



Housing and Malaria

Consensus Statement

Vector Control Working Group
Roll Back Malaria

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Introduction

New tools and approaches are required to achieve the ambitious targets outlined in the WHO *Global Technical Strategy for Malaria 2016-2030*¹ (GTS) and the complementary Roll Back Malaria (RBM) global framework for *Action and Investment to Defeat Malaria 2016-2030*² (AIM) of at least a 90% reduction in malaria mortality and case incidence, and elimination from 35 countries by 2030, while preventing re-introduction into malaria-free areas. Additional interventions are needed to compliment the current tools which rely heavily on effective insecticides for optimal protection. There is a need to look beyond long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), particularly to address the challenges of insecticide resistance and transmission that occurs at places and times when populations are not adequately protected by these two core interventions.

The value of a multi-sector developmental approach that couples current interventions with complementary strategies addressing key social and environmental determinants of malaria has been recognised by RBM and the United Nations Development Programme.³ The AIM framework cited above, notes the potential contribution of the housing sector to malaria control and elimination. AIM also considers the relation between the Sustainable Development Goals and malaria, noting three Goals where malaria, housing and the built environment intersect.⁴

There is compelling evidence that housing improvements enhance protection of residents from vector-borne diseases. The protective effect of preventing malaria mosquitoes from entering houses and biting people as they sleep, such as by closing eaves and installing ceilings or by screening doors and windows, has been established in many settings. Likewise, improvements such as metal roofs and sealed walls that reduce harbourages with favourable microclimates for indoor resting vectors, may also reduce overall survivorship and vectorial capacity of the local vector population. There are multiple opportunities to continue reducing malaria, as well as collateral benefits to the housing sector by improving housing standards, including for corporate and public housing programmes; provision of microfinance initiatives for home improvements; and education on improved house designs for protecting populations at risk of vector-borne diseases.

However, despite wide acknowledgement of the impact of improved housing on vector-borne diseases, numerous questions remain on the type and extent of housing interventions required for optimal impact in a given setting. There are also major programmatic considerations such as how such interventions could be replicated, scaled-up and sustained.

This *Consensus Statement on Housing and Malaria* aims to review current evidence on the interaction between incremental housing improvements and malaria and to identify opportunities to contribute to global efforts for the control and elimination of malaria in line with the *GTS* and *AIM*. It is hoped that this document will encourage broader partnerships to realise the full potential of this promising complimentary approach and will help focus the research efforts required. Key actions for endemic countries and their partners are outlined below.

This document was developed by the RBM Vector Control Working Group with additional contributions from numerous partners including UNHabitat, United Nations Development Programme (UNDP) and the WHO Global Malaria Programme.

Is housing protective?

The house is the nidus⁵, or focal point, where humans and vectors most commonly come in contact, whether it is fleas, sandflies, reduviid bugs or mosquitoes. The home is normally viewed as a place of relative safety, yet in many settings it is the place where the risk of malaria and other vector-borne diseases is highest. Improved housing is known to have contributed to the elimination of malaria in the United States⁶ and to its decline in Europe.⁷ However, the contribution of incremental improvements in housing to malaria control and elimination in other settings, including tropical areas, was not well established and therefore a systematic review and meta-analysis of the literature on housing and malaria was recently conducted.⁸

Overall, there is strong evidence that ‘modern’ housing is protective in many tropical countries. Of 15,526 studies reviewed in this study, 90 met the criteria for inclusion in a qualitative analysis and 52 were included in the meta-analysis; residents of modern homes had 42% lower odds of malaria infection compared to traditional homes and a 54–65% lower incidence of clinical malaria. It also appears that housing was protective irrespective of the intensity of the local malaria transmission. Housing and the peri-domestic environment are central to the control of *Aedes*-borne diseases, dengue and chikungunya; reduviid bugs and Chagas; and other leishmaniasis carried by sandflies. Indeed, the 1997 WHO publication “Vector control: methods for use by individuals and communities”, includes considerable attention to improved housing as a sustainable means of controlling a variety of vectors and the diseases they transmit.⁹

Improved housing is characterised by features that reduce the entry of mosquitoes indoors, such as closed eaves, ceilings, screened doors and windows. Ceilings, metal roofs and “finished” or improved wall surfaces may also reduce harbourages and change interior air temperature and humidity affecting indoor resting mosquitoes, influencing the overall vector population size and longevity.¹⁰

Home improvement strategies that specifically address thermal comfort through natural ventilation is integral to the principles of improved housing for malaria control. Thermally-comfortable and well-ventilated houses are more amenable to consistent bednet use,¹¹ and are key for ensuring the acceptability of other interventions such interventions as closing eaves and screening windows and doors, which might otherwise restrict or reduce air flow.¹²

There is recent work on screened “eave tubes” treated with conventional insecticides or entomopathogenic fungi to block or kill mosquitoes that try to enter houses.¹³ Other insecticide-based housing interventions for vector-borne disease control under development include durable wall linings for malaria,¹⁴ treated cur-

tains for dengue, as in the *Casa Segura* initiative,¹⁵ and insecticidal paints for Chagas.¹⁶ Management of larval habitats in the peri-domestic environment, critical for *Aedes* control, may also be important for *Anopheles* vectors in specific contexts, for example where pits are dug for making bricks or plastering walls.¹⁷ In summary, there is a range of structural interventions, in and around the house, which may impact vector feeding, survivorship, population density and overall vectorial capacity and thus the ability to transmit the malaria parasite or other pathogens.

How can ongoing development be leveraged?

The economies of many malaria-endemic countries are developing rapidly. Africa, the continent with the highest burden of malaria, has the fastest growing economy with a 30% increase in real income per person observed over the past decade. Gross domestic product is expected to rise on the continent by an average of 6% a year over the next decade.¹⁸ While it is well documented that economic development and wealth creation among communities leads to reduced disease burden, disparities in the distribution of wealth remain within countries, with malaria risk for the poorest of the poor twice as high as in other wealth quintiles.¹⁹ Identifying all opportunities to protect the poor, including through improved housing, is key to accelerating progress in malaria control and elimination.

Concurrent with the increases in personal wealth are improvements in living standards, including improvements in the availability and quality of housing. In Africa alone, it is projected that over 144 million new rural houses will be constructed by 2050.¹⁸ Influencing improvements to housing designs to create healthier homes and domestic environments that reduce the threat of malaria and other vector-borne diseases is a prime opportunity that should not be missed.

Our understanding of “rural” and “urban” environments (including “urban hubs” in the centre of rural villages²⁰) and risk of malaria transmission is also evolving.²¹ Attention to the impact of housing and the built environment on vectors in urban and peri-urban settings provides opportunities to engage a wider range of government agencies and development partners in the housing, water and sanitation sectors.

Aligned with the *AIM*, housing and management of the built environment will be a critical element, especially in the final phase of malaria elimination, when in specific contexts communities may transition from population-wide coverage with IRS and mass free distribution of LLINs, to a more targeted, surveillance-driven strategy. The input of entomologists and vector control specialists is critical for a targeted, surveillance-driven strategy and needs to be supported.²²

What are the key unanswered questions that need to be addressed?

In order to provide appropriate guidance on the optimal design of new housing structures and incremental improvements to existing housing, the following need to be considered:

1. What architectural features are protective? Could these features be improved further, especially through actions by house owners themselves?
2. What is the degree of protection against clinical malaria afforded by improved housing quality and modification of the peri-domestic environment and how does this vary across eco-epidemiological, socio-economic and cultural settings?
3. What other critical elements do we need to learn about vector ecology in relation to housing and the peri-domestic environment?
4. How does the cost of building improved housing compare with the cost of regular housing? What is the cost-effectiveness of housing improvements?

5. Who is willing to pay for improved quality housing and how can this be tied to the perceived desirability of interventions, local values and market demand?
6. What is the most efficient way to scale-up housing interventions? Can these be integrated into existing local/national government development strategies?
7. Can we develop new materials and innovative ways of protecting people in their homes?
8. What vector-borne diseases other than malaria does improved quality housing protect against?
9. How does house improvement interact with indoor interventions like IRS/LLINs?
10. What is the impact of screening and closing eaves against mosquitoes on ventilation and risk of other diseases, such as respiratory disease?
11. How can existing legislation on housing be reviewed/enforced to influence design the projected new housing units for better protection from vector-borne diseases?
12. How do we address the urban and peri-urban environments with regard to housing, infrastructure, water/sanitation and vector-borne diseases?

Advocacy and coordination with other relevant national and international sectors/agencies

At the country level

The *GTS*, Global Technical Strategy, stresses country implementation of malaria vector control through Integrated Vector Management, noting “Because implementation of vector control involves different sectors, countries should also strengthen intersectoral coordination”. To realize the full potential of improved housing as part of the overall malaria control strategy, National Malaria Control Programmes must engage the Ministry of Housing/Settlements and other Ministries and partners in the public sector; the private/commercial sector and Non-Governmental Organisations (NGOs) involved with housing and the environment; as well as banking and microfinance²³, architecture and building trades associations.

The *AIM*, Action and Investment framework, recommends among other actions the need to:

- *demonstrate to heads of state, ministers of non-health sectors, business partners and other key stakeholders the importance of continuing to reduce and eliminate malaria for economic growth and development;*
- *ensure that partners new to the malaria space receive technical guidance, and encourage them to work with stakeholders that are competent in the field of malaria; and*
- *integrate the activities introduced by non-health sectors to reduce malaria in the routine activities and budgets of the sector concerned at all levels of operation.*

At the international level

The RBM Vector Control Working Group will continue to advocate and grow a broad-based partnership with UN organizations, Government Agencies, the private sector, NGOs and training and research institutes, and through WHO, provide best practices and technical information for national programmes. The Vector Control Working Group, along with partners such as WHO and UNHabitat, will make efforts to engage other sectors involved with housing and infrastructure, including the finance sector and development banks, to ensure that investments in infrastructure, urban development and housing include the principles outlined in the consensus statement.

Conclusions

There is compelling and growing evidence that improved quality housing protects people against malaria and other vector-borne diseases. This is an intervention that can be incorporated into Integrated Vector

Management programmes and developed outside, but complementary to the health sector. Improved housing is an intervention that will protect people from vectors regardless of insecticide-susceptibility status and can be the foundation for transmission prevention, both in the control phase where LLIN and IRS programs are being implemented and in the elimination phase where some LLIN and IRS investments may be shifted or scaled-back. The potential for improved housing as a supplementary method for malaria control is enormous. In addition to its impact on vector-borne diseases, improved housing quality brings other benefits to general health and development.

At present, as more evidence is gathered, the RBM Vector Control Working Group advocates for reducing the entry points for mosquitoes in houses by closing open eaves, screening doors and windows with fly screens or mosquito netting and filling holes and cracks in walls and roofs. Additional modifications, including metal roofs, ceilings, finished interior walls and reduced larval habitats in the peri-domestic environment may also serve to reduce transmission of malaria and other vector-borne diseases. Further research is needed to demonstrate the protective efficacy of improved housing in different settings, develop new products that lend themselves to mass-scale-up and identify ways to accelerate adoption of housing interventions. While there are still many unanswered questions, comprehensive efforts towards improved housing should be considered as an important and sustainable component in the global effort for malaria control and elimination.

Recommendations to countries and partners

Following the WHO Integrated Vector Management Framework²⁴ with special recognition of the need for evidence-based guidelines to support a multi-sector approach to housing and malaria, the RBM Vector Control Working Group advocates the following:

Cross-sector collaboration

- Establish a task force on malaria and housing either within an existing National IVM committee or other appropriate coordination committee that includes key partners in the public sector, private/commercial sector, NGOs and civil society, including the financial services sector involved with housing.
- Ensure that the principles of “malaria and housing” are included in the national strategic plan for malaria control and elimination as well as any national strategic plans for housing and the built environment.
- Ensure that agencies involved with water and sanitation and with agricultural irrigation contribute to the reduction of mosquito larval habitats.

Advocacy and social mobilization

- Engage local architecture and engineering schools to raise awareness and to encourage innovation in the field of “healthy housing” and improvements that can reduce the risk of vector-borne diseases.
- Engage local government, community groups, schools and the media to encourage the use of screening and closing open eaves, improve thermal comfort and make other structural design changes to the house and peri-domestic environment to reduce mosquitoes and risk of malaria.
- Explore micro-finance initiatives to support housing improvements in the poorest homes, where the risk of malaria is often greatest.
- Advocate the corporate social responsibility potential of housing improvements.

Public-Private Partnerships

- Engage the private and commercial sectors, building materials and screening manufacturers, construction companies and building trades associations to incorporate improved ventilation for thermal comfort within the principles of mosquito reduction into their design and building practices.
- Encourage mosquito reduction as a means to strengthen house product branding.
- Ensure that financial services and housing microfinance projects support screening, thermal comfort and other investments that will reduce the risk of mosquitoes and malaria in the home environment.

Legislation and subsidisation

- Introduce or re-affirm building and planning legislation for housing standards aimed at reducing the risk of malaria and other vector-borne diseases.
- Explore subsidies for house building or improvement programmes that incorporate principles of protection against vectors.
- Ensure that metal-roofed houses are not taxed at a higher rate than traditional houses in order to encourage home owners to invest in these incremental housing improvements.
- Reduce or abolish import tax and tariff on materials such as screening.

Integrated approaches

- Ensure that structural measures to reduce mosquitoes are part of a comprehensive strategy that includes continued use of LLINs and IRS, and where appropriate, reduction of larval habitats in the peri-domestic environment.

Evidence-based decision making

With national training and research institutes, academia, central and local government, NGOs and partners, promote operational research related to housing, the built environment, malaria and other vector-borne diseases, including the “key unanswered questions” outlined above.

Capacity-building

- Ensure that district and municipal environmental health staff have been trained in the principles of vector control through housing, infrastructure improvements and larval source management.
- Ensure there are adequate entomological resources for continued monitoring associated with housing and infrastructure.
- Ensure capacity building within the private sector to sustain a strong market supply for housing improvements for malaria control.

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