with high risks of both maternal and perinatal morbidity and mortality. Routine antenatal care (ANC) services constitute an important malaria prevention and treatment delivery channel that ensures pregnant women who attend an ANC clinic at least once (77 percent in sub-Saharan Africa) are covered with a LLIN from their first ANC visit in each pregnancy and plays an important role in maintaining population-level coverage between mass distribution campaigns, particularly for women who become pregnant between campaigns and for infants born outside of campaign years. Antenatal clinics are also an essential delivery channel for chemoprevention (specifically, intermittent preventive treatment of malaria in pregnancy (IPTp)) for pregnant women.

In 2012, the WHO updated its policy with respect to IPTp administration to recommend administration at each antenatal care visit in the second and third trimesters, with a minimum of three, rather than two, doses. While rapid improvements in coverage were expected, gains have occurred more slowly than anticipated. It took an average of 2 years for countries to complete the process of revising their IPTp policies, and it was not until 2015 that all 17 President's Malaria Initiative (PMI) countries had updated their policies (Henry et al. 2018). Policy dissemination and training had not been completed in several countries as of early 2018, and only seven countries had fully implemented the new policy including updating their antenatal care registers to collect information on IPTp3+ coverage. The coverage of IPTp1+, 2+, and 3+ has increased by 19, 16, and 13 percentage points since the revised IPTp policy adoption (ibid.).

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2. Estimated odds ratio of female:male bed net use = 1.46 for the entire sample. Gender differences in bed net use were not evident in households where there was at least one bed net for every two people, nor for children under 15 years old (ibid.).

In order for bed net distribution and other antimalarial prevention and treatment services through ANC to be maximally effective, malaria programs need to work collaboratively with the maternal and child health system to address multiple supply-and-demand-side barriers to utilization, including gender barriers such as lack of male involvement at health facilities (Morgan et al. 2017). Box 3 provides additional examples of gender barriers that can impact access to IPTp. Evidence from multiple country programs suggests that with integrated malaria services, providers are often not clear about how to deliver IPTp for

specific cases (such as HIV-positive women) and how to address potential side effects. Given the uncertainty about the care pathways and fear of doing harm, health care workers providing integrated malaria services may opt for “doing nothing” rather than intervene and risk making an error, leading to lower coverage of IPTp (de Jongh et al. 2016). Promising approaches to increasing ANC attendance include community-directed interventions to introduce local-level distribution of quality-assured SP (cf. TIPTOP 2017) and in-person reminders from community health workers (Busso et al. 2017).

### Box 3.

## Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in sub-Saharan Africa

A systematic review and meta-analysis of evidence related to the determinants, barriers, and facilitators of malaria in pregnancy interventions (including intermittent preventative treatment in pregnancy (IPTp) and insecticide-treated bed nets (ITNs)) found that delivery of ITNs through antenatal clinics presents fewer problems than delivery of IPTp (Hill et al. 2013). Although IPTp has increased significantly over the past decade, fewer than one-third of pregnant women in sub-Saharan Africa receive the recommended three doses.

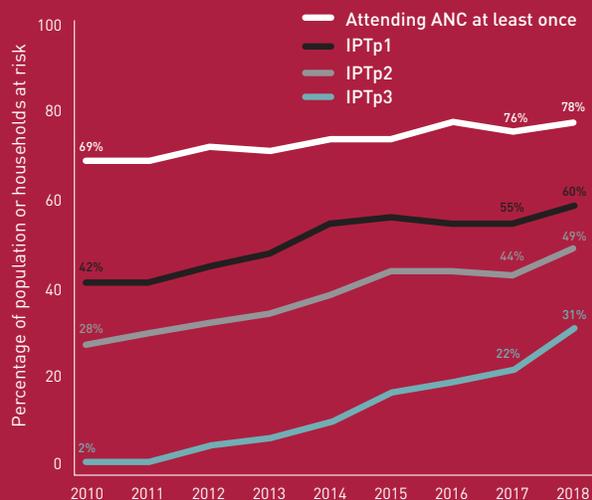
Among the barriers identified to receipt of IPTp were factors related to issues of time, poverty, mobility, intra-household power dynamics, and women’s economic agency. Examples include:

- It is common for women to have to purchase the sulfadoxine-pyrimethamine (SP) medication or water for taking the SP by directly observed therapy (DOT), constituting an important economic barrier to the uptake of IPTp.
- Commitments to farming, employment, and childcare were barriers to ANC attendance earlier in pregnancy, resulting in women receiving no or incomplete doses of IPTp.
- Women often delayed going to an ANC until the pregnancy was advanced (about seven months’ gestation) because their husbands did not give them money for transport, presenting a shorter window of opportunity to receive two doses of IPTp.
- In Nigeria, women reported needing their husband’s support or consent before attending an ANC or before taking any drugs.

Source: World Malaria Report 2019

Percentage of pregnant women attending ANC at least once and receiving IPTp, by dose, sub-Saharan Africa, 2010-2018.

Source: NMP reports, WHO and US Centers for Disease Control and Prevention estimates.



ANC: antenatal care; IPTp: intermittent preventative treatment in pregnancy, IPTp1: first dose of IPTp; IPTp2: second dose of IPTp; IPTp3: third dose of IPTp; NMP: national malaria programme; US: United States; WHO: World Health Organization.

### 3.3 Women's participation in vector control

There is sound evidence on links between gender composition of health worker and vector control teams and the acceptance of malaria interventions. For example, indoor residual spraying (IRS) is normally conducted in all sleeping spaces in a dwelling. Cultural norms may not permit a woman to allow an unknown adult male to enter the house, let alone the private spaces within the house, such as the bedroom (Gunn et al. 2017). Including women on an IRS team may address this concern (see Box 4). While inclusion of women may help address some program barriers, it could raise others. Gender norms may prohibit women from staying overnight to undertake mosquito sampling, travelling alone, being supervised by males, and working with insecticides (Hayden et al. 2018). Additionally, women-centered vector control programming has led in some instances to community pressure to include males (Gunn et al. 2017).

A pair of stakeholder convenings in Kenya and Indonesia, held as part of the "Accelerate to Equal: Engaging Women in Vector Control" project, identified the benefits, barriers, and strategies related to accelerating the involvement of women

in sustained support for vector control interventions (Ernst et al. 2018). Participants focused on three potential levels of engagement: the household-level in which women are empowered to carry out vector-control activities within their own homes, the community-level in which women carry out paid or unpaid vector control activities with residents to build collective action at the local level, and the professional level in which women engage in regional or national-level vector-control efforts. Among the benefits of engaging women in vector control are women's intimate knowledge of the household environment, effective communication skills, and willingness to take part in group activities and draw on social networks to implement vector control projects. Barriers to women's participation in malaria vector control include social norms and competing priorities as primary caretakers of the household, and lack of decision-making authority in the community. The workshops focus on several sets of strategies to actively promote a greater vector control role for women: enhancing women's knowledge about vector control through community-delivered curriculum, communications and messaging that depict women engaging in vector control, and developing recruitment, mentoring and training programmes for women in the vector control field.

#### Box 4. Strengthening the role of women on IRS teams

One of the primary control measures for malaria transmission is indoor residual spraying (IRS). Historically, vector control programs have employed men and women in roles that follow traditional gender norms (Gunn et al. 2017). Men are more likely to be involved with vector control methods that employ physical labor, such as reducing vector habitat, spraying insecticides, and improving sanitation. In contrast, women are more actively involved in organizing and educating their local communities. However, strictly adhering to binary gender roles for employment in vector control programs could impede their effectiveness.

In the case of IRS, success depends partly on gaining the trust and acceptance of households and communities to enable sprayers to attain good coverage. There is evidence that women and female-headed households in some endemic areas may not welcome IRS because they have poorer access to information about spraying or because they do not have a rapport with male-dominated spraying teams (Global Fund 2019). Efforts to address this gender barrier may include employing women as sprayers and community-level IRS promoters. A recent review of 17 vector control programs (11 of which were targeted to malaria) found that women can be successfully engaged in vector control programs and, when given the opportunity, they can create and sustain businesses that aim to decrease the burden of vector-borne diseases in their communities (Gunn et al. 2017).

Historically, few women have worked in IRS programs, despite the income-generating potential. Increasing women's roles in IRS requires understanding the barriers to women's participation and implementing measures to address them. An example of such an effort was carried out by the U.S. President's Malaria Initiative (PMI) Africa Indoor Residual Spraying (AIRS) Project, which is the largest implementer of IRS globally (Donner et al. 2017). PMI AIRS implemented a series of gender-guided policies, starting in 2015, in 10 sub-Saharan African countries. The policies included adapting physical work environments to ensure privacy for women, ensuring the safety of women in the workplace, guaranteeing safety and job security of women during pregnancy, and encouraging qualified women to apply for supervisory positions. The PMI AIRS Project increased women's employment from 23 percent in 2012 to 29 percent in 2015. Growth among supervisor roles was even stronger, with the percentage of women in supervisory roles increasing from 17 percent in 2012 to 46 percent in 2015. While the data showed that in most countries women sprayed fewer houses per day than men in 2015, the differences were not meaningful, ranging from 0.1 to 1.2 households per day. Gender norms shifted toward more egalitarian views in two of the four countries with survey data.

### 3.4 Women's empowerment: a key lever for malaria burden reduction

What explains the gap between many women's expressed preferences for adopting malaria prevention and treatment technologies and practices and their observed health-seeking behaviors on behalf of themselves and their children? Evidence suggests that women's ability to invest in malaria prevention and treatment is frequently limited by their low socioeconomic standing within their households and communities. Four studies using distinct research methodologies establish a strong case that strengthening women's agency over resources and household-level decision-making authority decreases malaria incidence and prevalence.

A 2007 survey of 846 Indian households measured women's decision-making power along four dimensions (including bed net purchase) and its predictive power with respect to bed net use (Tilak et al. 2007). Regression results indicate **that households were more than 16 times more likely to have used a bed net for a minimum of eight months during the previous year (including the four months of the monsoon season) if women had high levels of decision-making power** (a score of at least 5/8 on the measurement scale). While the research design could not establish causal impact, this correlation is higher than that of education, income, and malaria knowledge, all of which were controlled for in the analysis.

Using cross-country data from 90 malaria endemic countries, Austin et al. (2014) estimate the structural relationships between women's legal access to economic resources and malaria burden. They find **a strong and statistically significant negative association between women's legal rights to own agricultural land and property and their ability to independently enter into financial capital transactions, and malaria prevalence**. Controlling for income level, geography, and public health provision, most of the relationship is driven by the indirect association of gender equitable legal rights with an index of female educational and health status, suggesting that countries where women are less restricted with respect to capital and assets are also those where the gender gaps in education and health are smaller, and the malaria burden is lower.

An impact evaluation of BRAC's large-scale agriculture program in Uganda targeted exclusively to smallholder women farmers found that **providing extension services and supporting a network of female model farmers and community agricultural promoters—which increased household agricultural income by 27.6 percent—led to a 22 percent increase in the number of owned mosquito bed nets per capita and a 29 percent reduction in household-level malaria prevalence**, including a 22.4 percent reduction for children under 5 years old and a 56.8 percent reduction for pregnant women (Pan and Singhal 2019). The researchers conclude that the women's economic empowerment program contributed both to easing the income constraint on bed net acquisition and shifted preferences for the intra-household allocation of health resources toward the most vulnerable members.

The most rigorous evidence of the impact of female empowerment on malaria comes from innovative new research in Malawi (Klein et al. 2019). Using indicators of matrilineal inheritance and matrilineal residency to instrument for an earnings-based measure of intra-household bargaining power, this carefully designed study estimates that **a one standard deviation increase in women's bargaining power decreases the likelihood that a family member contracts malaria by 40 percent** (from a baseline incidence rate of 27 percent down to 16 percent). The primary mechanism for this result appears to be increased investment in household-level sanitation (specifically, private bathrooms) among families where women have a greater say in family decision-making, a result that is consistent with other research (Alam 2018, Yang et al. 2020).

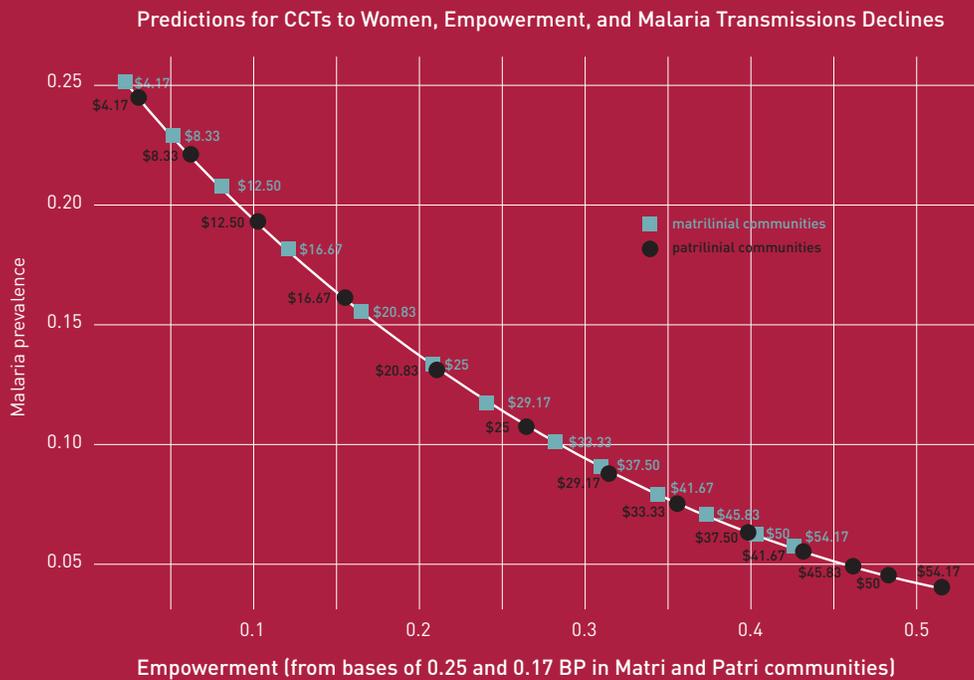
Taken together, these studies offer compelling evidence that malaria programming outcomes could be significantly accelerated if they were accompanied by or integrated into efforts to enhance women's access to and agency over income. One example of this is the use of cash transfers targeted to mothers, which may be made conditional on malaria-related behaviors such as bed net acquisition and use and/or antenatal clinic visits where IPTp is administered (see Box 5). More broadly, evidence of an empirically meaningful causal relationship between women's economic empowerment (WEE) and malaria burden reduction—which should be tested for replication in more study sites—argues for cooperation and coordination between the malaria sector and WEE programming.

## Box 5.

### Could (conditional) cash transfers reduce malaria burden?

Evidence of a positive causal impact of women's empowerment on reduced malaria burden suggests that integrating women's empowerment programs into malaria control efforts could yield substantial benefits. One example of such programs is cash transfers targeted to female household heads, oftentimes conditional on household educational and/or health investments. Gender-targeted cash transfer programs have been shown to have positive effects on both women's bargaining power (cf. Tommasi 2019) and health care access and health outcomes (cf. Evans et al. 2019). Cash transfers have become an element of HIV/AIDS prevention policy in several countries (Kohler and Thornton 2012, Huang et al. 2017), and have recently been identified as a core element of the World Health Organization's End TB Strategy, with an initial pilot program in Peru (Boccia et al. 2016). In their study of gender equality and malaria in Malawi, Klein et al. (2019) estimate the effect of a cash transfer

targeted to female decision-makers (see graph below). Using the parameters from their intra-household bargaining model, a transfer of roughly 30 USD per month to mothers would equate women's and men's predicted earnings. This balance in the intra-household distribution of income would translate to a 60 percent reduction in malaria transmission. Conditioning the transfer on malaria preventive behaviors, such as participating in an IRS campaign, acquiring a bed net, and/or receiving IPTp during antenatal visits, could amplify the effects even further. Any such intervention would need to be mindful of the ethical considerations that arise with conditionality, including the distribution of risks and burdens and indirect impacts and externalities (Krubiner and Merritt 2017). Of particular concern in a gender context is the unintended consequence of increasing women's time poverty (Cookson 2018).



Counterfactual analyses of cash transfers to female decision makers. Larger transfers generate larger increases in women's bargaining power, which translate into larger reductions in malaria prevalence. The blue squares are counterfactual analysis results for the matrilineal communities, defined as communities where more than 50% of families adhere to matrilineal and matrilocal tradition. The black circles report the results for the patrilineal communities.

### 3.5 Gender and malaria case management and surveillance

Just as gender mediates malaria preventive behaviors, there are important gender-related barriers to effective disease treatment and gender gaps in disease surveillance. Understanding the nature of these barriers and gaps can strengthen approaches to malaria case management in endemic areas. Key findings from the research are:

- Treatment-seeking for individuals exhibiting malarial symptoms is often a multi-step process involving complex intra-household negotiation.
- Women's financial autonomy and decision-making authority are positively associated with treatment-seeking for febrile children.
- Community-based case management can significantly reduce the costs associated with malaria treatment-seeking and address gender gaps in mobility, decision-making power, and time poverty.
- Malaria education programs that address symptom recognition and treatment protocols need to involve all relevant decision-makers—including husbands/fathers and elders—to help increase women's agency over the treatment-seeking process.
- Effective case management for pregnant women requires more attention to drug safety concerns on the part of women, their partners, and other family members, and quality-improvement interventions that reach all providers administering antimalarial drugs to increase adherence to WHO protocol.
- Malaria surveillance systems need to systematically collect and report age- and sex-disaggregated data.

#### **Treatment-seeking for individuals exhibiting malarial symptoms is often a multi-step process involving complex intra-household negotiation.**

A common pattern in many endemic areas is for mothers to bear primary responsibility for recognizing malarial symptoms, especially in children, and for providing home-based care while “waiting and seeing” before making a decision about whether to seek medical treatment. In many social contexts, mothers are expected to consult with and

request permission from husbands and/or elder family members (such as grandmothers) in order to bring a sick child to a clinic or hospital (Tolhurst and Nyonator 2006). Moreover, if women do not have an independently controlled source of income, they must request cash from their spouse to pay for transportation, food, and any medical costs associated with malaria treatment. The gender gap in agency over treatment-seeking behavior and household resources can delay treatment-seeking, particularly when there are considerable financial costs associated with attending a formal health facility.

#### **Community-based case management can significantly reduce the costs associated with malaria treatment-seeking, ease the burden on women to seek permission and resources from spouses for formal care, and address other gender barriers, such as time poverty and limited mobility.**

Health education messages targeting the importance of prompt treatment are likely to fail while caregivers are forced to engage in treatment-seeking strategies that attempt to prevent potentially catastrophic financial burdens on the household. Interventions to bring care closer to individuals' homes are essential to improve access to appropriate treatment. If anti-malarial treatments are not available from community health workers based at village health posts, women are often in the position of having to bargain with spouses and elders to convince them that a child's symptoms are severe enough to warrant the transportation and other costs associated with distant formal care (Ewing et al. 2016). Additionally, ability to travel is further limited by time poverty gaps of caregivers, given other responsibilities and people they have to care for.

Relevant for health systems strengthening work, as community-based case management is expanded, attention is needed to ensure there are no unintended negative consequences for community health worker (CHWs). In country contexts where CHWs, particularly volunteer CHWs, are primarily women, it is important to ensure these responsibilities do not further exacerbate their already-existing time poverty. Though this review found no studies specific to malaria of this practice, additional research should be done to understand gender dynamics of CHW positions in order to develop mitigation strategies to appropriately support women in these positions.

## Box 6.

### **Women's financial autonomy and decision-making authority are positively associated with treatment-seeking for febrile children in Malawi**

Research in the Chikwawa district of Malawi—where a community-based artemisinin-based combination therapy (ACT) trial for children below 5 years of age across 50 villages was under implementation—generates important qualitative evidence on the role of women's access to and control over resources and decision-making autonomy in seeking access to medical care when children present with malarial symptoms (Ewing et al. 2016).

One notable feature of the district is differences in traditions regarding descent (patrilineal versus matrilineal) and marital residence (matrilocal versus patrilocal) between different ethnic groups. Although males take the role of family head in both family structures, in matrilocal and matrilineal communities women are surrounded by their natal extended families

rather than those of their husbands and, therefore, may be able to draw on their support.

There were clear differences in the level of autonomy and authority that women possessed with regard to making treatment-seeking decisions in villages where patrilineal and patrilocal ethnic groups dominated versus villages where matrilineal and matrilocal ethnic groups were in a majority. Mothers in patrilineal/patrilocal villages not only had greater need for financial assistance for transport to health clinics, but also experienced limited authority to make decisions about the appropriate course of action. As a result, women in matrilineal/matrilocal communities were more likely to bring their febrile children to a formal health facility, while mothers in patrilineal/patrilocal communities were less likely to seek treatment.

### **Malaria education programs that address symptom recognition and treatment protocols need to involve all relevant decision-makers—including husbands/fathers and elders—to help increase women's agency over the treatment-seeking process.**

Involving the wider community, including men and grandmothers, in community-based education programs, would ensure that all those involved in the treatment-seeking process are included. Such interventions should be used to challenge, rather than reinforce, the underlying gender and generational inequalities that shape the treatment-seeking process, through working to promote the position of junior women and improve their power and autonomy in the treatment-seeking processes. Evidence-based guidelines for integrating gender into social and behavior change communication can be effectively adapted and utilized in the context of malaria education (HC3 2016).

### **Effective case management for pregnant women requires more attention to drug safety concerns on the part of women, their partners, and other family members, and quality improvement interventions that reach all providers administering antimalarial drugs to increase adherence to WHO protocol.**

In addition to gender barriers to treatment-seeking for malarial children, there are significant demand-and-supply-side challenges to case management for women themselves, which are particularly salient during pregnancy. A systematic review of women's access to and health care provider adherence to World Health Organization case management policy for malaria in pregnant women<sup>3</sup> found that barriers to access included poor knowledge of drug safety, prohibitive costs, and self-treatment practices, used by 5 percent to 40 percent of women (Hill et al. 2014). Health care provider reliance on clinical diagnosis and poor adherence to treatment policy, especially in the first versus other trimesters, was consistently reported. The meta-analysis of 37 studies concluded that substandard case management practices of malaria in pregnancy is widespread across endemic regions, and that both demand-and-supply-side interventions should be pursued to improve adherence to WHO policy. Specifically, pregnant women (and their spouses and other family members, who may be in decision-making roles) need access to information on which anti-malarial drugs are safe to use at different stages of pregnancy, and investments are required in quality improvement interventions that reach all providers administering antimalarial drugs in the community (ibid.).

3. WHO recommends prompt diagnosis and quinine plus clindamycin for treatment of uncomplicated malaria in the first trimester and artemisinin-based combination therapies in subsequent trimesters.

## Malaria surveillance systems need to systematically collect and report age- and sex-disaggregated data.

A significant barrier to gender-intentional malaria programming is the lack of availability and use of reliable sex-disaggregated data that is consistent across countries. Sex-disaggregated data on malaria prevalence and treatment-seeking for children under five are available in Malaria Indicator Surveys and Demographic and Health Surveys for some but not all endemic countries (Appendix B, Tables 1 and 2). In Kenya, routine

data from health facilities are initially recorded in health registers according to sex, but are subsequently summarized and entered into the district health information system (DHIS) as aggregated population data (Malaria Control Unit 2015). This eliminates the possibility for sex-disaggregated analysis and to identify any potential gender gaps, which in turn impacts the ability of program managers, decision-makers, and policymakers to make strategic decisions to implement activities that can target gender barriers and gaps. One example of using sex-disaggregation of data to contribute to epidemiology of malaria is linking gender-specific human activity patterns to malaria vector biting risk (see Box 7).

### Box 7. Gender differences in malaria exposure

Evidence suggests that given equal exposure, adult men and women are equally biologically vulnerable to malaria infection, except for pregnant women and adolescent girls, who are at greater risk of severe malaria in most endemic areas. However, women and men experience differential exposure to malaria due to gender norms and behavioral patterns. Men often face the risk of exposure through their occupations, such as fishing, mining, forestry, or agriculture, when these activities are conducted during peak biting times. Women face many of these same risks given their extensive roles in productive activities, in addition to their exposure through the conduct of reproductive and household responsibilities, including preparing evening meals, and gathering water and firewood in the early-morning hours (UNDP 2015). Two studies in East Africa offer detailed insight into gender differences in exposure to parasite-transmitting *Anopheles* mosquitoes.

In Uganda, where the most common malaria vectors are *Anopheles gambiae* s.l. and *Anopheles funestus*, both of which feed and rest indoors, peak biting times are in the late evening and early morning. Thus, activities where humans are indoors but not protected by an ITN in the late evenings and early mornings—including breastfeeding, which may be conducted outside the protection of a net—place them at the greatest risk

of infection. Women are also exposed during outdoor activities such as late-evening meal preparation and food marketing, and early-morning water collection (USAID 2017). Men's outdoor exposure risks were identified as productive labor activities, such as agriculture, fishing, and brick-making (where there is a high prevalence of standing water, which creates an ideal mosquito breeding ground) and late-night socializing (ibid.).

In southeastern Tanzania, detailed sex- and age-disaggregated recording of human activities data was triangulated with quantitative data on *Anopheles* mosquito bites occurring indoors and outdoors in communities where ITNs are already used but a lower level of malaria transmission persists (Finda et al. 2019). Higher proportions of people stayed outdoors than indoors in early-evening and early-morning hours, resulting in higher exposures outdoors than indoors during these times. Some of the popular activities that kept people outdoors included cooking, eating, relaxing, and playing. There was a clear gender difference in the popular activities observed indoors and outdoors. Activities like cooking, cleaning, eating, and sleeping under bed net were more popular among female household members while relaxing indoors, bathing indoors, and studying outdoors were more popular among the male household members (ibid.).



### 3.6 Opportunities for gender integration and evidence gaps in malaria prevention, treatment, and surveillance

There are several areas where existing evidence is strong enough to inform gender intentional malaria prevention, treatment, and surveillance programming. These include:

- Strengthening collaboration with maternal and child health systems to address gender barriers to antenatal clinic utilization that limit their efficacy as delivery channels for LLINs and IPTp. Evidence-based interventions include IPTp protocol training and supplies for ANC providers and community health workers, using digital communications and community health workers to deliver reminders, and women’s empowerment programs to reduce cost and decision-making barriers to early ANC visits and medication compliance.
- Gender-inclusive communications and messaging for malaria prevention and treatment, including bednet use, vector control, symptom recognition, and treatment-seeking protocols.
- Programming to increase the equitable participation of women in vector control at the household, community, and professional levels. Training and employing women as IRS sprayers appears to be a particularly promising, and potentially gender transformative, intervention.
- Require sex disaggregation of all malaria surveillance data collection and reporting.

Significant evidence gaps remain with respect to the relationship between gender equality and malaria prevention and treatment. Opportunities to strengthen the evidence base gender and malaria include:

- Examine systematic over-reporting of bed net coverage of young children and pregnant women (for example, by comparing survey with random spot-check/observational data) to have a more precise measure of gender gaps in bed net use.
- Measure the impact of community-based case management on the reduction of gender barriers and gaps to receiving malaria prevention and treatment.
- Validate/replicate the findings from Uganda and Malawi on the impact of women’s economic empowerment on malaria burden reduction by exploiting secondary datasets such as the DHS and by integrating measurement of malaria outcomes and candidate causal mechanisms into WEE evaluations. Pilot women-targeted cash transfer programs with malaria-related conditionality.
- Measure the impact of gender composition of ANC, CHW, IRS, and other health worker teams on community acceptance and outcomes of malaria interventions.

## 4. GENDER ISSUES IN MALARIA RESEARCH AND DEVELOPMENT

A review of the literature related to gender and biomedical research and product development suggests three key findings of particular relevance to malaria in this area:

1. The international malaria research agenda is not sufficiently integrating sex and gender analysis of differences in exposure risks, disease susceptibilities, prevention and treatment behaviors, and preferences in product design.
2. Gender barriers to career entry and development lead to the underrepresentation of women scientists in malariology, which in turn impacts the research agenda.
3. Clinical trial design and protocol face gender-specific socioeconomic and cultural barriers that limit the recruitment and retention of women.

### 4.1 Integrating sex and gender analysis into the malaria research agenda

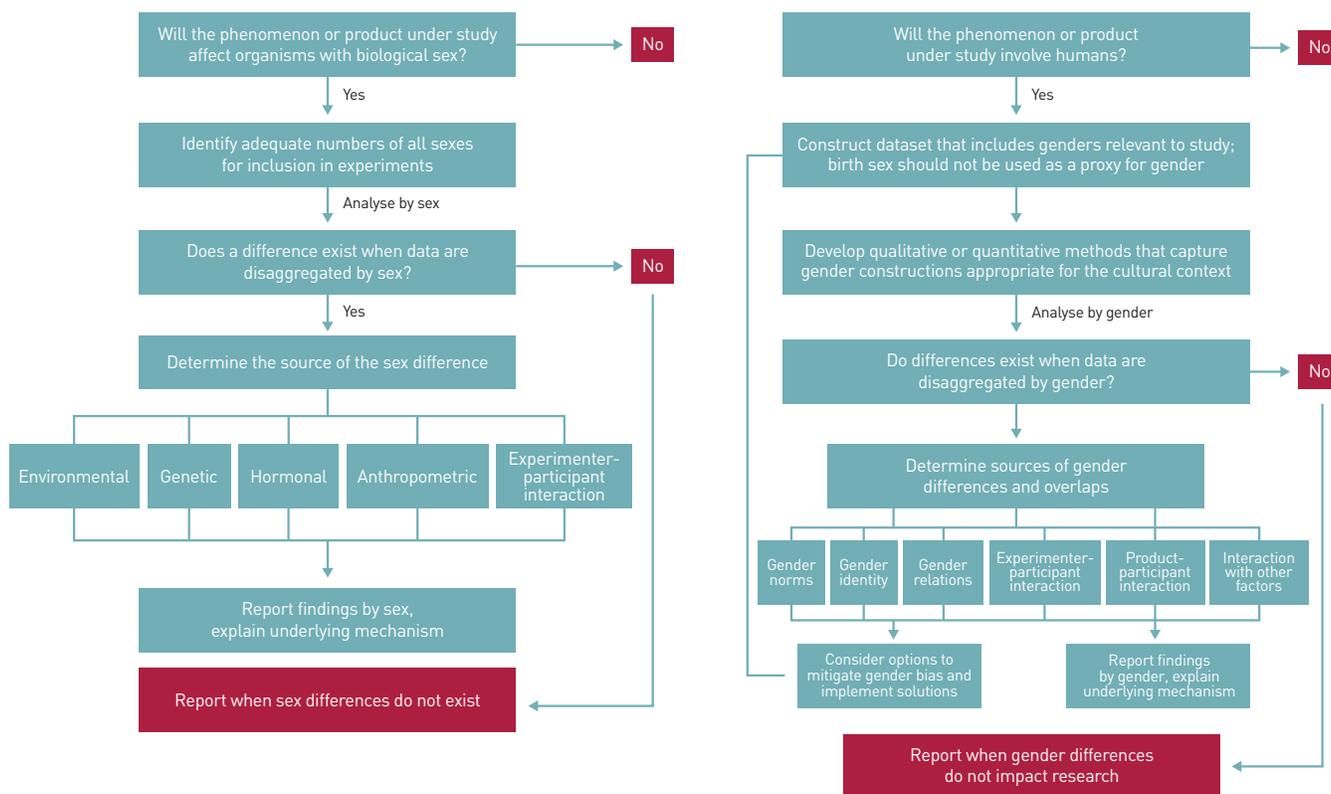
The international malaria research agenda is not sufficiently integrating sex and gender analysis of differences in exposure risks, disease susceptibilities, prevention and treatment behaviors, and preferences in product design. Physiological (sex) differences between women and men and the socially constructed characteristics of gender pervade the epidemiology of and responses to infectious diseases. Given this, biomedical research that integrates a gender lens can provide critical information on how risk is differentially distributed, how gender-specific pathways shape transmission, how access to care and treatment is limited by gender-based constraints, how the disease presents and impacts biologically, and how treatment and its effects on the body are differentially experienced (Sommerfeld et al. 2017). Gender-responsive interventions are critical for the prevention and treatment of infectious diseases of poverty, including malaria.



Photo: ©Bill & Melinda Gates Foundation/Frederic Courbet

A recent high-profile article in *Nature* argues that incorporating sex and/or gender analysis into scientific research can improve reproducibility and experimental efficiency, help to reduce bias, enable social equality in scientific outcomes, and foster opportunities for discovery and innovation (Tannenbaum et al. 2019). The authors present evidence from multiple scientific fields—including human drug development—that analyzing experimental results by sex and/or gender is critical for improving accuracy and avoiding misinterpretation of data, and that accounting for sex and gender enhances the likelihood of detecting meaningful effects, elucidating unexplained variability, and potentially reducing the overall number of experiments required to determine trends or make ground-breaking discoveries. The article provides practical decision trees for sex and gender analysis and reporting in science (reproduced below as Figure 3), and emphasizes that it is important to integrate such analysis, where relevant, into the design of research from the very beginning, because much of science research is path-dependent and thus becomes difficult to change once it has been designed. From a donor perspective, many international scientific granting agencies now require applicants to explain how sex and gender analysis will be incorporated into all phases of basic and applied research, where applicable.

**Figure 3: Sex and gender analysis and reporting in science and engineering**



Sex analysis and reporting in science and engineering. This decision tree represents a cognitive process for analysing sex. A 'no' indicates no further analysis is necessary. A 'yes' suggests the next step that should be considered. Source: Tannenbaum et al. (2019)

Beyond the general principle that malaria research and product development should be designed to detect sex (biological) and gender (social) differences, there are neglected areas of R&D that could be beneficial to particularly marginalized populations. With respect to malaria chemoprevention and treatment, of particular urgency is the need to evaluate antimalarials that can be safely administered to HIV-infected pregnant women on antiretroviral treatment and cotrimoxazole prophylaxis (González et al. 2016). Approximately one million pregnancies each year are complicated by coinfection with malaria and HIV in sub-Saharan Africa. The interaction between the two infections is particularly deleterious in pregnancy; HIV increases the severity of malaria infection and disease, and malaria infection increases HIV viral load, which in some studies has been shown to increase the risk of mother-to-child transmission of HIV (ibid.). The current WHO recommendation for control of malaria in pregnant women living in stable transmission areas relies on both the administration of Intermittent Preventive Treatment with sulfadoxine-pyrimethamine (IPTp-SP) beginning as early as possible in the second trimester and at every scheduled antenatal care visit thereafter, along with the use of insecticide-treated bed nets. However, in HIV-infected women, IPTp-SP is contraindicated to avoid the potentially

serious drug interactions with concomitant cotrimoxazole prophylaxis (CTXp), which is currently recommended in all HIV-infected pregnant women to prevent opportunistic infections.

In this context, the lack of specifically designed studies to evaluate additional malaria prevention strategies in this special population means that the most vulnerable women are also the least protected. In general, research on treatment protocols and drug choice for pregnant women often lags behind other advances in malarial science due to the ethical issues inherent in enrolling pregnant women in clinical trials. Studies are needed in HIV-infected pregnant women in endemic areas in SSA to evaluate improved malaria prevention tools, including alternative antimalarial drugs. These studies should include (or be preceded by) careful assessment of potential pharmacological and safety interactions between antimalarial and antiretroviral drugs (ibid.). Examples from how adjacent fields have approached developing sex-specific drugs, and the positive results these approaches had, can be found in Box 8. Additionally, there is a need to understand other gender barriers, such as stigma, that may disincentivize women with malaria and HIV co-infection from seeking treatment, even if available.

## Box 8.

### Sex analysis in human drug development: Examples from antidepressants, antidiuretics, and cancer immunotherapy

- In the areas of pain and depression, the discovery of sex differences in molecular pathways has signaled new directions for targeted therapies. Inhibitors of microglia—specialized immune cells located exclusively in the spinal cord and the brain—reduce pain sensing in male—but not female—mice, underscoring the potential importance of sex-dependent molecular pain pathways. Mouse models of depression also show sexually divergent networks in the brain with distinct patterns of stress-induced gene regulation in males and females. These findings have now been reproduced in humans and may provide insights into why males and females with major depressive disorder respond differently to treatment with antidepressants.
- Although sex-specific dosages are rare, a few already exist. Such is the case for the drug desmopressin that activates vasopressin receptors in the kidney to regulate water homeostasis. Because the gene for the arginine vasopressin receptor is found on the X chromosome, women are more sensitive to the antidiuretic effects of vasopressin than men. As a result, older women who take desmopressin are more likely to experience a reduced sodium concentration in the blood than men, which corresponds to a higher incidence of side effects in women.
- Cancer immunotherapy is benefitting from a deeper understanding of previously recognized genetic and hormone-mediated sex differences in immunity. Patients with melanoma or lung cancer who are treated with checkpoint inhibitors respond differently based on their sex, with a higher proportion of male than female patients achieving successful remission. Natural killer cells are sensitive to estrogen and testosterone, which may explain these observed sex differences. Understanding the underlying mechanisms will enable researchers to fine-tune future therapies.

Source: Tannenbaum et al. (2019)

## 4.2 Women's professional participation in malaria research

Gender barriers to career development lead to the underrepresentation of women scientists in malariology, which in turn impacts the research agenda. Gender norms significantly shape career paths and opportunities in biomedical science, even in high-income settings. Societal expectations of gender roles influence school attendance and completion; opportunities to proceed to post-secondary education; choices in areas of specialty; the application, award, field of study, and completion of doctoral degrees; and subsequent careers (Sommerfeld et al. 2017). In high- as well as lower-income settings, regardless of country productivity, women scientists face significant barriers to equal participation in the field. Data show that women publish less, are less often first or last authors on papers, are less often cited when they are in dominant author positions, their publication portfolios are more domestic, they continue to dominate in specific feminized fields, and they collaborate less nationally and internationally, so have fewer citations that flow from international collaborations (Larivière et al. 2013). Additional research into the barriers that drive these unequal outcomes, with a particular focus on the malaria sector, can guide approaches to strengthen women's professional opportunities.

Targeting the gender gap in women's professional participation in the malaria field requires attention to gender barriers to participation, as well as addressing unequal gender power dynamics on research teams that limit women's equal contributions to research, publications, and conference presentations. Targeting these dynamics is critical to ensure that women not only have access to professional positions in the sector but that gender gaps in agency within these teams are reduced. Box 9 highlights an example of how this has been approached in the agriculture development sector.

There are several potential benefits to gender diversity as it relates to scientific discovery, and addressing gender diversity on research teams is critical to accelerating gender equality outcomes. Improving gender balance is reported to increase the collective intelligence of a group, and mixed-gender teams have been found to be more effective than teams of all men or all women. Importantly for the scientific enterprise, evidence suggests that diverse groups outperform homogeneous groups of top performers in problem-solving activities, and groups that contain women are more adept at problem-solving. Because biomedical research requires multiple strategies, rigorous experimental designs and protocols, and critical data interpretation, multiple points of view facilitate a more comprehensive approach and more thorough analysis of the scientific premise and research findings. Women have been shown to value and enjoy collaboration and a less hierarchical organizational structure, which is also more conducive to the sharing of ideas and diversity of research focus (Plank-Bazinet et al. 2017).

Women's participation in medical science is also positively associated with attention to gender-related and sex-related factors in disease-specific research. Using a sample of more than 1.5 million medical research papers, Nielsen et al. (2017) found a robust positive correlation between women's authorship and the likelihood of a study including gender and sex analysis. These findings corroborate discussions of how women's participation in medical science links to research outcomes, and show the mutual benefits of promoting both the scientific advancement of women and the integration of gender and sex analysis into medical research. It is not known the extent to which this research controlled for women's professional skills in gender integration, or if this impact was achieved because of women's lived experiences in the medical science field.

In the specific case of malaria research and development, some female malariologists have expressed concern that women's participation in the field has not increased in tandem with greater international focus and funding of the past 15 years, and women are underrepresented at international conferences where the most current research is presented (Women in Malaria Research 2019). In 2018, the "Women In Malaria Research" web initiative was launched and currently hosts a list of more than 350 women who work in malaria research across the globe. The site also provides networking and professional resources with the intention of encouraging mentorship and networking among female malariologists at different stages of their careers.

### Box 9.

#### **Strengthening opportunities for women in science: An example from the agricultural development sector**

African Women in Agricultural Research and Development (AWARD) invests in increasing the visibility of African women scientists and leaders, generating and curating the evidence base on gender responsiveness in agricultural research, and strengthening the awareness of gender considerations into agriculture policies, programs, and accountability mechanisms (AWARD, 2019). AWARD provides tailored fellowship and mentorship opportunities to equip women scientists across sub-Saharan Africa with the science and leadership skills needed to deliver innovative, sustainable, and gender-responsive agricultural research. AWARD currently has 465 fellows and 397

unique mentors from 16 sub-Saharan African countries. AWARD provides capacity-building opportunities to fellows, such as: courses to equip participants to write and edit scientific papers for peer review and for effective fundraising proposal writing; courses on gender issues in agricultural R&D; support to compete for advanced science training placements at internationally recognized research institutions; and opportunities to attend science conferences to present papers and posters. The model created by AWARD may provide a replicable model for other sectors to develop programs that strengthen the capacity of women in science.

## **4.3 Gender considerations for clinical trials**

Clinical trial design and protocol face gender-specific socioeconomic and cultural barriers that limit the recruitment and retention of women. In 2017, the Bill & Melinda Gates Foundation developed a series of case studies, position statements, and grantee guidelines as part of an Internal Gender Challenge on Gender Considerations in Clinical Trials (BMGF 2017a-c). Importantly, this initiative went beyond an examination of sex representation to explore the gender-specific socioeconomic and cultural barriers that might limit women's ability to participate in clinical trials. The main points are summarized here and illustrated in Figure 4:

- Evidence supports the notion that biomedical products can affect men and women differently, with potentially serious health consequences. Trials are not always designed to detect differences, and sex differences are not routinely evaluated or reported. As the leading funder of biomedical research for global public health products, the foundation should join the National Institutes of Health in requiring that every clinical trial it supports includes

appropriate sex representation, sex-disaggregated analysis, and public reporting of findings. Grantee compliance should also be monitored.

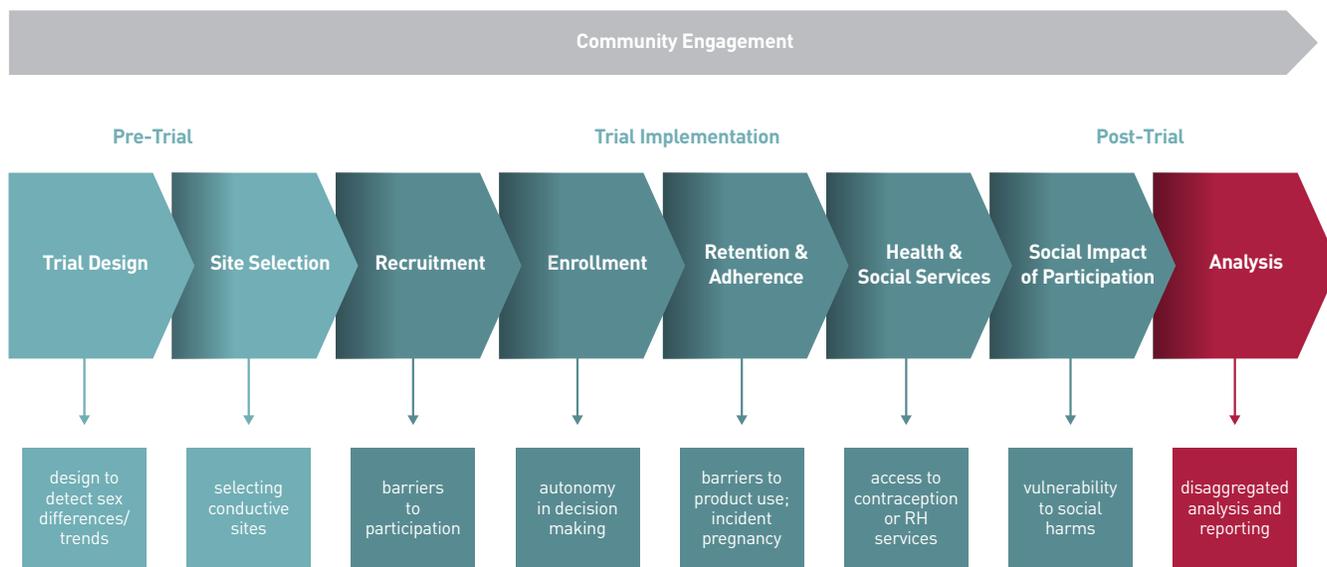
- Gender-specific barriers to recruitment, retention, and adherence to experimental products—including time and mobility restrictions and lack of male partner support—can make clinical trial processes less efficient and affect trial outcomes.

Gender is a key component of good ethical and public health and development practice. Attention to gender can help prevent and address social harms related to trial participation (e.g., loss of privacy, stigmatization, interferences with employment, or coercion) and ensure that participation is fully informed and voluntary and does not exacerbate underlying gender inequalities, and that men and women accrue equitable risks and benefits from participation. Examples of good practice include attention to women's limited decision-making autonomy with respect to informed consent, and assuring gender-equitable participation in community engagement activities.

There is a particularly compelling argument for ending the practice of the default exclusion of pregnant women from clinical trials for new antimalarial products, including malaria vaccine trials. Exclusion of pregnant women is still usual practice in trials that do not address obstetric conditions, largely due to concern about birth defects after specific drug exposure in utero and the view that high fetal risk without important medical benefits for the mother is not acceptable (Gomes et al. 2017). However, studies with pregnant women are needed because pregnancy alters the immune system, metabolism, cardiac output, and a variety of physiological mechanisms, so we cannot assume that drugs and vaccines given in pregnancy will work the same or require the same dosing as in non-pregnant adults (Krubiner 2018). Moreover, the lack of rigorous studies in

pregnant women can lead to limited and delayed adoption of safe and effective interventions by policymakers, providers, and women themselves. The absence of data on general medical conditions in pregnancy means that pregnant women continue to be treated for nonobstetric conditions with drugs which did not undergo rigorous scientific testing in pregnancy, and for which safe and effective therapeutic doses in pregnancy and maternal and fetal risks are largely unknown (Gomes et al. 2017). Detailed ethical guidance on the inclusion of pregnant women in vaccine development, which would be relevant for malaria vaccine research, have been developed by the Pregnancy Research Ethics for Vaccines, Epidemics, and New Technologies (PREVENT) Working Group (Krubiner et al. 2019).

**Figure 4: Sex, Gender and Clinical Trial Processes**



Source: BMGF (2017c)

## 4.4 Opportunities for gender integration and evidence gaps in malaria research and development

There are several areas where existing evidence is strong enough to inform gender intentional malaria research and development programming. These include:

- Investment in the development of antimalarial medications for HIV-positive pregnant women.
- Expanding opportunities for women's equitable professional participation and career advancement in malaria R&D.
- Implementing best practices for the gender integration of malaria clinical trials, including deployment of scientific and ethical criteria for non-exclusion of pregnant women from malaria vaccine trials as per PREVENT guidelines.

There is still a significant evidence gap on the role of gender in malaria research and development. Opportunities to close this gap include:

- Generating new evidence on differences in needs and preferences based on people's sex and gender in new malaria product development, including diagnostics, drugs, vaccines, and insecticides.
- Strengthening evidence on potential safe and effective malaria treatment for HIV-infected women, and on the gender barriers, such as stigma, that may inhibit women's access to treatment, even if available.
- Conducting research into the barriers that drive unequal career development outcomes in the malaria sector.
- Developing a database on gender representation in malaria research teams so that the size of the gender gap can be measured, and future progress in reducing the gender gap can be tracked.
- Exploratory research to identify gender barriers to recruitment and retention in malaria clinical trials, including vaccine trials.

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## 5. GENDER INTEGRATION IN MALARIA POLICY AND ADVOCACY

As Sections 3 and 4 of this evidence review show, there is growing evidence that there is an opportunity both to accelerate malaria control and elimination outcomes and to advance gender equality through gender integration in malaria control and elimination approaches. Advocacy efforts are needed to elevate this evidence to global leaders in the fight against malaria, ensure there is sustained political commitment for national policies that integrate gender considerations, and secure increased funding to ensure this work can be sustained at scale.

The following section identifies current gaps in gender integration in malaria policy and advocacy efforts, and outlines opportunities to strengthen gender integration into malaria policy and advocacy at the global, regional, and national level. These gaps were identified through a review of current advocacy and policy documents for malaria control and elimination, identified through targeted keyword searches and a review of online advocacy resource libraries. Additionally, this section highlights evidence gaps that can be targeted to track future progress in these efforts. The key opportunities identified are:

1. There is an opportunity to strengthen global technical guidance on gender integration into national malaria planning, policy, and programming, and to develop accompanying toolkits to guide uptake of these recommendations.
2. Targeted advocacy and communication efforts can raise the profile of the links between gender and malaria in order to strengthen political will to integrate gender considerations into malaria policies and programs.

### 5.1 Opportunities to strengthen global technical guidance on gender integration

There is a gap in global technical guidance on gender integration into national malaria elimination policies and programs. The World Health Organization's Global Technical Strategy for Malaria 2016-2030, which serves as the global roadmap for country-level malaria control and elimination policy and program design, places universal health coverage at the core of its guidance for malaria prevention and treatment. However, universal coverage in itself does not address structural barriers rooted in gender inequality that hinder people from benefiting from malaria prevention and

treatment equally. The current Global Technical Strategy (GTS) and the accompanying framework<sup>4</sup> to guide national malaria program managers to implement GTS-aligned actions do not address gender inequality within any of the strategy's three strategic pillars,<sup>5</sup> nor in supporting technical guidance (WHO, 2015). The global gap in consistent and reliable sex-disaggregated data on malaria morbidity and mortality is perpetuated through the strategy's lack of recommendation to collect and report sex-disaggregated data, with the exception of indicators related to women's receipt of IPTp during pregnancy.<sup>6</sup> Globally, malaria advocacy priorities are often developed in alignment with GTS priorities (for example Roll Back Malaria (RBM) Partnership's Action and Investment to Defeat Malaria 2016–2030 strategy), which results in malaria elimination political agendas, regional approaches, and financing goals that similarly lack the inclusion of gender considerations (RBM, 2018). While recommendations for gender integration in technical approaches and policy documents are emerging from some global health organizations like the Global Fund for AIDS, Tuberculosis, and Malaria (see Box 10), guidance is needed from leadership at the highest levels to ensure uptake across regional malaria elimination networks and national programs.

Few National Malaria Strategic Plans and other country-level health policies address gender integration into malaria control and elimination programming. The exact number of NMSPs that currently integrate gender considerations is unknown. A National Malaria Control Program's (NMCP) National Malaria Strategic Plan (NMSP) sets country-level priorities in malaria control and elimination, and ensures coordination across the numerous stakeholders and partners at various levels of the health system that carry out a country's malaria control and elimination efforts. NMSPs therefore present a critical opportunity to ensure that country-specific gender barriers and gaps in malaria elimination programming are identified, and that coordinated implementation strategies are in place to address these barriers and gaps. This includes strategies that promote collaboration across sectors and relevant ministries to address linkages between malaria elimination outcomes and maternal, newborn, and child health (MNCH) outcomes, as well as with women's economic development outcomes; and strategies that address potential unintended consequences, such as gender-based violence.

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4. The framework is intended primarily for national malaria program managers. It will also inform the governments of endemic countries, partners, donor agencies, and field workers about malaria elimination and how it is adapted and adopted in settings with different malaria epidemiology and health systems (WHO, A framework for malaria elimination, 2017).

5. Pillar 1. Ensure Universal Access to Malaria Prevention, Diagnosis, and Treatment; Pillar 2. Accelerate Efforts Towards Elimination And Attainment Of Malaria-Free Status; Pillar 3. Transform Malaria Surveillance Into A Core Intervention.

6. Indicator recommending sex-disaggregated data: "Proportion of pregnant women who received at least three or more doses of intermittent preventive treatment of malaria while attending antenatal care during their previous pregnancy (sub-Saharan Africa only)."

The number of countries that integrate gender considerations into their NMSP is an indicator of national country programs having appropriate technical guidance for gender integration into program design, and of political will to prioritize these recommendations. A key word search of publically available NMSPs revealed that a few countries are beginning to articulate a human rights-based approach to health delivery with a specific focus on gender equality in health interventions. Countries that articulate these goals include Tanzania, Uganda, and Kenya [see Box 11]. These NMSPs emphasize the need for gender sensitive and responsive health care systems, and national data collection methods that disaggregated health data by age and sex in order to allow for gender analysis. To date, no data is being systematically collected and reported to track gender integration into national policies, and therefore a full list of NMSPs that reflect gender considerations is not available. The current size of the gap of gender-intentional policies is unknown, and progress in reducing this gap is not being measured.

Very few global reports or advocacy and policy publications make the case for gender integration in malaria control and elimination programming. While the body of literature on links between gender and malaria is growing, there are limited global reports, advocacy and policy briefs, or investment cases that provide updates on the state of gender integration into malaria control and elimination approaches, or that make the case for investment in these approaches. WHO's World Malaria Report, the leading annual report and data repository for trends in malaria control and elimination at the global, regional, and country level, currently does not report on any gender data or measure the current state of the gap in sex-disaggregated data from country programs. Additionally, there is a gap in advocacy and policy briefs, and investment cases, from leading advocacy organizations that make the case for gender integration into malaria elimination approaches. For example, the Malaria Consortium, which hosts an online database of malaria advocacy briefs and advocacy reports, does not have any briefs or reports on the importance of addressing gender inequality as a part of malaria control and elimination approaches (Consortium, 2019). The Roll Back Malaria Partnerships Malaria Advocacy Working Group (MAWG) has not included key messages on gender integration in any of its key messaging briefs.



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There is an opportunity to strengthen global technical guidance on gender integration into national malaria planning, policy and programming, and to develop accompanying toolkits to guide uptake of these recommendations. Updated global guidance for gender integration can support NMCPs to develop NMSPs that take into account country-specific gender considerations and reduce the current gap in these policies.

Until the development of a new GTS, the case can be made to the WHO to leverage existing mechanisms to release updated global guidance on gender integration, such as the WHO's Malaria Policy Advisory Committee (MPAC),<sup>7</sup> to develop recommendations for gender integration into technical malaria approaches. To ensure strong consensus on these recommendations, advocates can call for the creation of a new Evidence Review Group (ERG)<sup>8</sup> on gender and malaria to develop recommended guidance for adoption and dissemination by the MPAC. Additionally, the WHO is in the process of establishing a new standing Guideline Development Group (GDG) to support the development of WHO recommendations for malaria and ensure consistency in how evidence is used to inform policy across all malaria interventions and strategies. There is an opportunity to advocate for gender integration in malaria to be given appropriate attention within each of these groups' agendas.

7. The Malaria Policy Advisory Committee (MPAC) provides independent, strategic advice to WHO on all policy areas relating to malaria control and elimination. MPAC brings together some of the world's foremost experts on malaria, and convenes twice a year in Geneva. The Committee is supported by the GMP Guidelines Development Group and ad hoc Evidence Review Groups that support the policymaking process.
8. Evidence review groups (ERGs) are expert groups convened for a limited time period to review a specific area of work, and to provide evidence-based information and options for recommendations.

## Box 10.

### The Global Fund's GFATM's Matchbox Toolkit example

In 2008, the Global Fund adopted a Gender Equality Strategy to affirm their commitment to gender equality and to encourage a positive bias in funding programs and activities that address gender inequalities and strengthen the responses to HIV, malaria, and TB for women and girls (GFATM, 2014). Under this new strategy, Global Fund Funding Requests all “must include, as appropriate, interventions that respond to key and vulnerable populations, human rights and gender-related barriers and vulnerabilities in access to services” (GFATM, Technical Brief, 2019). To ensure Country Coordinating Mechanisms have the capacity to develop plans that address gender barriers, the Global Fund developed a technical brief on gender and malaria, along with the Matchbox Toolkit to provide countries with guidance on how to identify risk factors and barriers impeding equitable and integrated people-centered malaria programs (GFATM, Malaria Matchbox Tool, 2019). The toolkit aims to:

1. Support national programs to identify areas and/or populations with barriers to malaria and primary health care services through a qualitative analytical framework to complement existing quantitative analyses (such as Malaria Program Reviews, HBHI assessments, etc.);
2. Assess equity through the prompt evaluation of programmatic approaches to service delivery to enhance inclusivity;
3. Promote provision of equitable, integrated, and people-centered services (ibid.).

Additional toolkits like the Global Fund's Matchbox Toolkit can be developed and disseminated among partners to further guide gender integration into malaria policy and program approaches.

Toolkits and frameworks providing practical guidance to integrate gender considerations can be developed to ensure malaria elimination implementers have the capacity to integrate gender-intentional and transformative approaches. For Example, the Global Fund to Fight Aids, TB, and Malaria (GFATM) developed the Malaria Matchbox Toolkit to support national programs to integrate gender considerations into their programs; partners and funders can now support the rollout and utilization of these tools to encourage their adoption (see Box 10). Additionally, new tools and frameworks

can be developed to ensure robust gender-integration guidance is available to non-government partners and other implementers not funded by the GFATM. Lessons learned from the GFATM process to develop their toolkit can be drawn on in developing additional tools. Finally, investment in country-specific policy and advocacy reports and gender analyses can ensure that detailed policy guidance is available that is specific to a country's social and political context. This approach was taken in Kenya to ensure gender equality goals in their NMSP can be realized (see Box 11).

## Box 11.

### Strengthening gender integration in Kenya's National Malaria Strategic Plan

Kenya's National Malaria Strategic Plan 2009–2018 (most recently updated in 2014) is one of the few NMSPs that acknowledges that “gender and human rights play an important role in exposure and access to malaria control interventions” (Kenya NMCP, 2014). The strategy states that all prevention and treatment activities and resource allocation must be done with a gender perspective, and it calls for the collection and analysis of sex disaggregated data in order to inform decisions, interventions, and policies (Kenya NMCP, 2014). Malaria intervention implementers had little guidance on how to achieve these goals. Therefore, in 2015 the MEASURE Evaluation PIMA Project in Kenya developed a report to identify tangible ways to

strengthen gender integration into Kenya's malaria programming. The report, titled “Gender and Malaria in Kenya”, identifies strengths and gaps in Kenya's NMSP related to gender integration, and identifies key recommendations with accompanying guidance for Kenya's National Malaria Control Program and partners.

The learning from Kenya's NMSP development to date can provide guidance to other NMCPs in their journey to integrate gender considerations into future NMSPs. Additionally, similar reports can be undertaken in other countries to provide context-specific recommendations for gender integration in malaria policies.

## 5.2 Gender integration in global advocacy and communications

Targeted advocacy and communication efforts can raise the profile of the links between gender and malaria in order to strengthen political will among key stakeholders and policymakers to integrate gender considerations into malaria policies and programs. Global momentum around events like World Malaria Day or the American Society of Tropical Medicine and Hygiene (ASTMH) Annual Meeting can be leveraged to expand the reach of this messaging. Many organizations have begun to utilize various communications platforms to call on other organizations, donors, and governments to adopt approaches to malaria elimination that take into account gender considerations. These strategies include hosting public events, publishing blogs<sup>9</sup> and op-eds<sup>10</sup> (see Box 12), disseminating public statements from organizations on their commitment to gender equality, and strategically using social network platforms like Facebook and Twitter to share key messages. Global advocacy networks, like RBM's Malaria Advocacy Working Group (MAWG), can be leveraged to widen the reach of these messages and develop coordinated campaigns that other partners can adopt and disseminate.

Advocacy efforts toward existing R&D coalitions and product development partnerships can strengthen gender integration in malaria R&D. Ensuring malaria R&D partners understand the importance of gender integration in their work will be critical to ensuring new tools, drugs, and insecticides are developed with gender considerations. There are current malaria R&D advocacy leaders, like the Global Health Technologies Coalition (GHTC),<sup>11</sup> that can be leveraged to strengthen the reach of these messages to ensure drug development and product development partners embrace the importance of integrating gender considerations.

Organizations and individuals with convening power can strengthen opportunities for stakeholders to be familiarized with the evidence on the benefits of gender integration in malaria elimination approaches. High-level stakeholder meetings, scientific conferences, and other convenings present an opportunity to elevate evidence on links between gender equality and malaria outcomes, and to advocate for gender integration into malaria programs. Large events like the ASTMH Annual Meeting are important moments in time to leverage (see Box 13).

### Box 12. Leveraging World Malaria Day

Every year on April 25, the global malaria community comes together to celebrate progress in the fight against malaria, and galvanize renewed commitment toward malaria control and elimination. This day is also an opportunity to strengthen messaging on gender considerations in malaria programming. In 2015, MEASURE Evaluation used World Malaria Day as an opportunity to increase awareness of the need for improved gender data in malaria programs, releasing a blog titled "Invest in the Future: Strengthen Malaria Programs with Gender Data" (MEASURE Evaluation, 2015). In their blog, MEASURE Evaluation called on all public health workers and decision-makers to "consider the impact of gender on treating one of the world's worst killers and to make the commitment to increase and improve gender-related data collection to assist in strategy and planning for effective malaria prevention and response." The blog highlighted gaps in currently available sex-disaggregated data globally and in "community-based health information systems, at health facilities, in routine health information systems, and in national surveys" (MEASURE Evaluation, 2015). By calling attention to these data gaps, MEASURE Evaluation hopes that available data will be improved, and that this data can be used in strategic planning and programming for malaria elimination that takes gender considerations into account.

### Box 13. Raising the profile of gender and malaria at ASTMH

Out of hundreds of presentations on malaria at the 2019 ASTMH Annual Meeting, one highlighted the importance of gender considerations: *Human Rights, Gender and Ethics Considerations when Targeting Malaria Interventions to MMPs*. There is an opportunity to capitalize on the high attendance of ASTMH and raise the profile of evidence on the links between gender and malaria by hosting an entire panel session on gender and malaria elimination, highlighting evidence to date and lessons learned in experiences in integrating gender into malaria elimination approaches.

9. <https://www.kff.org/news-summary/friends-of-global-fight-blog-post-explores-impact-of-gender-equality-on-treatment-for-hiv-tb-malaria/>; <https://www.undp-capacitydevelopment-health.org/en/legal-and-policy/key-populations/malaria-humanrights-and-genderequality/>

10. <https://sciencespeaksblog.org/2017/04/23/projects-goal-end-malaria-for-all/>

11. A coalition of more than 25 nonprofit organizations advancing policies to accelerate the creation of new drugs, vaccines, diagnostics, and other health tools that bring healthy lives within reach for all people.

### 5.3 Opportunities to strengthen gender integration in malaria advocacy and policy efforts

There are several opportunities to integrate gender considerations into malaria advocacy and policy efforts. These include:

- Strengthen global technical guidance on gender integration into national malaria planning, policy, and programming:
  - Support countries to articulate gender equality considerations in National Malaria Strategic Plans. Measure and track the gap in gender intentional NMSPs to track progress.
  - Develop country-specific policy guidance informed by gender analyses to ensure detailed policy guidance is available that is specific to a country's social and political context. Develop toolkits to guide uptake of technical recommendations for gender integration.
  - Ensure global reports, including the WHO World Malaria Report, report on sex-disaggregated data.
  - Elevate gender integration to the agenda of key global policy bodies, including the WHO MPAC and the WHO's new GDG. Advocate for the creation of a new WHO Evidence Review Group on gender and malaria to strengthen evidence and adoption of best practices.
- Generate momentum for gender intentional and transformative malaria elimination approaches:
  - Develop advocacy and policy briefs that make the investment case for gender integration into malaria elimination approaches.
  - Utilize creative communication channels, global events, and existing advocacy networks (i.e. RBM MAWG) to expand the reach of gender-integrated messaging.
  - Leverage high-level stakeholder meetings, scientific conferences, and other convenings to increase understanding on the links between gender equality and malaria outcomes.

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## 6. CONCLUSION

There is a growing body of evidence that links strengthened gender equality with improved malaria outcomes. The findings strongly suggest that gender integration into malaria prevention and treatment, research and development, and advocacy has the potential to accelerate burden reduction and disease elimination. Among the most compelling policy- and program-relevant implications of this research is the need for malaria programming to work hand-in-hand with both women's economic empowerment initiatives and the maternal and child health sector to achieve high levels of adoption and use of preventive and treatment technologies. With regard to upstream malaria biomedical research, there is an important opportunity for the Bill & Melinda Gates Foundation to provide leadership and funding for the development of chemoprevention products that can be safely used by HIV-infected pregnant women.

There are still significant gaps in the understanding of how gender disparities and barriers intersect to create gender-specific vulnerabilities to malaria morbidity and mortality, and how malaria control and elimination approaches can be designed to address those gender disparities and barriers. Given this, it is necessary to drive resources toward interventions, research, and programming that aim to generate new data and address these vulnerabilities.

Given the foundation's influence in the global malaria field, there is also an opportunity to encourage other leading organizations and coordinating bodies to take up these considerations. New lessons that emerge can be shared to the global malaria community as a public good, integrated into global malaria guidance, and can make the case for the return on investment of gender-intentional and transformative malaria elimination approaches to ensure these strategies remain at the forefront of other donor and implementer priorities.

Addressing the often-overlooked but significant links between gender equality and malaria vulnerabilities is imperative to improve malaria health outcomes, as well as to make progress toward a more gender-equitable future.

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## APPENDIX A: QUALITY OF EVIDENCE ASSESSMENT

Type/Strength of Evidence	Low (excluded from review)	Medium	High
<b>Single research site using qualitative methods</b>	Weakly defined research objectives, methods, and/or analysis	Descriptive with small sample (n = 6)	Innovative use and analysis of qualitative methods and data (n = 1)
<b>Single research site using quantitative methods</b>	Weakly defined research objectives, methods, and/or analysis	Cross-sectional descriptive or regression analysis lacking identification strategy (n = 4)	Well-identified non-experimental model (eg. Instrumental variables, difference-in-difference, regression discontinuity design) (n = 5)
<b>Multiple research sites using quantitative methods</b>	Weakly defined research objectives, methods, and/or analysis	Cross-country descriptive or regression analysis lacking identification strategy (n = 2)	Well-identified cross-country regression analysis (n = 3)
<b>Literature review/meta-analyses</b>	Weakly defined research objectives, methods, and/or analysis	Evidence-based commentary/advocacy (n = 11)	Systematic reviews (n = 7)
<b>Intervention research</b>	Weakly defined research objectives, methods, and/or analysis	Pre/post comparisons (n = 3)	Quasi-experimental and experimental research (n = 8)

## APPENDIX B: SEX-DISSAGGREGATED DHS AND MIS MALARIA DATA BY COUNTRY

**Table 1: Malaria prevalence in children age 6-59 months, by sex**

Country	Survey	Malaria prevalence in children age 6-59 months according to RDT (%)		Malaria prevalence in children age 6-59 months according to microscopy (%)	
		Male	Female	Male	Female
Angola	2015-16 DHS	13.3	13.6		
Benin	2017-18 DHS	36.3	36.3	39.7	38.4
Burkina Faso	2017-18 MIS	19.9	20.5	17.0	16.8
Burundi	2016-17 DHS	37.8	38.1	26.7	26.9
Cameroon	2011 DHS	30.0	29.9		
Congo Democratic Republic	2013-14 DHS	30.7	30.9	23.2	22.0
Cote d'Ivoire	2011-12 DHS	41.2	41.8	17.9	17.9
Gambia	2013 DHS	2.5	2.3	0.9	0.6
Ghana	2016 MIS	29.0	26.7	21.8	19.4
Guinea	2012 DHS	46.7	47.1	42.8	45.0
Kenya	2015 MIS	9.0	9.1	4.9	5.0
Liberia	2016 MIS	43.8	46.0		
Madagascar	2016 MIS	5.3	5.0	6.8	7.0
Malawi	2017 MIS	36.3	35.6	24.3	24.3
Mali	2018 DHS	19.7	18.2		
Mozambique	2018 MIS	39.8	38.0		
Nigeria	2018 DHS	36.6	35.7	23.4	21.8
Rwanda	2017 MIS	11.4	12.2	7.2	7.2
Senegal	2017 DHS	1.0	0.8	0.4	0.3
Sierra Leone	2016 MIS	53.5	52.0	40.4	39.9
Tanzania	2017 MIS	7.5	7.2		
Togo	2017 MIS	44.1	43.7	28.9	27.7
Uganda	2016 DHS	29.2	31.5		

Source: The DHS Program STATcompiler

Notes: The 95% confidence intervals around each estimate provided by DHS fail to reject the null hypothesis of equal female and male prevalence rates.

**Table 2: Percentage of children under age five with fever in the two weeks preceding the survey for whom advice or treatment was sought, by sex**

Country	Survey	Children <5 with fever for whom advice or treatment was sought (%)	
		Male	Female
Afghanistan	2015 DHS	64.3	63
Albania	2017-18 DHS	60.8	58.3
Angola	2015-16 DHS	51	50.5
Benin	2017-18 DHS	52	54.4
Burkina Faso	2017-18 MIS	74.1	72.9
Burundi	2016-17 DHS	70	69.1
Cambodia	2005 DHS	83.9	79.5
Cameroon	2011 DHS	54.9	56.5
Chad	2014-15 DHS	37.4	36.4
Comoros	2012 DHS	53.9	51.7
Congo	2011-12 DHS	67.6	62.7
Congo Democratic Republic	2013-14 DHS	54.9	55.7
Cote d'Ivoire	2011-12 DHS	43.5	42.2
Eswatini	2006-07 DHS	60.5	63.1
Ethiopia	2016 DHS	35.9	34.7
Gabon	2012 DHS	70.4	64
Gambia	2013 DHS	63.5	65.8
Ghana	2016 MIS	71.8	71.9
Guinea	2018 DHS	63.8	60.6
Guyana	2009 DHS	63.4	68.7
Haiti	2016-17 DHS	38.8	41.9
India	2015-16 DHS	74.2	72.1
Indonesia	2007 DHS	90.7	89.1
Jordan	2017-18 DHS	68.1	68.8
Kenya	2015 MIS	71.6	72.2
Liberia	2016 MIS	76.7	79.7
Madagascar	2016 MIS	53.2	57.7
Malawi	2017 MIS	58.3	50.3
Mali	2018 DHS	53.1	52.5
Mozambique	2018 MIS	67.7	69.5
Myanmar	2015-16 DHS	64.2	65.7
Namibia	2013 DHS	64.3	62.4
Niger	2012 DHS	61.8	65.2
Nigeria	2018 DHS	73.4	72.2
Pakistan	2017-18 DHS	82.9	79.8
Papua New Guinea	2016-18 DHS	51.8	47.3

Philippines	2017 DHS	58.6	49.9
Rwanda	2017 MIS	53.1	58.8
Sao Tome and Principe	2008-09 DHS	67.1	77.5
Senegal	2017 DHS	51.6	51.3
Sierra Leone	2016 MIS	70.5	72.2
Tajikistan	2017 DHS	44.6	43.4
Tanzania	2017 MIS	75.2	75.6
Timor-Leste	2016 DHS	55.8	59.6
Togo	2017 MIS	52.8	59.1
Uganda	2016 DHS	80.8	81.6
Zambia	2018 DHS	79.4	74.9
Zimbabwe	2015 DHS	46.8	53.8

Source: The DHS Program STATcompiler

Notes: Confidence intervals around the estimates not provided by DHS, so we are unable to assess statistical significance of differences between female and male treatment rates.