

LETTER TO THE EDITOR

Open Access



# Malaria vaccines– latest developments

Arushi Sangwan<sup>1\*</sup>

To the Editor,

Malaria, a mosquito-borne disease caused by the *Plasmodium* parasite continues to be a serious health issue worldwide. The World Health Organization (WHO) World Malaria Report 2023 reported approximately 249 million cases in 85 malaria-endemic regions, with a total of 608,000 recorded deaths secondary to malaria [1]. From an estimated total of 35.4 million pregnancies, 12.7 million (36%) patients were exposed to malaria during pregnancy [1]. Young children were disproportionately affected with approximately 462,000 (76%) of all malaria deaths reported in children under the age of five [1]. Recent climate change has often been associated with higher rates of malaria transmission [1]. Although the exact relation between the two is complex, frequent extreme weather events such as flooding can lead to malaria epidemics [1].

Significant progress has been made to combat malaria on a larger scale, including new interventions and expanding healthcare access for at-risk populations. The development of malaria vaccines has been an ongoing project since the early 1960s [2]. The parasite's complex biological system, genomics, life cycle, and ability to evade the human immune system are some instances of barriers to the successful development of a vaccine until recent years [2].

RTS,S/AS01 (Mosquirix™), the first WHO-approved malaria vaccine, was approved in October 2021 for widespread use [3]. Indicated for active immunization, WHO recommends RTS,S to be provided in a schedule of 4

doses starting in infants around 5 months of age, with an additional option of a fifth dose in children residing in high-risk areas [4]. This vaccine was approved after it demonstrated an adequate safety profile in more than 2 million children in Ghana, Kenya, and Malawi in trials ongoing since 2019 [1, 4]. 18 more countries were approved by the WHO, with vaccine rollout scheduled to start in early 2024 [5].

In October 2023, R21/Matrix-M™ became the second WHO-approved malaria vaccine [1, 6]. In December 2023, it was given the prequalification status [5]. Ghana, Nigeria, and Burkina Faso have approved the use of R21/Matrix-M™ in an expanded age range of 5 to 36 months [2]. In January 2024, Phase 3 trial results demonstrated an average of 78% vaccine efficacy over the first year of follow-up in over 4800 young children in Burkina Faso, Kenya, Mali, and Tanzania [7]. Further deployment is expected to start in mid-2024 [3].

Both vaccines, intended for active immunization, are circumsporozoite protein (CSP) vaccines that target the pre-erythrocytic stage [8]. RTS,S was created using genes from the repeating (“R”) and T-cell epitope (“T”) of the CSP of the *Plasmodium falciparum* parasite, along with a surface antigen (“S”) of the Hepatitis B virus [9, 10]. It also includes an additional Hepatitis B surface antigen (HBsAg) (the extra “S”) [9, 10]. Similarly, R21/Matrix-M™ includes HBsAg fused to the C-terminus and central repeats of CSP, but it lacks the additional HBsAg that is found in RTS,S [11]. AS01 and Matrix-M™ represent the adjuvant systems that enhance and improve the immunogenicity of both vaccines [8]. Known adverse effects are mild to moderate including fever, injection site pain and swelling, and rarely, self-limited febrile seizures [12, 13]. Contraindications for both vaccines include hypersensitivity to either a previous dose or to a component of the vaccines [13].

\*Correspondence:

Arushi Sangwan  
arushisanga@gmail.com

<sup>1</sup> Department of Internal Medicine, Paras Hospital, 134107 Panchkula, India

In conclusion, vaccines have historically proven to be extremely efficient in eradicating diseases such as polio, measles, tetanus, and other diseases. The Coronavirus disease 2019 (COVID-19) pandemic was another example where swift vaccine development helped to reduce mortality and morbidity rates worldwide. In my opinion, these vaccines will help in reducing the malaria burden in at-risk regions to a great extent. However, to eradicate malaria, it is essential to enhance public knowledge and awareness about its transmission, interventions, vector-eradicating techniques, and methods of prevention. I believe that as physicians it is important to be cognizant of the recent advances in immunization efforts against malaria.

#### Abbreviations

WHO	World Health Organization
CSP	Circumsporozoite protein
HBsAg	Hepatitis B virus
COVID-19	Coronavirus disease 2019

#### Acknowledgments

Not applicable.

#### Authors' contributions

Not applicable.

#### Funding

The author declares that they have no funding.

#### Availability of data and materials

Not applicable.

#### Declarations

#### Ethics approval and consent to participate

Not applicable.

#### Consent for publication

Not applicable.

#### Competing interests

The author declares that they have no competing interests.

Received: 9 April 2024 Accepted: 25 April 2024

Published online: 01 May 2024

#### References

- World malaria report 2023. World Health Organization. [Internet] Available from: <https://www.who.int/publications/i/item/9789240086173>. Last Accessed on 9 Apr 2024
- El-Moamly AA, El-Sweify MA (2023) Malaria vaccines: the 60-year journey of hope and final success—lessons learned and future prospects. *Trop Med Health* 51(1):29. <https://doi.org/10.1186/s41182-023-00516-w>
- WHO recommends groundbreaking malaria vaccine for children at risk. World Health Organization. [Internet] Available from: <https://www.who.int/news/item/06-10-2021-who-recommends-groundbreaking-malaria-vaccine-for-children-at-risk>. Last Accessed on 9 Apr 2024
- Malaria vaccines (RTS,S and R21). World Health Organization. [Internet] Available from: <https://www.who.int/news-room/questions-and-answers/item/q-a-on-rt-s-malaria-vaccine>. Last Accessed on 9 Apr 2024
- WHO recommends R21/Matrix-M vaccine for malaria prevention in updated advice on immunization. World Health Organization. [Internet] Available from: <https://www.who.int/news/item/02-10-2023-who-recommends-r21-matrix-m-vaccine-for-malaria-prevention-in-updated-advice-on-immunization>. Last Accessed on 9 Apr 2024
- Press Release. Serum Institute Of India. [Internet] Available from: [https://www.seruminstitute.com/press\\_release\\_sii\\_021023.php](https://www.seruminstitute.com/press_release_sii_021023.php). Last Accessed on 9 Apr 2024
- Press Release. Serum Institute Of India. [Internet] Available from: [https://www.seruminstitute.com/press\\_release\\_sii\\_010224.php#](https://www.seruminstitute.com/press_release_sii_010224.php#). Last Accessed on 9 Apr 2024
- Sang S, Dattoo MS, Otieno E et al (2023) Safety and immunogenicity of varied doses of R21/Matrix-M™ vaccine at three years follow-up: A phase 1b age de-escalation, dose-escalation trial in adults, children, and infants in Kilifi-Kenya [version 1; peer review: awaiting peer review]. *Wellcome Open Res* 8:450. <https://doi.org/10.12688/wellcomeopenres.19795.1>
- Egbewande OM (2022) The RTS, S malaria vaccine: Journey from conception to recommendation. *Public Health Pract (Oxf)* 4:100283. <https://doi.org/10.1016/j.puhip.2022.100283>
- Laurens MB (2019) RTS, S/AS01 vaccine (Mosquirix™): an overview. *Hum Vaccin Immunother* 16(3):480–489. <https://doi.org/10.1080/21645515.2019.1669415>
- Dattoo MS, Natama MH, Somé A et al (2021) Efficacy of a low-dose candidate malaria vaccine, R21 in adjuvant Matrix-M, with seasonal administration to children in Burkina Faso: a randomised controlled trial. *Lancet* 397(10287):1809–1818. [https://doi.org/10.1016/S0140-6736\(21\)00943-0](https://doi.org/10.1016/S0140-6736(21)00943-0)
- Malaria: The malaria vaccine implementation programme (MVIP). [Internet] Available from: <https://www.who.int/news-room/questions-and-answers/item/malaria-vaccine-implementation-programme>. Last Accessed on 24 Apr 2024
- R21 Malaria Vaccine (Recombinant, Adjuvanted). [Internet] Available from: [https://extranet.who.int/prequal/sites/default/files/vwa\\_vaccine/FVP-P-446-447\\_R21Malaria\\_SIIPL\\_PI-2023\\_1.pdf](https://extranet.who.int/prequal/sites/default/files/vwa_vaccine/FVP-P-446-447_R21Malaria_SIIPL_PI-2023_1.pdf). Last Accessed on 24 Apr 2024

#### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.