Path towards a malaria-free future: an overview of current challenges and strategies for malaria vaccine development

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Malaria is one of the deadliest and most common parasitic diseases worldwide, leading to about quarter million new cases and one million deaths per year.[1] Annually, there are more than 3.3 billion people at risk of developing malaria. This is especially more common in higher risk populations such as elders, pregnant women, and children under the age of five residing in resource-poor regions of the world.[2]

Although there have been major efforts to control malaria, this parasitic mosquito borne disease is still a pressing public health problem in endemic African countries where up to 40% of health spending and more than half of hospital admissions is due to malaria. Fortunately, malaria is treatable and preventable. Current WHO prevention strategies such as anti-malarial medications (i.e. oral artemisinin-based mono therapies) and mosquito eliminations methods (i.e. insecticide-treated nets) are implemented to control the disease.[3] However, these strategies have socioeconomic impacts and are a heavy burden in low-income countries.[4] The misuse of insecticide treated nets and emergence of drug resistance parasites as a result of drug misuse, high dosages, unregulated drug use, and poor quality counterfeit or substandard medications renders malaria control strategies partially ineffective.

The current challenges with prevention strategies calls for a technically feasible and efficacious intervention. Currently, new vaccine technologies such as novel adjuvants and vectored prime-boost regimes are under investigation with the goal of creating a partially effective vaccine that can target different stages of the parasite's life cycle.

However, genetic variation of malaria parasite can trouble the process of vaccine development because an ideal vaccine should be able to induce protective antibodies against all associated antigens.[5] To overcome genetic variation of parasite, epigenes and major histocompatibility complex molecules have been under investigation.[6] An efficacious malaria vaccine should incorporate latency-expressed antigens or those stably expressed throughout the infection. Although more than 5,000 potential antigens are identified, no correlates of protection are defined. Insufficient understanding of vaccine-induced immunity therefore is a hurdle to malaria vaccine development.

Currently there are more than two-dozen active vaccines under clinical development.[2,7] They aim to either target one/ more than one stage of parasites lifecycle or to interrupt transmission of the disease. There are three main types of malaria vaccine: (i) transmission blocking vaccines (TBVs) (sexual-stage vaccines); (ii) pre-erythrocytic vaccines; and (iii) blood-stage vaccines. RTS,S subunit vaccine in combination with AS02 adjuvant is shown to be the most advanced proposed candidate. As of July 24, 2015, RTS,S vaccine, known as Mosquirix™, has been approved by the European Agency as the first ever vaccine against a human parasite. Although the vaccine is only 30% effective, benefits of implementing it at a global level outweighs its low efficacy rate. In combination with other malaria control strategies (insecticides, bed nets, chemotherapy, early diagnosis etc.), the hope is to use this vaccine and reach the ambitious goal of a malaria-free world.

Global Health Relevancy

Malaria is the most common parasitic disease worldwide and is a huge burden (both economically and socially) for resources in most nations. Also, malaria vaccine development is a recent and very important technological advancement that could result in an ambitious malaria-free world.