

SAFE HUMAN SETTLEMENTS AND MALARIA

INTRODUCTION

The United Nations Development Programme (UNDP), the Roll Back Malaria Partnership (RBM) and other partners developed the *Multisectoral Action Framework for Malaria* to consolidate the evidence on the many interfaces between the non-health sectors, malaria transmission and the possibilities for responding to the disease. The framework builds on the body of knowledge that shows how endemic malaria disappeared from most of northern Europe and North America as general social and economic development took hold, including better and less crowded housing, improved land drainage and stronger health systems.¹

Environmental change has a tremendous impact on malaria transmission, making the disease a potential threat wherever there is a receptive environment.² Activities like deforestation, large-scale irrigation, and urbanization can all affect the mix of vector species, their abundance, host choice, longevity and behaviour, and ultimately malaria transmission.^{3,4,5} It is expected that, by 2050, more than two thirds of the global population will live in urban centres. Urbanization can contribute to the reduction of malaria in endemic countries, because cities can bring benefits such as better housing, greater access to basic services and fewer breeding sites.⁶ However, these

benefits often remain elusive for the world's more than 800 million slum dwellers. Indeed, there is a strong body of evidence that people of low socioeconomic status are particularly vulnerable to natural and man-made disasters, unhealthy housing, poor working and environmental conditions.⁷

Whenever landscapes are artificially adapted and human settlements emerge, environmental legislation, regulations and safeguards are needed to 'build out' mosquitoes and monitor the risk of malaria resurgence. Without such efforts, new mosquito breeding sites and resting places may be inadvertently created – resulting in the 'building in' of mosquitoes, with the potential knock-on effect on malaria transmission. This again underscores the need for a multisectoral response to malaria: decisions on major development projects such as dam construction, hydroelectric and resettlement schemes are taken by ministries of planning, finance, infrastructure, energy and water. Vector-control activities, such as land drainage regulations, may fall under the remit of environmental health agencies etc. Health impact assessments that pay attention to malaria need to be carried out as part of the feasibility studies of any major new infrastructure development project.⁸

In specific relation to housing, a systematic review has shown that in endemic areas, people living in traditional houses were twice as likely to suffer from malaria as those living in modern houses, after adjusting for socioeconomic status. Importantly, improved housing may even be protective in places with exceptionally high levels of malaria transmission.⁹ In Africa, where consumer spending is expected to double over the next decade, more than 144 million

1 Roll Back Malaria Partnership & UNDP Multisectoral Action Framework for Malaria (2013). <http://www.rollbackmalaria.org/files/files/about/MultisectoralApproach/Multisectoral-Action-Framework-for-Malaria.pdf>

2 Patz, J. A., Graczyk, T. K., Geller, N. & Vittor, A. Y. Effects of environmental change on emerging parasitic diseases. *Int. J. Parasitol.* 30, 1395–1405 (2000).

3 Tatem, A. J., Gething, P. W., Smith, D. L. & Hay, S. I. Urbanization and the global malaria recession. *Malar. J.* 12, 133 (2013).

4 Yasuoka, J. & Levins, R. Impact of deforestation and agricultural development on anopheline ecology and malaria epidemiology. *Am. J. Trop. Med. Hyg.* 76, 450–460 (2007).

5 Health and Environment Linkages Initiative (HELI), World Health Organization & UNEP. Malaria control: the power of integrated action (2015). <http://www.who.int/heli/risks/vectors/malariacontrol/en/index6.html>

6 De Silva, P. M. & Marshall, J. M. Factors contributing to urban malaria transmission in sub-Saharan Africa: a systematic review. *J. Trop. Med.* 2012, 819563 (2012).

7 Turley, R., Saith, R., Bhan, N., Rehfuess, E. & Carter, B. Slum upgrading strategies involving physical environment and infrastructure interventions and their effects on health and socio-economic outcomes. *Cochrane Database Syst. Rev.* 1, CD010067 (2013).

8 Roll Back Malaria Partnership: Action and Investment to defeat Malaria 2016-2030 (AIM) – for a malaria-free world (2015) (<http://www.rollbackmalaria.org/about/about-rbm/aim-2016-2030>)

9 Tusting, L. S. et al. The evidence for improving housing to reduce malaria: a systematic review and meta-analysis. *The Lancet* (2015).

rural houses are set to be built by 2050.¹⁰ Closing the eaves, installing a ceiling, or screening doors and windows can all have a protective effect against malaria.¹¹ Many of these features also have additional functional and aesthetic benefits that residents value. Incorporating these features into housing standards, corporation and public housing programmes, microfinance initiatives for home improvements, and education on improved house designs presents the malaria community with a tremendous opportunity, while also bringing specific benefits to the housing sector.¹²

Action and Investment to Defeat Malaria, 2016–2050 describes how malaria is closely linked to issues of infrastructure, settlements and ecosystems: across the sustainable development agenda. By ensuring that major construction and development projects do not introduce or increase malaria transmission, the benefits of progress can be reaped, while also protecting human health and ecosystems. Well-planned infrastructure and improved housing help reduce exposure to mosquitoes,¹³ and facilitate greater access to health and malaria services.

CASE STUDIES

Minha casa, minha vida (My house, my life)¹⁴

The Amazon region covers 50% of the land, 14% of the population and 99.7% of the reported malaria cases in **Brazil** – with most cases occurring in low-income rural areas with poor infrastructure. The annual number of malaria cases has decreased from about 615 000 in 2000 to about 242 000 in 2012. This decline has been enabled by regional and national development plans. New collaborations on the drawing board include: Minha casa, minha vida (My house, my

life), a federal social programme in partnership with state and municipal administrations and non-profit organizations aiming to help people with few resources to acquire quality housing; Ministries of Agriculture, Fishing and Social Development to make fish farming malaria-safe; FUNASA (National Health Foundation) and Ministry of Cities to improve basic sanitation in municipalities; and tourism authorities to protect visitors and investors from malaria.

Effect of improved housing on illness in children under 5 years old in northern Malawi: cross sectional study¹⁵

The objective of this study was to evaluate the effects of a Habitat for Humanity housing improvement programme in northern Malawi on the prevalence of childhood illnesses according to maternal recall, laboratory or clinical data. Results showed that children living in improved homes were less likely to have respiratory, gastrointestinal, or malarial illnesses. Improved housing significantly reduced the burden of disease among children under 5 years of age.

Plasmodium vivax in urban areas¹⁶

Peru has presented a decreasing malaria trend during the last decade, particularly in areas on

The northwestern coast. However, a limited number of cases continues to be reported yearly mainly in malaria hotspots. This report reviews a two-phase study that was conducted to identify spatial and temporal clusters of incident *Plasmodium vivax* malaria, as well as to determine risk factors associated with households (HH) presenting *P. vivax* malaria episodes in an urban area of the northwestern Peruvian coast from June 2008 to May 2010. It concluded that *P. vivax* malaria incidence is highly heterogeneous in space and time in the urban study area with important geographical and housing risk factors associated with symptomatic episodes.

10 Economist The world's fastest-growing continent. Aspiring Africa. Mar 2nd 2013 from print edition (2013).

11 Bradley, J. et al. Reduced prevalence of malaria infection in children living in houses with window screening or closed eaves on Bioko Island, equatorial Guinea. *PLoS ONE* 8, e80626 (2013).

12 Anderson, L., Simpson, D. & Stephens, M. Effective malaria control through durable housing improvements: can we learn new strategies from past experience? *Habitat for Humanity* (2014).

13 Lindsay, S. W., Emerson, P. M. & Charlwood, J. D. Reducing malaria by mosquito-proofing houses. *Trends Parasitol.* 18, 510–514 (2002).

14 Multisectoral action framework for malaria. Geneva: United Nations Development Programme/Roll Back Malaria Partnership; 2013. (<http://bit.ly/1hKirWe>)

15 Wolff CG et al. Effect of improved housing on illness in children under 5 years old in northern Malawi: cross sectional study. *British Medical Journal*, 2001; 322:7296. (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC31618/>)

16 Rosas-Aguirre A et al. *Plasmodium vivax* malaria at households: spatial clustering and risk factors in a low endemicity urban area of the northwestern Peruvian coast., *Malaria Journal*. 2015; 14:176. (<http://www.malariajournal.com/content/pdf/s12936-015-0670-y.pdf>)

House structure and the risk of malaria¹⁷

Good house construction may reduce the risk of malaria by limiting the entry of mosquito vectors. This study assessed how house design may affect mosquito house entry and malaria risk in **Uganda**. Modern housing was associated with a 50% reduction in mosquito house entry and malaria infection, compared to traditional housing, at three sites across the country. House design represents a promising target for future interventions, especially in highly endemic areas.

¹⁷ Wanzirah H et al. Mind the gap: House structure and the risk of malaria in Uganda. PLoS. 2015; 10:1. (<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0117396>)

