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Perspective

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Malaria vaccines in India: Bridging the gap between hope and reality

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In early 20th century India, there were initiatives that focused on more structured control measures, leading to the launch of the National Malaria Control Programme in the 1950s. However, malaria reemerged in India during the 1970s due to the development of resistance to chloroquine among *Plasmodium* parasites and insecticide resistance among mosquito vectors. As a response, India took a number of strategic initiatives over the following decades. The Enhanced Malaria Control Project in 1997 and the Intensified Malaria Control Project in 2005 were significant efforts that introduced new tools for malaria prevention and control, including rapid diagnostic tests, artemisinin-based combination therapies, and long-lasting insecticidal nets[1,2,3]. Despite these measures, malaria remains endemic in many parts of India[4].

1. The emergence of malaria vaccines

Plasmodium falciparum RTS,S/AS01 (Mosquirix) vaccine has shown partial efficacy in preventing malaria among young children. Clinical trials have demonstrated that RTS,S/AS01 can reduce severe malaria cases by approximately 30% among vaccinated children[5]. Although the RTS,S/AS01 vaccine is not highly effective, it provides a crucial addition to the malaria control toolkit, particularly in areas with high transmission rates[6,7].

On December 21, 2023, The World Health Organization prequalified a second vaccine, R21/Matrix-M, which has shown higher efficacy in early trials. Both RTS,S/AS01 and R21/Matrix-M are circumsporozoite protein-based vaccines administered as three primary doses, followed by a booster[8].

2. The benefits of malaria vaccines

Vaccination can lead to a significant reduction in malaria incidence and mortality, especially in vulnerable populations such as children aged younger than 5 and pregnant women. RTS,S/AS01 has an efficacy of 36% against clinical malaria in children aged 5-17 months, and it has been administered to nearly 2 million children in pilot studies in Ghana, Kenya, and Malawi, resulting in a 13% reduction in child mortality[9]. Phase 3 results for R21/Matrix-M show an efficacy of 75% at seasonal transmission sites and 68% at annual transmission sites for children aged 5-36 months[10,11].

3. Challenges and strategies in the deployment of malaria vaccines

The implementation of malaria vaccination programs in India faces numerous challenges, including logistical, financial, and social barriers.

Once vaccines are procured, countries will have to make decisions about who should receive the vaccine first. This includes determining whether priority should be given to specific regions and populations. Furthermore, whether seasonal booster doses should only be administered to high-risk groups should also be determined.

Vaccine hesitancy is another primary challenge in deploying malaria vaccines, also fueled by misinformation, cultural beliefs and lack of trust in medical facilities. Communication with the community leaders and religious leaders as well as leveraging media platforms for targeted health education campaigns are crucial in overcoming these barriers[12].

India's diverse geography presents significant logistical challenges

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in vaccine distribution, particularly in rural and tribal areas where the malaria burden is highest. Currently, rural and tribal areas which suffer the most from the malaria burden, often lack the infrastructure necessary for effective vaccine storage and distribution. It is critical to have a robust cold chain and reliable transportation to ensure vaccine efficacy.

Sustained funding is essential for the successful rollout of malaria vaccination programs. Although international initiatives like the Gavi Vaccine Alliance provide financial support, domestic funding and political commitment are crucial for long-term success. Widespread vaccination coverage requires the allocation of sufficient resources for vaccine procurement, distribution, and administration.

4. Conclusions

Achieving malaria elimination in India requires sustained and collaborative efforts from all stakeholders, including government agencies, non-governmental organizations, the private sector, and international partners. The successful rollout of malaria vaccines, combined with traditional malaria control measures, can significantly advance India's goal of eliminating malaria by 2030.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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Data availability statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Authors' contributions

Samajdar SS, Chatterjee R, and Venkatraman S conceptualized and designed the manuscript. Mukherjee S and Chatterjee N were responsible for gathering relevant literature and supporting data. Samajdar SS, Chatterjee R, and Venkatraman S drafted the initial manuscript. Mukherjee S contributed substantially to the writing and editing process. Chatterjee N and Venkatraman S critically revised the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript. Samajdar SS, Chatterjee R and Venkatraman S are the guarantors of the paper.

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