Label-free sorting of *P. falciparum*-infected cells to improve the diagnosis of human malaria

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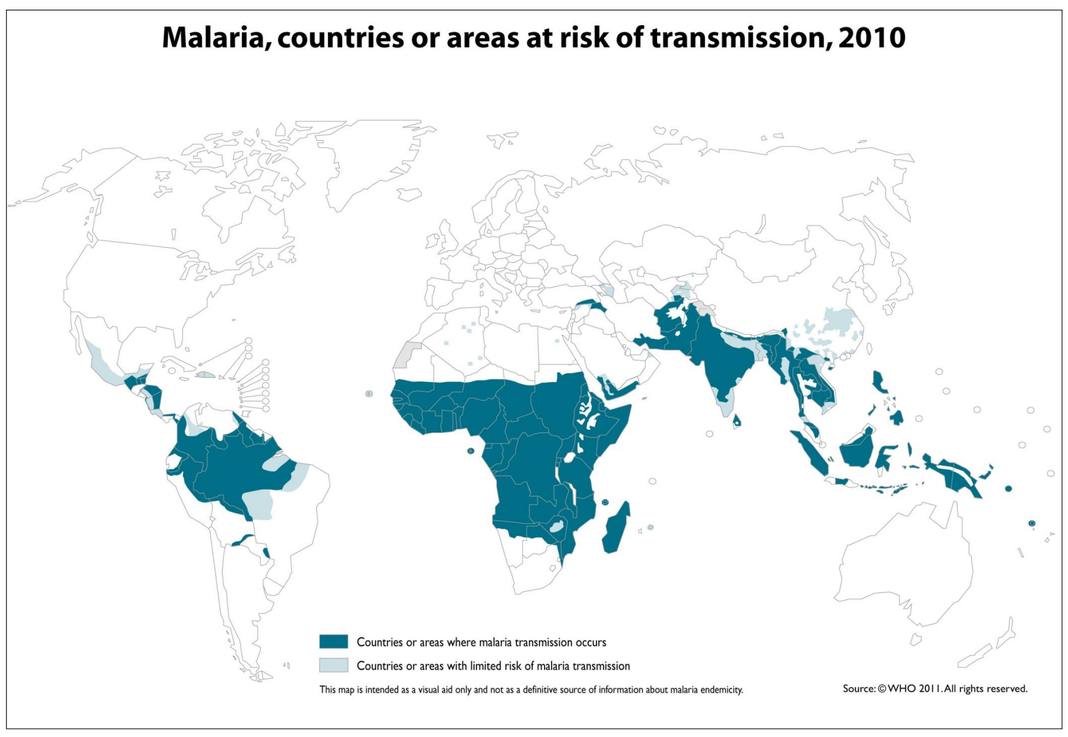
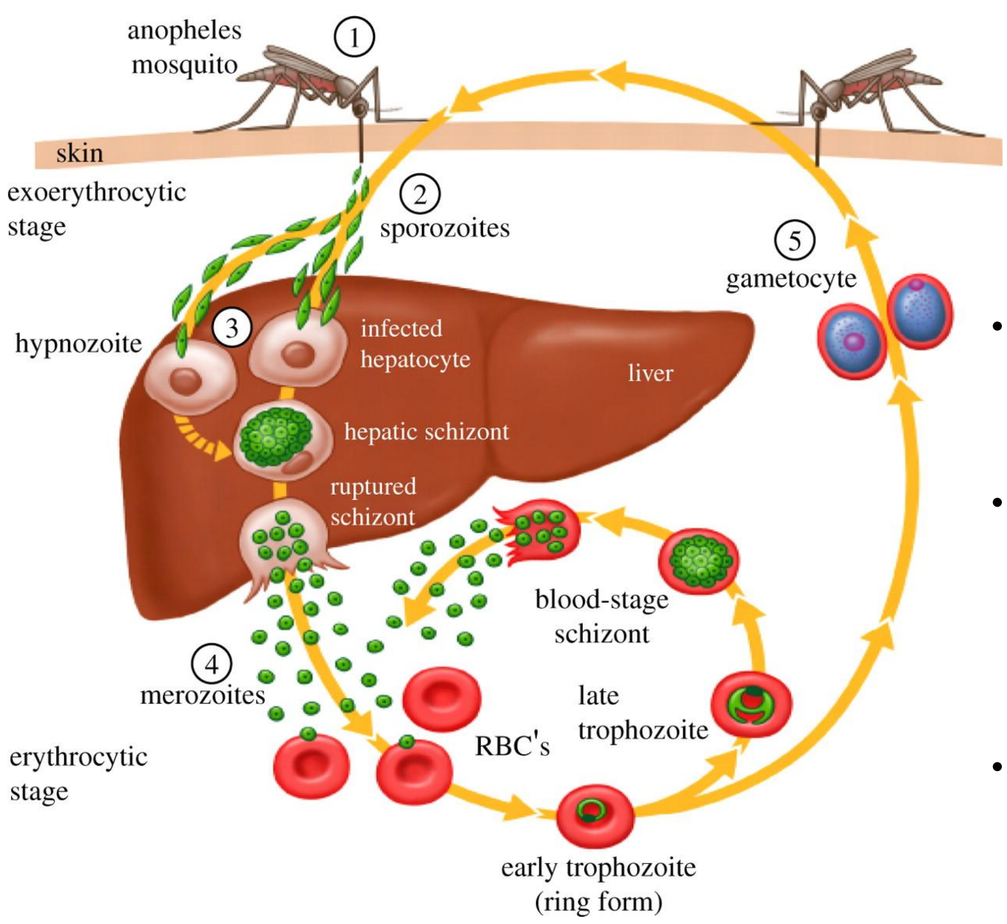
Malaria is the most prevalent parasitic disease worldwide. Around the 40% of human population lives in areas at risk of the disease, in the regions within the two Tropics (African Sub-Saharian, Asia and South America) and 198 million cases have been estimated in 2013. The disease led to about 600 000 deaths every year, mainly spread between children aged under 5 years, occurring by 90% in the African regions.



World distribution of malaria- Figure distributed by WHO.

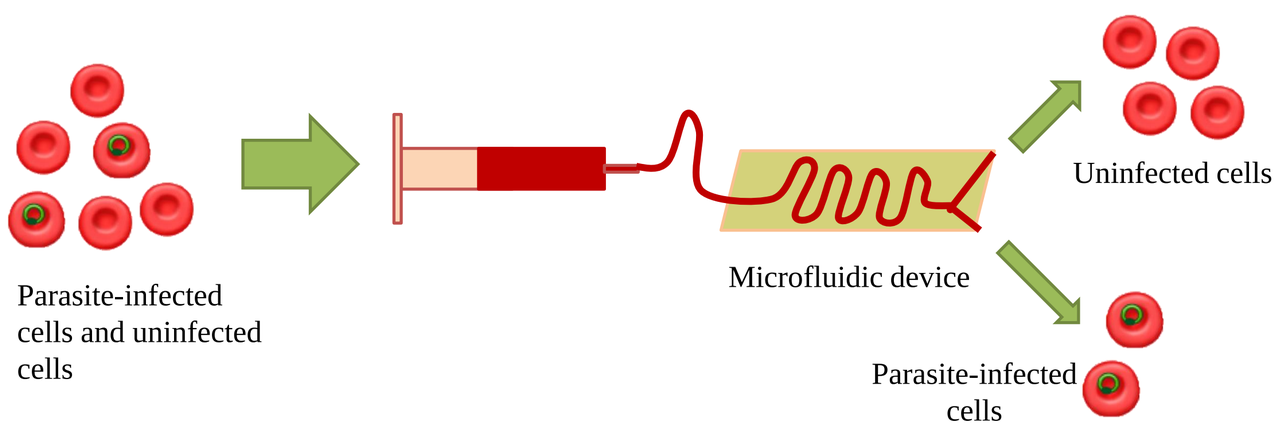
Life cycle



- The causative agents of human malaria are protozoan parasites of the genus *Plasmodium* and the species *falciparum*, *vivax*, *malariae*, *ovale* and *knowlesi*.
- Parasites are injected into the human blood through a mosquito byte (1,2).
- After an initial period in the liver, thousands of merozoites are released into the blood, where they infect the red blood cells (3,4).
- The parasites undergo the asexual stage, during which they replicate inside the red blood cells.
- Some parasites mature in gametocytes that are taken from the mosquito during its blood meal (5)*.

Diagnosis of malaria – Problems and solutions

PROBLEMS	Current diagnostic methods cannot detect low levels of parasites in the blood	Methods currently used are too complicated and cannot be used in endemic countries
SOLUTIONS	**Sample enrichment** with the parasite infected cells.	**Microfluidics** allows the integration of sample handling and parasite detection in a simple and portable device and the reduction of the cost through mass production.



The LAPASO project and malaria

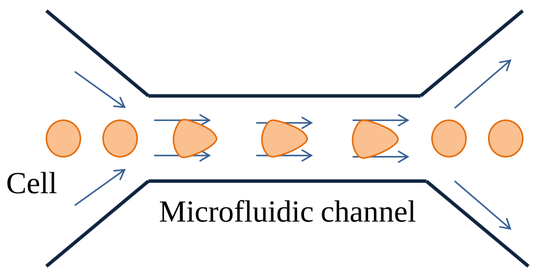
: LAbel-free PArticle SOrting

Objective: develop label-free microfluidic sorting device based on cell mechanical and dielectric properties in order to separate parasite-infected cells from uninfected ones in the blood.

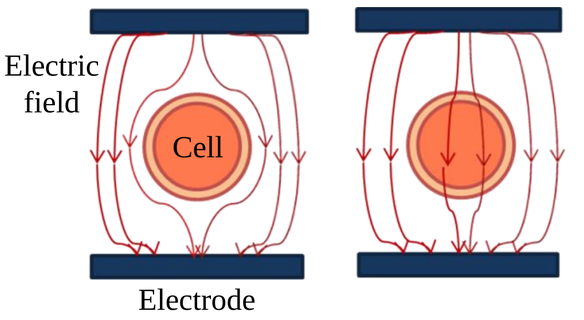
Mechanical properties — Dielectric properties

INVESTIGATION

Real-Time Deformability Cytometry

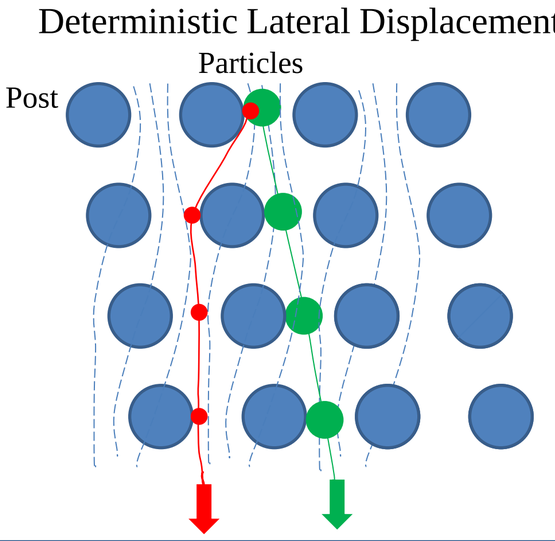


Microfluidic Impedance Cytometry

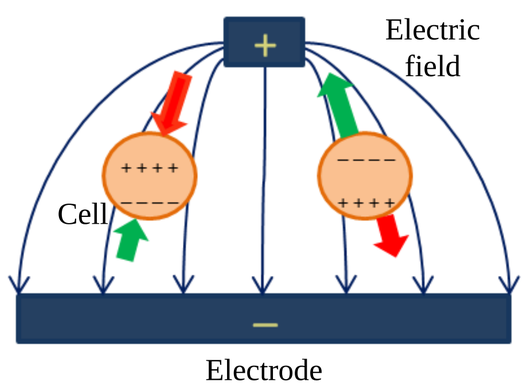


SORTING

Deterministic Lateral Displacement



Dielectrophoresis



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*: Figure taken from: Hill, A. V. Vaccines against malaria. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* **366**, 2806-2814, doi:10.1098/rstb.2011.0091 (2011).