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Editorial Note on Human Malaria Control Strategies

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Editorial

Malaria is a difficult disease to control, owing to the adaptability of the vector and parasites involved. While effective malaria-fighting tools have been developed and will continue to be developed, parasites and mosquitos will inevitably evolve ways to circumvent those tools if they are used in isolation or ineffectively. To achieve long-term malaria control, healthcare professionals will need a combination of new approaches and tools, and research will be critical in developing those next-generation strategies.

Special populations

Malaria has a serious impact on the health of infants, young children, and pregnant women all over the world. Malaria kills over 800,000 African children under the age of five each year. Malaria also contributes to childhood malnutrition, which indirectly kills half of all children under the age of five worldwide. Every year, malaria infects 50 million pregnant women around the world. Malaria is responsible for one-fourth of all cases of severe maternal anaemia and 20% of all low-birth weight babies in malaria-endemic areas. Scientists are working to better understand how malaria affects children and pregnant women in particular, as well as to develop new research tools, methods, and products tailored to these populations.

Vaccine research and development

The development of a malaria vaccine that is both safe and effective will be critical in malaria control, prevention, and eradication efforts. There is currently no licenced vaccine against malaria (or any other parasitic disease that affects humans). The Plasmodium parasite's complexity, as well as a lack of understanding of critical processes such as host immune protection and disease pathogenesis, have hampered vaccine development efforts.

Pharmaceutical research and development

Antimalarial drugs, in conjunction with mosquito control programmes, have historically played a critical role in malaria control in endemic areas, resulting in a significant reduction in the geographic range of malarial disease worldwide. However, the emergence and spread of drug-resistant parasites has contributed to the re-emergence of malaria, effectively rewinding control efforts. The need for new, effective malaria drugs has emerged as a critical priority on the global malaria research agenda.

Researchers funded by the NIAID are attempting to decipher the molecular biology of the Plasmodium parasite and how it interacts with its human host at each stage of the parasite's life cycle. Scientists hope to use this information to develop new drugs that block various molecular processes required for parasite survival and to identify the mechanisms of emerging drug resistance.

The National Institute of Allergy and Infectious Diseases (NIAID) funds a broad research programme to promote vaccine development. Several candidate vaccines targeting different stages of the malaria parasite's life cycle are being developed. Furthermore, the NIAID is investigating novel vaccine strategies, such as transmission-blocking vaccines, which work by preventing malaria parasite transmission to the mosquito vector.

Diagnostics

New and improved diagnostics are required for malaria control to be effective. Currently, the most reliable method for diagnosing malaria is labour-intensive, as it has been for the past century, relying on highly trained technicians using microscopes to analyse blood smears. Such microscopic analysis takes time, is of variable quality, is difficult to use in resource-limited field settings, and cannot detect drug resistance. As a result, NIAID funds research to develop simple tests that identify the malaria parasite that is causing an infection and its drug resistance profile.

Methods of vector management

Insecticides, environmental modification, and bed nets have historically contributed significantly to successful malaria control efforts, but have faced setbacks in recent years due to factors such as the emergence of insecticide resistance in mosquitoes. The NIAID is funding research into new vector management strategies to reduce mosquito populations and prevent parasite transmission (from humans to mosquitos and mosquitos to humans).

Despite recent malaria control efforts that have significantly reduced the global burden of malaria, there has been a relative increase in the proportion of infections due to the five other Plasmodium species in many regions where *Plasmodium falciparum* and other *Plasmodium* are co-endemic, particularly where PCR-based testing is performed. *Plasmodium vivax* is thought to cause approximately million clinical episodes of malaria each year, though much higher estimates exist. Once thought to be a harmless infection, vivax malaria is now known to cause severe and fatal outcomes in a variety of epidemiological settings. This parasite also causes significant indirect mortality due to recurrent infections and a heightened risk of severe anaemia. Outside of Sub-Saharan Africa, *Plasmodium vivax* is now frequently the leading cause of malaria; however, this shift in disease burden has yet to be adequately weighted in research prioritisation.

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