

Methods and Sources for Preparing Maps and Country Profiles

This section describes the methods used for preparing the data and maps presented in the country profiles. Many of these maps have been published in peer-reviewed literature. Some maps have been updated and are being presented here for the first time to include more recent data where they have been identified. Sources for the peer-reviewed publications (for further reading) can be found in the reference section below and in the Appendix of the *Atlas*.

Overview

Malaria at a Glance

Data presented in the Malaria at a Glance box was gathered from the World Health Organization (WHO) World Malaria Report 2010.(1) Unless otherwise noted, all data reported are for 2009. Reported cases of malaria are calculated minus any known imported malaria cases to reflect only indigenous cases. The percentage of population-at-risk is calculated by dividing the total number of people at risk of malaria by the total country population estimates for 2009, as identified in the World Development Indicators online statistical database,(2) which is published by the World Bank. Annual parasite index (API) and slide positivity rate (SPR) were calculated using the data provided in the annex of the WHO World Malaria Report 2010. Annual parasite index is presented as reported malaria cases per thousand of the total population per year. Slide positivity rate is presented as the percentage of positive microscopy slides divided by the total number of slides obtained.

Reported Malaria Cases

The graph of Reported Malaria Cases for the years 2000–2009 is plotted using the data provided in the annex of the WHO World Malaria Report 2010.(1)

Health and Economic Indicators

Data presented in the Health and Economic Indicators box was gathered from the online World Development Indicators database (2010).(2) Figures are presented in United States dollars (US\$). Private health expenditure is calculated by subtracting the percentage of public health expenditure from total health expenditure.

Strategic Program Goals for Elimination

All national and subnational Strategic Program Goals for Elimination are gathered through a variety of online sources such as Global Fund proposals, national malaria documents and strategic elimination plans, peer-reviewed literature, and international malaria meeting presentations. Sources for these strategic program goals, where identified, are listed in the Appendix A. Note that the program goals identified in

this section were collected between June 2010 and September 2011 from the best information available. Strategic program goals may have been updated; those changes may not be accurately reflected in this *Atlas*.

Maps

Each of the maps contained within this document are oriented north (up) and have a scale bar in kilometers (1 kilometer = 0.6 mile).

Human Population Density

The Human Population Density maps represent the population count per km² in 2010. The maps are generated using the Global Rural Urban Mapping Project (GRUMP) beta version (3) of gridded population counts at 1 x 1 km globally for the year 2000 and an ancillary surface of urban extents. These were projected to the year 2010 by applying national, urban, and rural specific growth rates (4) to the relevant areas and adjusting national totals to match the United Nations' estimates. This resulted in the 2010 population count surface shown, which was used to derive the population totals.

Transmission Limits

Malaria risk was first defined using Annual Parasite Incidence (API) data for each administrative unit averaged over the most recent four years for which data were available (as detailed in the Appendix B). Risk was stratified into *Plasmodium falciparum*—or *Plasmodium vivax*-free, unstable transmission of <0.1 case per 1,000 population (API) and stable transmission of ≥0.1 case per 1,000 population (API). Where sufficient data were available, stable risk was further stratified into low stable transmission (≥0.1 case and <1.0 case per 1,000 population) and stable transmission (≥1.0 case per 1,000 population). The additional category of risk of low stable transmission has been introduced as it confers with the WHO cutoff for countries entering the elimination phase of malaria control. As more data becomes available, this new category will appear in future iterations of the *Atlas*. The transmission limits were then further refined using temperature and aridity data. Locations were classified as zero risk where the average temperature profile did not allow a window of time throughout the year for transmission to take place. Risk at locations that were identified as being extremely arid (bare areas) were down-regulated by one class, i.e., stable transmission areas were reclassified as unstable transmission, and unstable transmission areas were reclassified as no-risk. Data from international travel and health guidelines (ITHG) were used to identify zero risk in certain cities, islands, and other administrative areas. Full details can be found in two publications on *P. falciparum* transmission (5) and *P. vivax* transmission.(6)

Occurrence of Malaria Vector Species

An extensive literature review of the habits and behavior of each of the dominant malaria vector species was used to generate the Bionomics Vector Species Tables. Each table summarizes key characteristics of all the vectors believed to be present in a country. A vector map is presented for each of the vectors considered to be most important in malaria transmission in that country. The Occurrence of Malaria Vector Species maps show, by single species, the predicted probability of occurrence of that species. Boosted Regres-

sion Tree models, using expert opinion ranges combined with actual occurrence data and environmental and climatic variables, were used to predict the probability that a species occurs at each location. Full details can be found in a paper on the Asia-Pacific.(7) Within the Bionomics Vector Species Tables, the 'zoophilic/anthropophilic' field lists preferences for feeding on animals or humans, respectively. The 'endo/exophagic' field lists preferences for feeding indoors or outside, respectively. The 'endo/exophilic' field lists preferences for resting indoors or outside, respectively.

References

1. WHO. World Malaria Report 2010. Geneva: World Health Organization, 2010. http://www.who.int/malaria/world_malaria_report_2010/worldmalariareport2010.pdf.
2. The World Bank. World Development Indicators online. Geneva: The World Bank, 2011. <http://data.worldbank.org>.
3. Socioeconomic Data and Applications Center (SEDAC). <http://sedac.ciesin.columbia.edu/gpw>.
4. United Nations Department of Economics and Social Affairs. World Urbanization Prospects: The 2007 Revision Population Database. <http://esa.un.org/unup>.
5. Guerra, CA, Gikandi, PW, Tatem, AJ, Noor, AM, Smith, DL, Hay, SI and Snow, RW. (2008). The limits and intensity of *Plasmodium falciparum* transmission: implications for malaria control and elimination worldwide. *Public Library of Science Medicine*, 5(2): e38.
6. Guerra, CA, Howes, RE, Patil, AP, Gething, PW, Van Boeckel, TP, Temperley, WH, Kabaria, CW, Tatem, AJ, Manh, BH, Elyazar, IRF, Baird, JK, Snow, RW and Hay, SI. (2010). The international limits and population at risk of *Plasmodium vivax* transmission in 2009. *Public Library of Science Neglected Tropical Diseases*, 4(8): e774.
7. Sinka, ME, Bangs, MJ, Manguin, S, Chareonviriyaphap, T, Patil, AP, Temperley, WH, Gething, PW, Elyazar, IRF, Kabaria, CW, Harbach, RE and Hay, SI. (2011). The dominant Anopheles vectors of human malaria in the Asia-Pacific region: occurrence data, distribution maps and bionomic précis. *Parasites and Vectors* 4:89.