

Malaria Epidemiology

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Learning Objectives



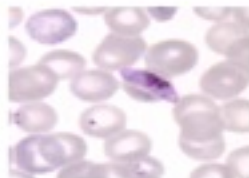
1. Describe global distribution and burden of malaria
2. Describe risk factors of infection and disease
3. Summarize current malaria control and prevention strategies



Malaria



- Malaria is a vector-borne parasitic disease caused by the *Plasmodium* parasite (protozoa)
- *Plasmodium falciparum*
 - Causes most severe form of disease
 - Most common in Africa
- *Plasmodium vivax*
 - Moderate to severe disease, little death
 - Majority of cases in Asia and South America
- Other *Plasmodium* species relevant to disease in humans - *ovale*, *malariae* and *knowlesi*
- Only transmitted by female *Anopheles* mosquitoes





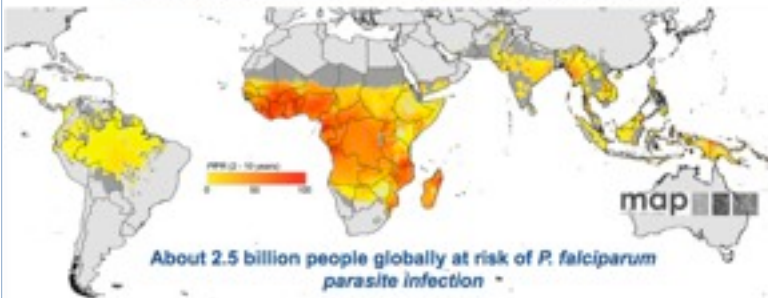
Malaria case definition

- **Clinical case definition (treatment algorithm)**
 - Think of this as who should be treated- anyone with a parasite infection by laboratory diagnoses (microscopy or RDT), with or without symptoms of diseases (i.e. fever)
 - In absence of diagnostics, malaria often defined clinically (e.g. have fever) and treated in endemic areas (often not really malaria)
 - **Epidemiological case definition**
 - Malaria parasite infection (at locally-defined parasite density threshold- e.g. 5,000 parasites per μ l blood) + fever (e.g. 37.5 °C)
- ⇒ Clinical case does not always equal epidemiological case



Malaria burden

Global distribution of *P. falciparum* malaria risk



PPR (2-10 years): Yearly *P. falciparum* parasite infection prevalence among children 2-10 years old - calculated as mean proportion of children positive for *P. falciparum* infection / total children 2-10 sampled (Hay S et al., 2009)

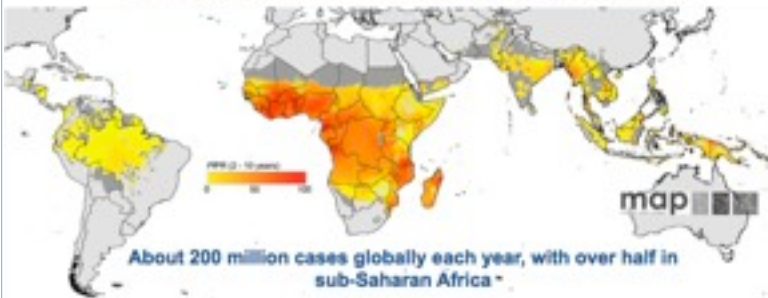


The data are the model-based geostatistical point estimates of the annual mean-PPR(2-10) for 2007 within the stable spatial limits of *P. falciparum* malaria transmission, displayed as a continuum of yellow to red from 0%–100%. The rest of the land area was defined as unstable risk (medium grey areas, where PPAR = 0.1 per 1,000 ps) or no risk (light grey, where PPAR = 0 per 1,000 ps)



Malaria burden

Global distribution of *P. falciparum* malaria risk



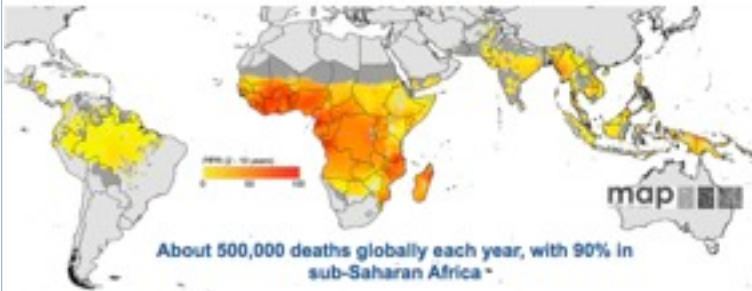
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Malaria burden

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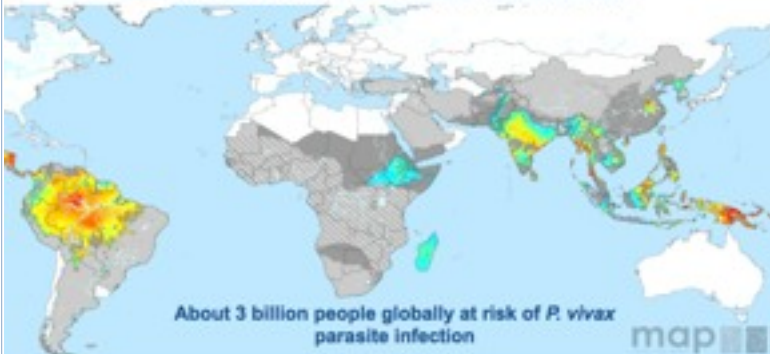
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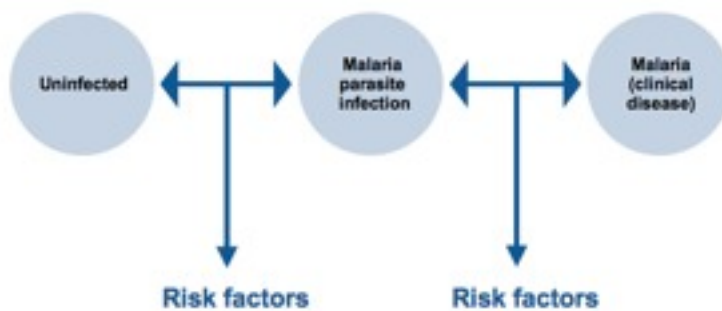
Malaria burden

Global distribution of *P. vivax* malaria risk



The medical intelligence and predicted Duffy negativity layers are overlaid on the *P. vivax* limits of transmission as defined by the PPFR data and biological risk layers. Areas where Duffy negativity prevalence was estimated as 100% are hatched, indicating where PAR estimates were modulated most significantly by the presence of this genetic trait (Guerra et al., 2008)

Risk factors of infection and diseases



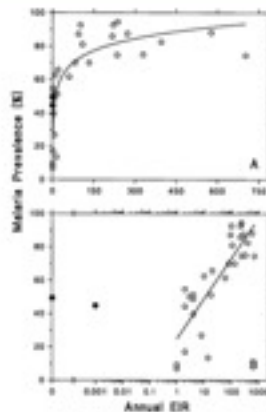
Malaria parasite infection ≠ diseases



Risk factors of infection

- **Key risk factors of infection include:**

- Climate suitability- abundant rainfall and tropical temperatures
- Vector competence – e.g. *An. gambiae* in Africa
- Season - high transmission follows rainy season
- Urban-rural - highest in rural areas
- Socio-demographic characteristics
- Man-made environmental factors

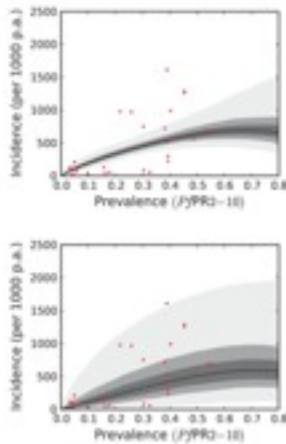


Boyer et al., 1999

Risk factors of disease

- **Key risk factors of disease among infected individuals include:**

- Acquired immunity from past infections
 - Function of age, transmission intensity and risk of infection
- Host genetics – e.g. Duffy antigen null protective against *P. vivax*
- Nutritional status and anemia
- Other infections – multiplicity of infection
- Access to health care
- Pregnancy



Pfay et al., 2010

Malaria control tools

Current tools available for malaria control and elimination

- **Diagnosis**

- Slide microscopy
- New rapid diagnostic tests (RDTs)
 - HRP2 antigen detection most common



- **Treatment**

- Artemisinin combination therapies (ACTs)
- Current first-line drug for *P. falciparum* in most of world **Highly effective**
- Resistance detected in Greater Mekong Subregion



