

# Status Report: R21 & RTS,S Malaria Vaccine Rollout

28 March 2024



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Regular status reports will be posted on 1Day Africa's website [here](#), and a public file is available [here](#) for comments and feedback as we continue to update this report on a rolling basis. Please email [ryan.duncombe@1daysooner.org](mailto:ryan.duncombe@1daysooner.org) with any other questions or comments. The following people contributed to this report: Mat Allen, JP Barretto, Iain Briongos, Mathias Bonde, Francis Burke, Clara Collier, Oscar Delaney, Ryan Duncombe, Jake Eberts, Chinwendu Ezeanya, Anemone Franz, Latisha Harry, Sandy Hickson, Jacob Hopkins, Zachariah Kafuko, Mitch Laughlin, Zoe Miller, Josh Morrison, Claire Nyquist, Nneka Omin, Ming Ong, William Putnam, Oliver Sayeed, Adrian Sperling, David Tellett, Remi Turquier, Moritz von Knebel, and Alex Zhu.

# Malaria Vaccine Status Report: March 2024

## Executive Summary

**The Goal:** Vaccinate 40 million children against malaria in 2024.

### Background

- **New malaria vaccine could save many lives:** A new malaria vaccine (R21/Matrix-M) has been recommended by the WHO and can be produced in enough volume to save the lives of hundreds of thousands of African children. Two studies estimate around 6,000 lives saved per million children vaccinated.
- **Current rollout plans do not fit available supply:** Over 100 million R21 doses could be produced and delivered in 2024, but the WHO does not expect distribution to begin until the middle of this year. Recent reporting indicates just 25 million R21 doses are planned for delivery to Africa this year.
- **We must commit to using every dose that can be made this year:** 120 million doses at \$3.90 per dose would cost \$468 million, with distribution costs adding several hundred million dollars more. At this price, the average cost of saving a child's life is projected to be less than \$4,000. Global institutions are obligated to set the shared expectation that all doses available will be distributed in 2024.
- **Prequalification is complete, but steps remain:** On December 21, the WHO prequalified R21, allowing UNICEF to procure doses. Batch testing by Indian regulators and regulatory approval by African countries remain to be completed.

### Immediate Priorities

- **Funding:** Western governments and philanthropies must raise the funds necessary for vaccine distribution.
- **African logistical planning** needs to take place on a nation-by-nation basis, including national dose projections for Gavi applications for R21.
- **Gavi application review windows** were changed from a quarterly review process to a rolling process during COVID-19, which should be repeated for R21.
- **Expediting Indian batch testing:** The R21 vaccine needs to be batch-tested by the Indian government prior to export. This process can normally take months but ought to proceed on an expedited basis.
- **Updated Gavi forecast:** Gavi should update its malaria vaccine demand forecast and indicate what steps are needed to vaccinate 40 million children in 2024.

### Developments since Last Report

- The latest reports indicate 25 million doses of R21 are expected to be distributed in 2024 in seven countries: Chad, Central African Republic, Democratic Republic of the Congo, Mozambique, South Sudan, Uganda, and Nigeria. This number is up from last month's most recent source of 10 million doses.
- Latest reports from the Serum Institute of India indicate they expect R21 production to peak at 100 million doses annually, down from previous estimates of 200 million.
- RTS,S rollout is underway in Cameroon, Burkina Faso, and Sierra Leone, with at least 10,000 total doses delivered so far, primarily in Cameroon.

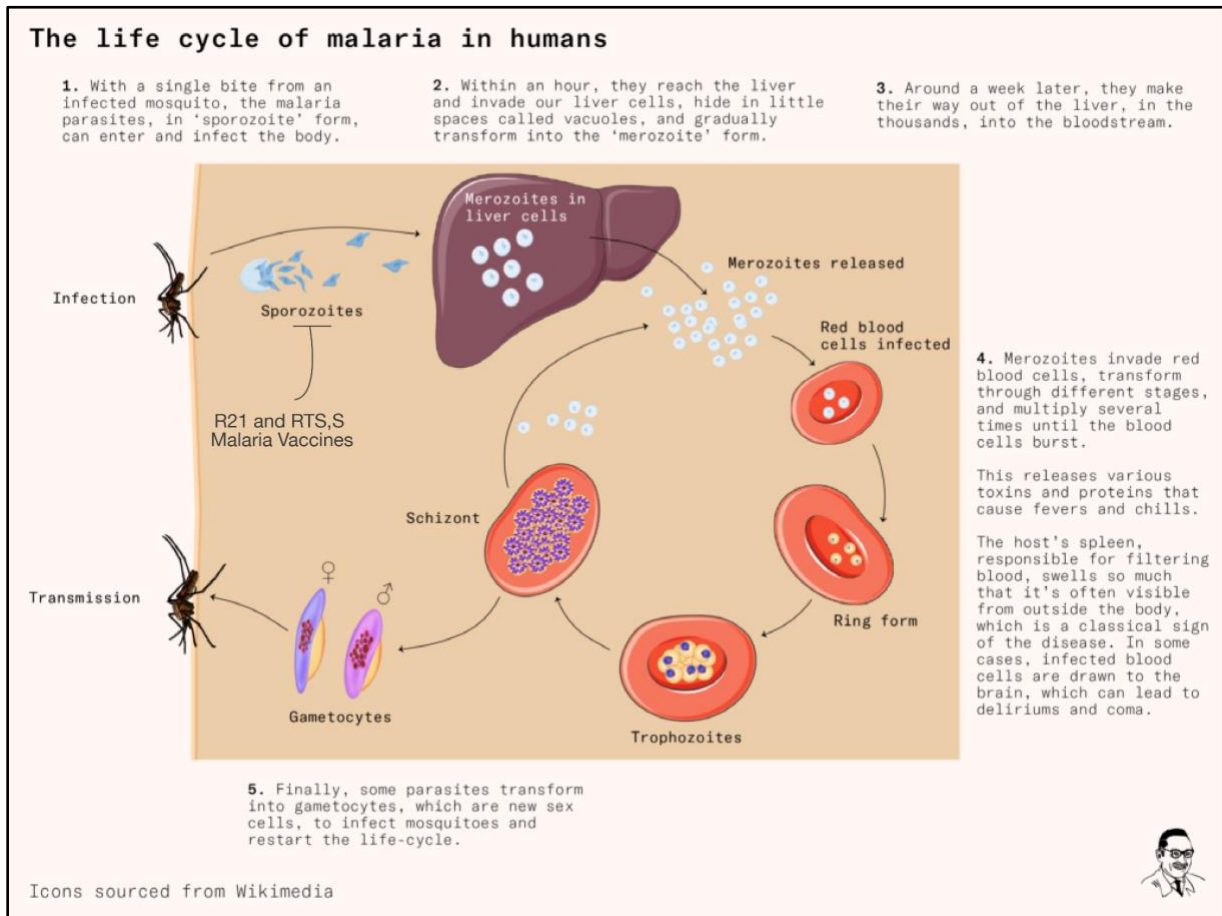
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## Background on malaria and estimates of R21 vaccine impact

### What is malaria?

Malaria is a disease caused by parasites of the *Plasmodium* genus carried by mosquitoes. Common symptoms include fatigue, fever, chills, and headaches. Severe cases can include impaired consciousness, convulsions, and abnormal bleeding.<sup>1</sup> Some cases are profoundly painful: one survivor likened it to “being stung repeatedly by an electric shock gun”.<sup>2</sup>



**Figure 1. Illustration of the malaria life cycle and vaccine mechanism.** The R21 and RTS,S malaria vaccines both block the entry of malaria sporozoites into the liver after a bite from an infected mosquito. (© [Works in Progress](#) 2023, adapted with permission.)

<sup>1</sup> [Malaria](#), WHO, March 29, 2023.

<sup>2</sup> Coumba Makalou, “[What it feels like to have Malaria](#),” NothingButNets, June 5, 2007.

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Worldwide, in 2022 there were roughly 249 million malaria cases, which caused 608,000 deaths.<sup>3</sup> 94% of malaria cases and 95% of deaths from malaria occur in Africa, almost entirely in Sub-Saharan Africa.<sup>4</sup> About three quarters of people who die from malaria are children under the age of 5.

The species *Plasmodium falciparum* is responsible for the vast majority of malaria deaths. *P. falciparum* needs to infect both a human and a mosquito to complete the four stages of its life cycle. As an infected mosquito bites a human, it releases parasites into the blood. Within minutes, they travel to the liver, where they further mature for about 5-7 days. The parasite re-enters the bloodstream and invades red blood cells, reproducing and breaking out of infected cells cyclically every two days, leading to characteristic “waves” of fever. Some reproductive forms of the parasite are then transmitted to mosquitoes that bite the infected person, beginning the life cycle once again.<sup>5</sup>

Existing methods of prevention include chemoprevention, mosquito control, and bed nets. Diagnosis of malaria alone has a median estimated cost of \$6.06, more than the cost of a dose of the R21 vaccine but less than the cost of RTS,S.<sup>6</sup> Vaccination combined with existing methods will further reduce the burden of malaria in Africa.

## **The two malaria vaccines: RTS,S and R21**

After more than six decades of struggle to create a working malaria vaccine, two have been approved by the World Health Organization in the last three years. The vaccines are RTS,S/AS01 (brand name Mosquirix, by GSK, “RTS,S” below) and R21/Matrix-M (developed by Oxford and manufactured by the Serum Institute of India, “R21”). Both were developed using multiple human challenge studies and protect against *P. falciparum*, the deadliest species of the malaria parasite.<sup>7</sup>

**The two vaccines are closely related:** the creators of R21 describe it as “a next-generation RTS,S-like vaccine.”<sup>8</sup> Both target the parasite’s circumsporozoite protein (CSP) before it can enter the liver,<sup>9</sup> employ virus-like particles built from scaffolding derived from the hepatitis B virus,<sup>10</sup> and use similar adjuvants, which enhance the immune response to a vaccine.<sup>11</sup> The surface of the R21 particle is covered with a greater density of the malaria protein (CSP) antigen than RTS,S.<sup>12</sup> The WHO recommended RTS,S in

<sup>3</sup> [World malaria report 2023](#), WHO, November 2023, p. 8.

<sup>4</sup> [World malaria report 2023](#), WHO, November 2023., p. 11-12. Nearly half of malaria cases in 2022 occurred in four countries (Nigeria, the Democratic Republic of the Congo, Uganda, and Mozambique). Slightly more than half of all malaria deaths in 2022 occurred in four countries (Nigeria, the Democratic Republic of the Congo, the United Republic of Tanzania, and Niger). Note that the [WHO African Region](#) does not encompass all of Africa; it excludes Somalia and most countries in North Africa.

<sup>5</sup> Stephen L. Hoffman, Carlos C. Campbell & Nicholas J. White, “[Malaria](#),” in *Tropical Infectious Disease: Principles, Pathogens and Practices* (3rd. Ed., 2011).

<sup>6</sup> Conteh et al. (2021), [Costs and Cost-Effectiveness of Malaria Control Interventions: A Systematic Literature Review](#), *Value Health* 24:8.

<sup>7</sup> Sekhar & Kang (2020), [Human challenge trials in vaccine development](#), *Seminars in Immunology*, 50:101429.

<sup>8</sup> Collins et al. (2017), [Enhancing protective immunity to malaria with a highly immunogenic virus-like particle vaccine](#), *Scientific Reports* 2017;7:46621. See also Katharine Collins (2014), [R21, a novel particle based vaccine for a multi-component approach to malaria vaccination](#), PhD thesis, St Cross College, Oxford University.

<sup>9</sup> Laurens (2020), [RTS,S/AS01 vaccine \(Mosquirix™\): an overview](#), *Human Vaccines and Immunotherapeutics* 16:3.

<sup>10</sup> For details on manufacturing standards related to production of R21, see Mukhopadhyay et al. (2022), [Production of a high purity, C-tagged hepatitis B surface antigen fusion protein VLP vaccine for malaria expressed in Pichia pastoris under cGMP conditions](#), *Biotechnology & Bioengineering* 119:10. See also Collins (2014), [R21, a novel particle based vaccine for a multi-component approach to malaria vaccination](#), PhD thesis, St Cross College, Oxford University; and Collins et al. (2017), [Enhancing protective immunity to malaria with a highly immunogenic virus-like particle vaccine](#), *Scientific Reports* 7:46621.

<sup>11</sup> The adjuvants in these vaccines are saponins, a chemical derived from the soapwort plant. R21 uses a simpler saponin-based adjuvant, Matrix-M (a Novavax product), than RTS,S, which uses a saponin-based adjuvant mixed with the liposomal compound MPL.

<sup>12</sup> [Collins et al. \(2017\)](#).

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October 2021 and completed prequalification in July 2022.<sup>13</sup> R21 was recommended on October 2, 2023 and prequalified on December 21, 2023.<sup>14, 15</sup> (Prequalification is required before global funders like Gavi and UNICEF can formally procure vaccines.) Burkina Faso, Ghana, and Nigeria have already licensed R21.<sup>16</sup>

Malaria Vaccines' Characteristics and Cost		
	RTS,S	R21
Price (not including distribution cost) <sup>17</sup>	\$10.20 per dose	\$3.90 per dose.
Doses deliverable in 2024	6 million <sup>18</sup>	Up to 120 million <sup>19</sup>
Doses for full vaccination	Schedule of 4 doses with at least 4 weeks between doses	
Recommended population	Children around five months old. <sup>20</sup>	
Vaccine storage	Stable for three years at 2°-8°C. <sup>21</sup>	Stable for two years at 2°-8°C, and up to two weeks between 25°-40°C. <sup>22</sup>

RTS,S was first created by GSK in 1987. Phase 3 testing concluded in 2014 and the European Medical Association approved the vaccine in July 2015,<sup>23</sup> but concerns about a potential meningitis risk led to WHO requiring further testing.<sup>24</sup> This took place from 2019-2021 and confirmed the vaccine's safety.

R21 was first formulated in 2011 at the Jenner Institute at Oxford University by Katharine Collins.<sup>25</sup> The first clinical trials testing the vaccine began in 2015, including a phase I study evaluating R21 combined with Novavax's adjuvant Matrix-M.<sup>26</sup> A phase 2b study concluded 2023,<sup>27</sup> and results of the phase 3 trial were published in February 2024.<sup>28</sup>

<sup>13</sup> Cassandra Willyard, [The slow roll-out of the world's first malaria vaccine](#), *Nature Outlook*, December 19, 2022.

<sup>14</sup> [WHO prequalifies a second malaria vaccine, a significant milestone in prevention of the disease](#), WHO, December 21, 2023.

<sup>15</sup> [Oxford R21/Matrix-M™ malaria vaccine receives WHO recommendation for use paving the way for global roll-out](#), Serum Institute of India, October 2, 2023.

<sup>16</sup> Dattoo et al. (2024), [Safety and efficacy of malaria vaccine candidate R21/Matrix-M in African children: a multicentre, double-blind, randomised, phase 3 trial](#), *The Lancet* 403:10426.

<sup>17</sup> [Malaria Vaccines: Questions and Answers on Supply, Price, and Market Shaping](#), UNICEF Supply Division, October 2023.

<sup>18</sup> [Malaria Vaccines: Questions and Answers on Supply, Price, and Market Shaping](#), UNICEF Supply Division, October 2023.

<sup>19</sup> [‘The West is complacent’: inside the world’s biggest vaccine factory](#), *The Times*, March 10, 2024. The most recent reports indicate that the Serum Institute can increase production capacity of R21 up to 100 million doses, though they [indicated](#) in October 2023 that they have “more than 20 million doses” on hand and [stated](#) that they have “already established production capacity for 100 million doses per annum, which will be doubled over the next two years,” for a total of 200 million doses per year by 2026. A more recent statement by the CEO of the Serum Institute was more conservative

<sup>20</sup> [Malaria vaccines \(RTS,S and R21\)](#), WHO, October 17, 2023.

<sup>21</sup> [Mosquirix: Product Information](#), European Medicines Agency, October 2023, p. 12.

<sup>22</sup> [‘A high efficacy malaria vaccine’](#) lecture by Adrian Hill, August 2023, c. 33:45.

<sup>23</sup> [The RTS,S malaria vaccine](#), PATH, September 17, 2019.

<sup>24</sup> Meredith Wadman, [First malaria vaccine slashes early childhood mortality](#), *Science*, October 24, 2023.

<sup>25</sup> [Collins \(2014\)](#).

<sup>26</sup> There were two phase I safety/immunogenicity studies conducted by the Jenner Institute beginning in late 2015, assessing AS01B (NCT02600975) and Matrix-M (NCT02572388) as adjuvants.

<sup>27</sup> [Safety, Immunogenicity and Efficacy of R21 Matrix-M in 5-17 Month Old Children in Nanoro, Burkina Faso](#) (NCT03896724)

<sup>28</sup> [Dattoo et al. \(2024\)](#).



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The comparatively greater efficacy at 12 months and indications that R21 may exhibit greater durability suggest that R21 is potentially a more potent vaccine.<sup>29</sup> It is possible, though not likely, that R21 proves less effective in the long term, as peer-reviewed, four-year follow-up data is not yet available. The WHO has stated that there is no sufficient evidence to conclude either vaccine is better than the other, as the two vaccines have not been tested in head-to-head trials.<sup>30</sup>

Efficacy differs based in part on age and seasonality. Malaria in some parts of Africa is seasonal, corresponding with rainy seasons that allow for mosquitos to proliferate. In other parts of Africa, it is a perennial threat. R21 trials have timed some vaccinations optimally with malaria season at seasonal sites, which could lead to greater efficacy than in real-world scenarios. The observed efficacy gap between R21 trials conducted in seasonal and standard sites is relatively small.

Malaria vaccine efficacy and immune response		
	RTS,S	R21
Phase 3 perennial efficacy in children age 5-17 months	First 12 months: 56% efficacy First 48 months: 36% efficacy <sup>31</sup>	First 12 months: 68% efficacy <sup>32</sup> First 48 months: Unknown <sup>33</sup>
Phase 3 seasonal efficacy in children	First 6 months: >60% efficacy <sup>34</sup> First 12 months: First 3 years: First 5 years: 54.7% (41.5-56.5)	First 12 months: 80% efficacy <sup>35</sup> First 42 months: 71% <sup>36</sup>

Both R21 and RTS,S are good vaccines, but the WHO has compiled a database of 89 malaria vaccine candidates under clinical development and more effective vaccines should continue to be developed.<sup>37</sup> Implementing a strong distribution infrastructure today will serve to save lives now and enhance the utility of future vaccines.

## How many children in Africa should be vaccinated, and how many vaccines are needed?

Suitable R21 and RTS,S vaccine recipients must live in areas where there is a risk of *P. falciparum* malaria and be at least five months old. Existing data on age and malaria risk from the WHO and other international sources enable a rough estimate of the number of children meeting these criteria in 2024:

<sup>29</sup> For more, see our detailed discussion on our website of the [efficacy and durability](#), and [immunogenicity](#) of the two vaccines. Direct comparison between R21 and RTS,S titers is hampered by substantial methodological variables between the two studies: [Dattoo et al. \(2024\)](#) and [RTS,S Clinical Trials Partnership \(2015\)](#).

<sup>30</sup> [Malaria vaccines \(RTS,S and R21\)](#), WHO, October 17, 2023.

<sup>31</sup> RTS,S Clinical Trials Partnership (2015), [Efficacy and safety of RTS,S/AS01 malaria vaccine with or without a booster dose in infants and children in Africa: final results of a phase 3, individually randomised, controlled trial](#), *The Lancet* 3867:9988.

<sup>32</sup> [Dattoo et al. \(2024\)](#).

<sup>33</sup> Initial results from the phase 2b R21 study in Burkina Faso did not include a four-year followup, and only recently concluded; results have not yet been posted. The phase 3 study includes data from followup at 18-months at seasonal sites, where VE was 74% for first-time malaria episodes and 72% for multiple episodes, including 18-36-month olds, in whom vaccine protection is notably less strong ([Dattoo et al. \(2024\)](#)).

<sup>34</sup> Cairns et al. (2022), [The duration of protection against clinical malaria provided by the combination of seasonal RTS,S/AS01E vaccination and seasonal malaria chemoprevention versus either intervention given alone](#), *BMC Medicine*.

<sup>35</sup> Dattoo et al. (2022), [Efficacy and immunogenicity of R21/Matrix-M vaccine against clinical malaria after 2 years' follow-up in children in Burkina Faso: a phase 1/2b randomised controlled trial](#), *The Lancet Infectious Diseases* 22:12.

<sup>36</sup> Natama et al. (2023), [EFFICACY OF R21/MATRIX-M™ IS MAINTAINED IN A PHASE IIB TRIAL IN CHILDREN IN BURKINA FASO OVER FOUR MALARIA SEASONS \(Abstract #6949\)](#), presented at the ASTHM Conference, October 2023.

<sup>37</sup> [WHO review of malaria vaccine clinical development](#), WHO, November 2022.

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about 80 million. How we arrived at this estimate:

- Approximately 91.7% of the population in Sub-Saharan Africa — 1.01 billion people — are at risk of contracting malaria, according to WHO estimates for 2021.<sup>38</sup> Malaria cases in Sub-Saharan Africa in recent years are almost exclusively (>99%) caused by *Plasmodium falciparum*.<sup>39</sup>
- U.S. Census International Database population projections for Sub-Saharan Africa indicate that approximately 178.6 million people are children under the age of five as of 2023; 91.7% of this is 163.78 million.<sup>40</sup>
- Assuming half of this 163.78 million fall between 5 and 36 months old,<sup>41</sup> the ideal age range for vaccination, approximately 82 million should thus be suitable targets for a malaria vaccine in 2024. 2 to 4 million children are to be vaccinated with RTS,S<sup>42</sup> so we round down to **about 80 million children who should be eligible for R21 and fall within the ideal age window for vaccination in 2024.**

This calculation is an estimate based on publicly available information and is not intended to be highly precise.

Each child requires three R21 doses in the first calendar year followed by a booster a year later. Thus, covering the approximately 80 million eligible children in 2024 who need a vaccine would require 240 million doses along with another 80 million doses in 2025 as boosters.

The Serum Institute of India (SII) has previously stated it can produce 100 million doses in 2024,<sup>43</sup> in addition to the 25 million it has on hand in January 2024,<sup>44</sup> so the goal should be to **use every single one of the vaccine doses that can be made available in 2024** — enough to cover 40 million children.<sup>45</sup>

Beyond the 80 million children who currently need the vaccine, each year more than 25 million children are born in areas with moderate to high malaria transmission,<sup>46</sup> and as the population of Sub-Saharan Africa grows, this number will likely continue to rise. This estimate is substantially larger than demand figures calculated by UNICEF, as discussed below (see “What are the deficiencies of the current plan to deploy malaria vaccines?”).

For more discussion of the number of vaccine doses needed in ongoing years, see 1Day Sooner’s blog post, [How many malaria vaccine doses are needed in Africa?](#)

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<sup>38</sup> [World malaria report 2022](#), WHO, December 2022, Annex 4G. Sum of all countries in the WHO African Region (AFRO) in the spreadsheet (Algeria, which is in AFRO but is not Sub-Saharan, is not listed) plus Somalia.

<sup>39</sup> [World Malaria Report 2023](#), WHO, November 2023, pg. 12.

<sup>40</sup> [U.S. Census Bureau IDB](#), accessed November 27, 2023.

<sup>41</sup> R21 was tested and had high efficacy in children between 5 and 36 months old.

<sup>42</sup> 6 million doses of RTS,S are expected to be delivered in 2024. How many vaccinations occur will depend on how many of these doses are used as boosters and how many are used in the primary three-dose vaccination courses.

<sup>43</sup> [Oxford R21/Matrix-M™ malaria vaccine receives WHO recommendation for use paving the way for global roll-out](#), Serum Institute of India, October 2, 2023.

<sup>44</sup> [New phase 3 trial data confirm the uniquely high efficacy and good safety profile of the R21/Matrix-M malaria vaccine in African children](#), Oxford, February 1, 2024.

<sup>45</sup> The exact figures SII claims to be able to produce have varied somewhat over time. See “How many doses are currently planned for delivery in 2024?” later in this report.

<sup>46</sup> Table 1, [Framework for the allocation of limited malaria vaccine supply](#), WHO, July 2022.



## How many lives will be saved through malaria vaccination?

Two different peer-reviewed studies suggest that it is realistic to expect about 6,000 lives saved per million children vaccinated with R21.

A recent study by researchers at Imperial College, co-authored by members of the Oxford R21 team, projected that in malaria endemic regions of Sub-Saharan Africa with rates of transmission between 3-65%, for every million children vaccinated by R21 age 5-17 months, about 6,300-6,500 deaths and 1.8-2 million cases of malaria would be averted over the next 15 years (children can, and often do, contract malaria multiple times in high-prevalence areas).<sup>47</sup> The study's conclusions are highly dependent on malaria prevalence and are based on average prevalence across large areas of sub-Saharan Africa. Children in these areas are often infected with malaria multiple times, and the study assumes that multiple infections can be prevented. Importantly, the 40-80 million children this campaign is prioritizing are primarily within areas where malaria is at least this common. If the study's conclusions are accurate, **vaccinating 40 million children would save more than 200,000 lives.**<sup>48</sup>

Moreover, a recent WHO study found that RTS,S vaccination reduced childhood mortality, excluding accidental causes, by 13% for every child vaccinated.<sup>49, 50</sup> If R21 has a similar impact, we would thus expect it to save around 6,000 lives per million children vaccinated, similar to the estimates modeled in the Imperial and Oxford paper.<sup>51</sup> Because the data behind the 13% number has not been made public, the 6,000 lives-saved projection is necessarily a rough estimate. Contrariwise, R21 may be more effective than RTS,S given its stronger efficacy and immune response in trials (see “The two malaria vaccines: RTS,S and R21” above).

For more discussion of the number of lives we expect malaria vaccines to save, see 1Day Sooner's blog post, [How many lives could be saved through malaria vaccination?](#)

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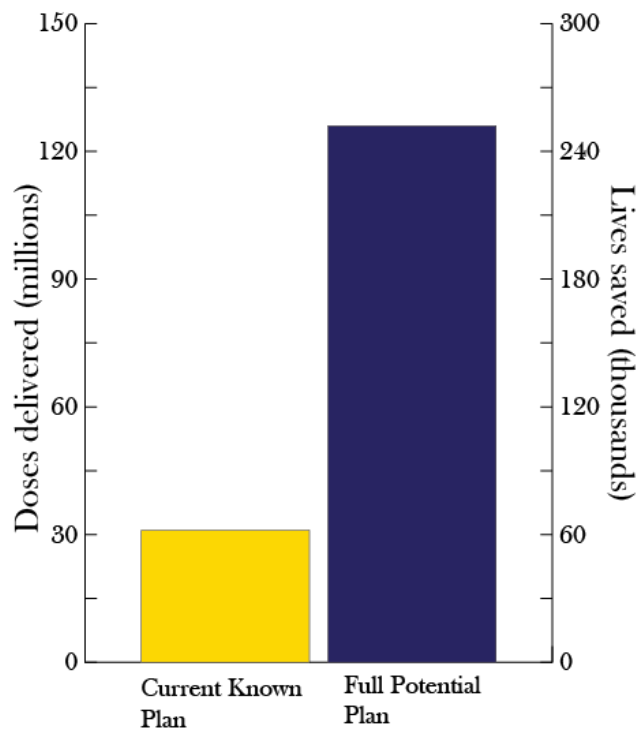
<sup>47</sup> Schmit et al. (2024), [The public health impact and cost-effectiveness of the R21/Matrix-M malaria vaccine: a mathematical modelling study](#), *The Lancet Infectious Diseases*. Modeled efficacy depended on the intensity and seasonality of malaria in given areas. In areas with seasonal malaria transmission, 653 deaths per 100,000 fully vaccinated children could be averted.

<sup>48</sup> Note that lives saved per million will be lower for children vaccinated at age 18-36 months because they have fewer years at peak risk of death (under 5 years of age).

<sup>49</sup> Meredith Wadman, [First malaria vaccine slashes early childhood mortality](#), *Science*, October 24, 2023.

<sup>50</sup> The originally published [preprint](#) from July 2023 indicates a 9% reduction in mortality among eligible children (excluding injuries) and a 32% reduction in severe malaria. The [Science article](#) cited above as well as a [Gavi article](#), published in October and November 2023, respectively, are based on findings from the same study shared at the Annual Meeting of the American Society of Tropical Medicine and Hygiene, but with updated values of 13% mortality reduction and a 22% reduction of severe malaria. The authors of the study presumably altered or updated their analysis, but we do not currently have access to an updated preprint. We use 13% as the more relevant and recent figure.

<sup>51</sup> 74 out of 1,000 children born in Sub-Saharan Africa die before the age of 5, 27 of whom die in the first month of life and would not be protected by a malaria vaccine ([Levels and trends in child mortality](#), United Nations Inter-Agency Group for Child Mortality Estimation Report 2022). Subtracting 27 from 74 yields 47 deaths out of 1,000 children; reducing this by 13% would save about 6,110 children per million children vaccinated. This number is somewhat liberal given that children can die after the first month of life but before vaccination, and it does not account for accidental deaths, but that it is in the same range as the Imperial and Oxford estimate is encouraging.



**Figure 2. Lives saved if all 120 million R21 doses are deployed alongside 6 million RTS,S doses compared to the current rollout plan of RTS,S + 25 million R21 doses.** Lives saved calculated in the text above, with ~6,000 lives saved per full vaccination course of RTS,S or R21.

## What are the estimated costs of R21 vaccination?

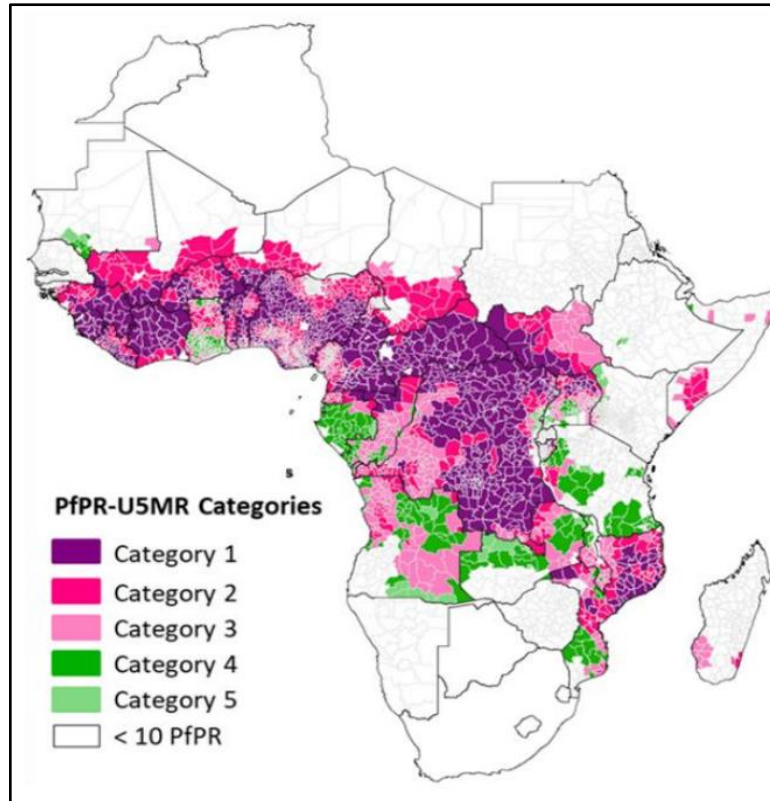
Based on analysis of RTS,S distribution costs and the current per-dose cost of R21, fully vaccinating children could cost as little as **\$25 per full course in early years**, and prices will decrease as vaccination campaigns scale. Based on studies suggesting around 600 lives saved per 100,000 fully vaccinated children, vaccination programs **will cost as little as \$4,000 per life saved initially, and less than \$3,000 in the long run.**

The net economic cost of RTS,S and R21 is likely to be lower, as these estimates factor in the economic cost of using existing healthcare resources (such as staff time) to deliver vaccinations, but not the effect of a reduction in cases of clinical malaria in vaccinated children on resources used to diagnose and treat malaria.

The above are very rough estimates and should not be taken as precise predictions. Distribution costs are highly variable, and will likely be higher where states use additional resources to maximize coverage or optimize vaccination schedules for peak malaria season. Nevertheless, it is clear that through R21, the deaths of many children can be prevented at a low cost. Read more on 1Day Sooner's cost estimates [here](#).

## The current plans for malaria vaccine rollout

Both the RTS,S and R21 malaria vaccines are expected to be delivered in line with a framework developed by the WHO that categorizes countries based on need, calculated by malaria prevalence and mortality rates in children under five (Figure 3).



**Figure 3. Composite classification of malaria prevalence and all-cause under-five mortality as proxy for need, WHO.** Category 1 is greatest need and category 5 is lowest need, and areas are prioritized by a combination of malaria prevalence and all-cause mortality in children under five. Areas with a PfPR <10% are excluded from the categorization and shown in white. Graphic adapted from the WHO [Framework for the allocation of limited malaria vaccine supply](#), page 18.

## How many doses are currently planned for delivery in 2024?

**RTS,S vaccine deployment** is expected to continue, with GSK committed to delivering 6 million doses in 2024 and 8 million in 2025.<sup>52</sup>

**R21 rollout plans are unclear.** The WHO has stated that it expects rollout to begin in mid-2024,<sup>53</sup> but details have been lacking. UNICEF announced a deal in October 2023 to secure supply of R21 with the Serum Institute of India from 2024–2028, but has not disclosed the number of doses covered by the

<sup>52</sup> [Malaria Vaccines: Questions and Answers on Supply, Price, and Market Shaping](#), UNICEF Supply Division, October 2023.

<sup>53</sup> Donato Paolo Mancini, [Oxford vaccine developer criticises WHO's mid-2024 target for malaria shot](#), *Financial Times*, October 6, 2023.

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deal.<sup>54</sup> The Serum Institute also announced in October 2023 that it had already established production capacity for 100 million doses a year and would double that capacity over the next two years.<sup>55</sup>

In March 2024, however, the CEO of SII told *The Times* that in “coming years we can scale up to 100 million doses a year,” suggesting that current anticipated capacity is less than previously stated.<sup>56</sup> *The Times* further reported that 25 million doses had already been manufactured and are being prepared for delivery, but we have been unable to confirm this information with UNICEF sources.

For the purposes of this report, we continue to assume that production of 100 million doses is possible, in addition to the 25 million the Serum Institute had already produced in early 2024.<sup>57</sup> We are continuing with the latest confirmed estimates of an approximately 120 million dose capacity (and a goal of 40 million vaccinations) until we can confirm a lower capacity for 2024. As the year progresses, we recognize that the maximum production capacity for 2024 may in fact substantially decrease from 120 million doses.

## **How are vaccines distributed through Gavi?**

Most African countries cannot afford to purchase vaccines without assistance, so they rely on Gavi, the Vaccine Alliance, to help buy them. Gavi procures vaccines through UNICEF, which pays the vaccine manufacturer, and then transfers the vaccines to African countries, which manage distribution (sometimes with the assistance of regional partners or other NGOs). Gavi has a cost-sharing formula so that poorer countries pay a smaller proportion of a vaccine’s cost than Gavi-eligible countries with higher incomes. UNICEF and Gavi cannot purchase a vaccine unless it has been prequalified by the WHO.<sup>58, 59</sup> For R21, now that prequalification is complete, “it is expected... that final steps to make doses available and ready for shipment will take a few months.”<sup>60</sup>

Gavi purchases vaccines and provides them to countries based on its forecast of their demand. That is, countries develop plans to distribute vaccines internally and then provide requests to



<sup>54</sup> [UNICEF signs deal to deliver new malaria vaccine in breakthrough for child survival](#), UNICEF, October 11, 2023.

<sup>55</sup> [Oxford R21/Matrix-M™ malaria vaccine receives WHO recommendation for use paving the way for global roll-out](#), Serum Institute of India, October 2, 2023.

<sup>56</sup> [‘The West is complacent’: inside the world’s biggest vaccine factory](#), *The Times*, March 10, 2024.

<sup>57</sup> [New phase 3 trial data confirm the uniquely high efficacy and good safety profile of the R21/Matrix-M malaria vaccine in African children](#), Oxford, February 1, 2024.

<sup>58</sup> UNICEF has stated that its purchase of R21 doses is conditional on prequalification ([UNICEF signs deal to deliver new malaria vaccine in breakthrough for child survival](#), UNICEF, October 11, 2023). COVID vaccines were an exception, but they went through a more rapid WHO emergency use listing process that was a substitute for prequalification. See the WHO’s [Regulation and Prequalification of COVID-19 vaccines](#) web page.

<sup>59</sup> [WHO RECOMMENDATION OF WORLD’S SECOND MALARIA VACCINE – SEPTEMBER 2023](#), Gavi, October 2, 2023. “Once a vaccine is prequalified it can then be offered through Gavi programmes.”

<sup>60</sup> [1st MALARIA VACCINE SHIPMENTS: Frequently Asked Questions \(FAQs\)](#), Gavi, 2023.

Gavi to purchase doses on their behalf, which Gavi aggregates into a market shaping forecast.

## **What is the deployment pipeline for the R21 vaccine?**

The Oxford developers of the R21 vaccine have a manufacturing deal in place with the Serum Institute of India, which reportedly has the production capacity for 100 million doses per year.<sup>61</sup> In addition to this, the Serum Institute of India will engage in a technology transfer deal to allow for the production of vaccines in other countries like Ghana, conditional upon the provision of manufacturing facilities in the capital.<sup>62</sup> As of February 1st 2024, 25 million doses had been produced and were ready for rollout within 3-4 months.<sup>63</sup>

One uncertainty in current rollout plans is whether available doses should be distributed on a seasonal schedule to align maximum immunity with the peak malaria season, or whether vaccines should be incorporated into existing national EPI programs to maximize distribution. Thus far, RTS,S is only being distributed through existing EPI programs and we have not seen any evidence of plans to treat R21 differently, though some experts are calling for this.

An additional uncertainty surrounds which age groups should be vaccinated. While 5 months is the current target that will enable simple distribution of vaccines in existing EPI infrastructure, this will leave many children in the 7-to-36-month age range with multiple years left at high risk of death from malaria.

## **The current status of R21 and RTS,S rollout in Africa**

Gavi has approved 20 African countries for RTS,S or R21 roll-out: Ghana, Kenya, Malawi, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Côte d'Ivoire, the Democratic Republic of the Congo, Guinea, Liberia, Mozambique, Niger, Nigeria, Sierra Leone, South Sudan, Sudan, and Uganda,<sup>64, 65</sup> following a specific prioritization framework.<sup>66</sup>

## **What is the current status of RTS,S rollout?**

RTS,S is currently in the initial stages of a broad rollout, beginning in November 2023 in Cameroon, December in Sierra Leone, and February 2024 in Burkina Faso, with additional expansion into other countries (including Liberia and Niger) in the coming months.<sup>67, 68</sup> At least 3 million doses are set to be delivered across those five countries and others in the next two years, with additional African countries set to receive doses later this year as well.

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<sup>61</sup> [Five things you need to know about the new R21 malaria vaccine](#), Gavi, April 13, 2023.

<sup>62</sup> [Five things you need to know about the new R21 malaria vaccine](#), Gavi, April 13, 2023.

<sup>63</sup> [New phase 3 trial data confirm the uniquely high efficacy and good safety profile of the R21/Matrix-M malaria vaccine in African children](#), Oxford, February 1, 2024.

<sup>64</sup> [Update on malaria vaccines](#), WHO Malaria Policy Advisory Group Meeting, Yaoundé, Cameroon, March 4-5, 2024;

<sup>65</sup> [18 million doses of first-ever malaria vaccine allocated to 12 African countries for 2023–2025: Gavi, WHO and UNICEF](#), UNICEF, July 5, 2023.

<sup>66</sup> [Framework for the allocation of limited malaria vaccine supply](#), WHO, July 2022.

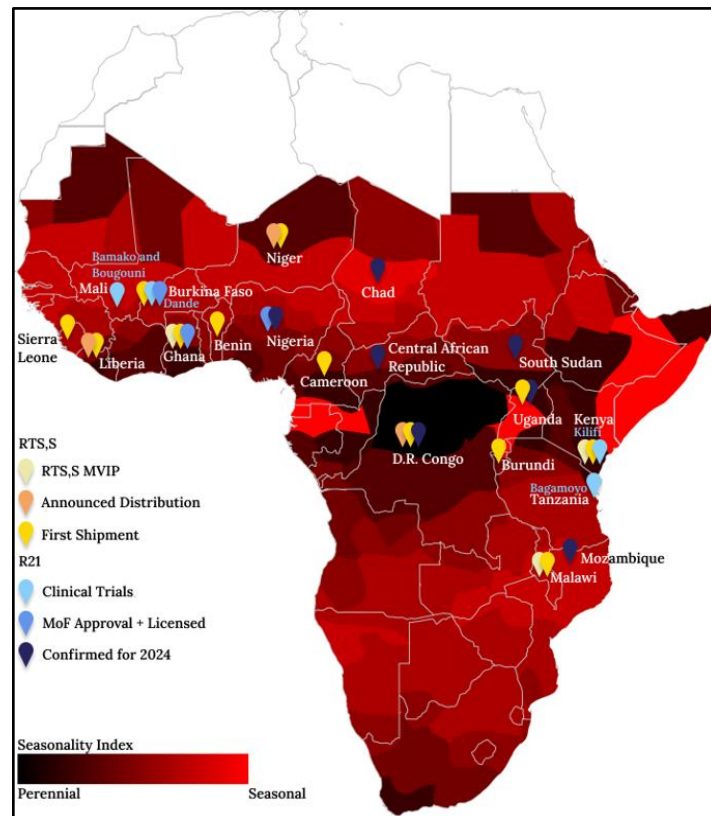
<sup>67</sup> [Shipments to African countries, including Sierra Leone, herald final steps toward broader vaccination against malaria](#), UNICEF, December 15, 2023.

<sup>68</sup> [“Relief” as RTS,S malaria vaccine rollout set to begin in Burkina Faso](#), Gavi, February 1, 2024



# Malaria Vaccine Status Report: March 2024

Three additional countries, Ghana, Kenya, and Malawi, have been administering RTS,S since 2019 as part of the Malaria Vaccine Implementation Programme (MVIP).<sup>69</sup> These three countries are expanding their RTS,S programs moving forward and have been guaranteed some number of doses with continued support from Gavi.<sup>70</sup>



**Figure 4. Malaria Transmission Seasonality.** Map of sub-Saharan Africa depicting the Markham Seasonality Index (MSI), which reflects the degree of seasonality in malaria transmission. Red regions denote highly seasonal transmission and black regions denote perennial transmission. Map overlaid with pins representing the status of R21 and RTS,S rollout. Data adapted from model simulations which align closely with observed malaria incidence, demonstrating MSI's robustness in capturing seasonal variations in transmission.<sup>71, 72</sup> Figure adapted from [Cairns et al., 2015](#).

## What is the status of the ongoing RTS,S rollout in Cameroon?

After initial receipt of the RTS,S vaccines in November 2023, there was a significant mis/disinformation surrounding its effectiveness and safety (particularly regarding risk of meningitis),<sup>73</sup> as well as suspicions

<sup>69</sup> [Malaria: The malaria vaccine implementation programme \(MVIP\)](#), WHO, March 2, 2020.

<sup>70</sup> [Malaria vaccines \(RTS,S and R21\)](#), WHO, January 17, 2024.

<sup>71</sup> [Seasonality in malaria transmission: implications for case-management with long-acting artemisinin combination therapy in sub-Saharan Africa](#), Cairns et al., August 19, 2015.

<sup>72</sup> [Modelling the impact of vector control interventions on \*Anopheles gambiae\* population dynamics](#), White et al., July 28, 2011.

<sup>73</sup> [AIRA Infodemic Trends Report 21-28 November 2023 \(Weekly brief #98\)](#), Africa Infodemic Response Alliance. "This includes claims that 'It's mRNA just like the COVID shot', low efficacy after vaccination, and a 10-fold increase in meningitis cases among vaccinated people."



of being a subject of medical experimentation,<sup>74</sup> all of which have persisted through the rollout 22 January 2024.<sup>75</sup>

Gavi considers Cameroon to be in the Preparatory Transition phase of its vaccine support program,<sup>76</sup> meaning that Gavi will pay for most of the vaccine, with Cameroon contributing up to \$0.20 per dose in the first year of introduction,<sup>77</sup> a contribution that will increase by 15% annually.<sup>78</sup> There are expected to be 18 million total doses of the RTS,S vaccine made between 2023 and 2025 to be distributed across multiple countries. Cameroon has received the first 331,200 of their 1,295,600 doses. For the total doses, Cameroon will contribute ~258,000 USD and Gavi ~6 million USD.<sup>79</sup> These are to be distributed across 42 districts in Cameroon's 10 regions (accounting for 20% of health districts) and will reach an estimated 249,133 children aged 0-24 months.<sup>80</sup> It is unclear if Cameroon will continue using the RTS,S vaccine once the R21 vaccine becomes available, as indicated by Dr. Manaouda Malachie, Cameroon's Minister for Public Health.<sup>81</sup>

## **What is the status of the ongoing rollout in Burkina Faso?**

Burkina Faso has the second highest malaria death rate in the world as of 2019.<sup>82</sup> Over the past two years, the country has been involved in early trials of both the RTS,S and R21 malaria vaccines. As of mid-February 2024, Burkina Faso is actively distributing RTS,S to patients and is planning to start rolling out R21 imminently.

On February 5th, 2024, Burkina Faso introduced RTS,S into its routine vaccination program for children, marking "the start of a major initiative by the WHO Regional Office for Africa's Accelerated Malaria Vaccines Introduction and Rollout in Africa (AMVIRA)".<sup>83</sup>

Gavi reports that "the initial phase of the vaccine roll-out aims to reach nearly 250,000 children aged 5–23 months, across 27 health districts out of the total 70."<sup>84</sup> The WHO confirms that these are 27 "priority health districts", and the roll-out is frontloading parts of the country with the highest malaria death rates.<sup>85</sup> The rest of the country will be covered by R21.

As of February 16th, we don't have figures on the pace of the vaccine roll-out. The WHO reported on 9th February that 10,000 children had been vaccinated "in Burkina Faso and Cameroon",<sup>86</sup> but as Cameroon had a two-week head start and is wealthier, we assume most of this total is from Cameroon.

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<sup>74</sup> [AIRA ibid.](#), "to illustrate the argument that Africa has been positioned as a testing ground for medical experiments."

<sup>75</sup> Nalova Akua, [A turning point: Cameroon rolls out world's first malaria vaccine](#), Gavi, January 22, 2024.

<sup>76</sup> [Gavi Eligibility](#), Gavi, March 17, 2023.

<sup>77</sup> [Ministère de la Santé Publique du Cameroun Press Release](#), November 29, 2023.

<sup>78</sup> [Vaccine Funding Guidelines](#), Gavi, September 2023, p. 60: "For preparatory transition countries: country co-financing starts at US\$ 0.20 per dose in the first year of introduction, and the price fraction increases by 15% annually."

<sup>79</sup> [Ministère de la Santé Publique du Cameroun Press Release](#), November 29, 2023.

<sup>80</sup> Nalova Akua, [A turning point: Cameroon rolls out world's first malaria vaccine](#), Gavi, January 22, 2024.

<sup>81</sup> [Ministère de la Santé Publique du Cameroun Press Release](#), November 29, 2023: "Furthermore, he notes that a second vaccine developed in Burkina-Faso and which shows an efficacy of 67% after 3 years of monitoring, has just been approved by WHO and Cameroon will seize the opportunity at any time to transition a more adequate vaccine as soon as the stock is accessible, in order to continue protecting our children."

<sup>82</sup> [Death rate from malaria, 1990-2019](#), Our World in Data, accessed March 20, 2024.

<sup>83</sup> [Nearly 10 000 children vaccinated as malaria vaccine rollout in Africa expands](#), WHO, February 09, 2024.

<sup>84</sup> ["Relief" as RTS,S malaria vaccine rollout set to begin in Burkina Faso](#), Gavi, February 1, 2024

<sup>85</sup> [BULLETIN D'INFORMATIONS SPECIAL](#), WHO, January 7, 2024.

<sup>86</sup> [Nearly 10 000 children vaccinated as malaria vaccine rollout in Africa expands](#), WHO, February 09, 2024.

## What lessons can be drawn from the rollout of RTS,S?

- **Regulatory speed matters:** In 2015, the European Medicines Agency approved the RTS,S vaccine.<sup>87</sup> In 2016, the WHO recommended pilot program implementation, and in 2019 RTS,S launched in Ghana, Kenya, and Malawi.<sup>88</sup> RTS,S was first recommended for widespread use by the WHO in October 2021.<sup>89</sup> The six-year delay between the EMA's approval and the WHO greatly slowed the rollout of RTS,S and shows how regulatory uncertainty and delays can be massively consequential.
- **Advance financing affects rollout:** In 2019, Gavi reduced the risk of investment in RTS,S vaccine, allowing production to begin while evidence was collected to support implementation plans and policies.<sup>90</sup> A similar effort to reduce financial risk by providing funding and transparency for R21 could accelerate deployment.
- **Community engagement is important:** Interviews with health service managers and frontline health workers in Ghana in 2019 aimed to understand lessons learned during RTS,S vaccine implementation, which was the first malaria vaccine deployment. Community engagement early in RTS,S deployment was important to the success of the vaccine.<sup>91</sup>
- **MVIP sets a strong path to follow:** During the Malaria Vaccine Implementation Programme pilot programs, supportive supervision visits for sites with low uptake improved vaccine coverage. Updating communications materials for healthcare workers on guidance when children do not receive doses on schedule was also important. Planning early for R21 implementation will reduce barriers encountered for RTS,S.<sup>92</sup> Because R21 is expected to be available in larger volumes, it may be used by larger countries to avoid the need to switch products.<sup>93</sup>
  - Many challenges encountered during MVIP were related to infrastructure issues in Sub-Saharan Africa; however, others were specific to the MVIP: the term “pilot program” and unclear eligibility criteria led to distrust on social media<sup>94</sup> and the multiple dosing made it hard for full coverage, especially for the fourth dose.
  - Given that R21 will have less strict cold chain requirements and not be a pilot program, there is reason to expect lower administrative costs and greater uptake of the R21 vaccine than the MVIP program achieved for RTS,S.
- **Four-dose distribution works:** While there were challenges, RTS,S deployment showed that implementation of a four-dose vaccine works with careful planning and that scaling up distribution is possible.

## What is the current status of R21 rollout?

R21 distribution is still pending country-based approval and has not yet been initiated. First delivery is planned for late April, with distribution beginning in May and June. However, the latest sources indicate

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<sup>87</sup> [Mosquirix](#), European Medicines Agency, 2015.

<sup>88</sup> [UNICEF Procurement: Comprehensive supply for impactful and cost-efficient health programmes](#), WHO, December 2022.

<sup>89</sup> [Malaria vaccines \(RTS,S and R21\)](#), WHO, October 2023.

<sup>90</sup> [1st Malaria Vaccine Shipments: Frequently Asked Questions \(FAQs\)](#), Gavi, 2023.

<sup>91</sup> Grant et al. (2022), [Challenges and lessons learned during the planning and early implementation of the RTS,S/AS01E malaria vaccine in three regions of Ghana: a qualitative study](#), *Malaria Journal* 21:147.

<sup>92</sup> [Learning lessons from the pilots: overcoming knowledge gaps around the malaria vaccine schedule in support of vaccine uptake](#), WHO, October 2022.

<sup>93</sup> [1st Malaria Vaccine Shipments: Frequently Asked Questions \(FAQs\)](#), Gavi, 2023.

<sup>94</sup> Grant et al. (2022); Adjei et al. (2023), [Post introduction evaluation of the malaria vaccine implementation programme in Ghana, 2021](#), *BMC Public Health* 23:586.

25 million doses are set to be delivered this year across seven countries: Chad, Central African Republic, Democratic Republic of the Congo, Mozambique, South Sudan, Uganda, and Nigeria.<sup>95</sup>

## Problems with current plans for R21 distribution

### What are the deficiencies of the current plan to deploy malaria vaccines?

The latest number of planned R21 doses to be delivered in 2024, 25 million, is sufficient to vaccinate only around 8 million children.<sup>96</sup> This is about 100 million fewer doses than what previous information from the Serum Institute indicated would be possible (100 million producible in 2024; 25 million on hand as of January 2024<sup>97</sup>). 100 million doses would be enough to vaccinate over 30 million more children with the primary course (the first three doses of the four dose vaccine series). Based on the modeling done by researchers at Imperial and Oxford (see “How many lives will be saved through malaria vaccination?” above), vaccinating 30 million more children in 2024 would avert over 200,000 deaths.<sup>98</sup>

Moreover, a plan to begin rollout in mid-2024 is likely to leave many children vaccinated in 2024 unprotected during the peak malaria season in their country.<sup>99</sup>

This deficit is not just a problem for 2024. 2022 projections by UNICEF estimated vaccine demand in 2025 to reach 60 million doses and 75 million doses in 2026 (see Slide 17 in [this 2022 UNICEF presentation](#); this applies to only 19 countries).

### Challenges to vaccinating more children in 2024

- **Vaccination campaigns are normally slow:** Vaccines typically take about ten years from starting human testing to regulatory approval and another 10-15 years to achieve broad distribution.<sup>100</sup> Malaria vaccine development has taken decades. Thus there is institutional and psychological inertia weighing against an immediate sprint to deploy vaccines, especially when sprinting is far outside the norm.
- **There’s not much money:** African countries must spend very limited resources to fight a variety of diseases. Philanthropic funding for global health is similarly overburdened. We estimate that about \$1 billion will be needed to purchase and distribute R21 vaccine doses. These budgets cannot be shifted at a moment’s notice, and without new sources of funding spending on one priority means shorting another.
- **Four doses are tough:** Many vaccines require fewer than four doses, and the timing for the current malaria vaccines does not fit well with the existing schedule for vaccinating children. This is not impossible: vaccination rates for RTS,S have been high in communities where it has been introduced,<sup>101</sup>

<sup>95</sup> [Cut-price Malaria Vaccine To Begin Africa Rollout From May](#), Barron’s, March 9, 2024.

<sup>96</sup> [Cut-price Malaria Vaccine To Begin Africa Rollout From May](#), Barron’s, March 9, 2024.

<sup>97</sup> [The West is complacent’: inside the world’s biggest vaccine factory](#), *The Times*, March 10, 2024.

<sup>98</sup> Roughly 630 deaths averted per 100,000 children vaccinated multiplied by 370 is 230,000. (The actual number of deaths averted varies slightly in [Schmit et al. \(2024\)](#) based on various factors, such as timing of vaccination campaigns.)

<sup>99</sup> Malaria is mostly seasonal, and tends to peak during the rainy season when mosquitoes are most active. Rainy seasons can vary in timing throughout Sub-Saharan Africa, but some of the areas of highest malaria prevalence in West Africa exhibit peak malaria transmission between [July and November](#). If rollout begins in June and takes >4 months, most recipients will be unprotected during the peak season.

<sup>100</sup> See [SAVAC Stakeholders Meeting video](#) at 1:20:30. See also Plotkin’s *Vaccines*, 7th ed., Chapter 4 (“The Vaccine Industry”), table 4.3.

<sup>101</sup> Mumtaz et al. (2023), [Acceptance, availability, and feasibility of RTS,S/AS01 malaria vaccine: A review](#), *Immunity, Inflammation & Disease*, 11:6; Schmit et al. (2024), [The public health impact and cost-effectiveness of the R21/Matrix-M malaria vaccine: a mathematical modelling study](#), *The Lancet Infectious Diseases*. “Pilot implementation of this regimen through the Malaria Vaccine Implementation Programme (MVIP) in Ghana, Kenya and Malawi has subsequently demonstrated the feasibility of delivery. To date, high demand has been demonstrated with 89%,

and parents are very experienced with malaria and motivated to protect their children. But it is not as easy as distributing most new vaccines.

- **The process is very complicated:** Institutionally, vaccination in poor countries requires a series of interlocking steps (described above) between the manufacturer, regulator, payor, facilitator, and nation-state distributors (including national and sub-national agencies and political bodies). Each of those institutions in turn may have multiple departments who share responsibility for a decision. This creates significant friction and delay, particularly if each step must be completed sequentially before the next can begin. Practically, giving out hundreds of millions of doses of a vaccine across dozens of countries requires educating and enabling tens of thousands of providers located across many poor and inaccessible areas, as well as coordinating with many country's public institutions such as Ministries of Health, Finance, Interior, and others that may have relevant authorities.
- **Vaccinologists are human:** While the many heroes who spent decades developing malaria vaccines are motivated primarily by saving lives, there are human factors that inhibit rapid and seamless cooperation. Tremendous effort was spent advancing RTS,S over many years, which can make it hard to immediately shift towards driving forward a different vaccine (even if that vaccine is based almost entirely on RTS,S). Moreover, while many people contributed to R21's development, the senior scientist overseeing the work was Oxford professor Adrian Hill, who a book about Operation Warp Speed described as "a polarizing figure who spent years fighting malaria and being abrasive to his peers."<sup>102</sup>

## What lessons can be drawn from the African COVID vaccine experience?

The response to Covid-19 showed that a fast and large-scale vaccine roll-out was feasible in low-to-middle-income countries. The COVAX mechanism was an initiative of Gavi, WHO, CEPI, and UNICEF that played a key role in making the vaccine available in 92<sup>103</sup> eligible countries. From 2021 to 2022, 1 billion doses were delivered through COVAX<sup>104</sup>. However, the effectiveness of distribution varied significantly among these countries, as evidenced by a large comparative study that found that, over the first year of COVAX, vaccination rates ranged from 0.13% in the Democratic Republic of the Congo to 44% in Botswana.<sup>105</sup> Notably, integrating COVID vaccination with routine medical services improved distribution and uptake. All 22 African countries in the study recommended better integration with routine services, and many highlighted Zambia's success integrating COVID vaccination with routine tuberculosis vaccination, antiretroviral therapy clinics, and family planning services.

Conversely, less successful aspects of the COVID-19 vaccine rollout highlighted critical areas for improvement relevant for R21 distribution. While COVAX provided vaccine doses, many countries encountered significant challenges due to inadequate funding for essential operational aspects. These included preplanning, community outreach, post-vaccination monitoring, and training additional healthcare workers.<sup>106</sup> Together, these lessons underscore the value of integrating with existing healthcare

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76% and 83% uptake of the 1st dose, 76%, 73% and 72% uptake of the 3rd dose and 50%, 52% and 36% uptake of the first booster dose in Malawi, Ghana and Kenya respectively in 2022."

<sup>102</sup> Gregory Zuckerman, *A Shot to Save the World: The Inside Story of the Life-or-Death Race for a COVID-19 Vaccine*, Portfolio (2021).

<sup>103</sup> [92 low- and middle-income economies eligible to get access to COVID-19 vaccines through COVAX](#), Gavi, July 31, 2020.

<sup>104</sup> [COVAX: 1 billion vaccines delivered](#), UNICEF, January 19, 2022.

<sup>105</sup> Masresha, Ruiz, Atuhebwe & Mihigo (2022), [The first year of COVID-19 vaccine roll-out in Africa: challenges and lessons learned](#), *Pan Afr Med J* 29;41(Suppl 2):2.

<sup>106</sup> [Masresha et al. \(2022\).](#); Afolabi et al (2021), [Tracking the uptake and trajectory of COVID-19 vaccination coverage in 15 West African countries: an interim analysis](#), *BMJ Glob Health* 6(12):e007518.

frameworks and the importance of thorough pre-planning and operational support to ensure successful vaccination campaigns.<sup>107</sup>

## **The Goal: deliver every dose that can be produced in 2024**

### **Vaccinating 40 million children**

R21 vaccination purchases about a week of a child's life for every dollar spent.<sup>108</sup> At that price, **no dose that can be produced should go unused in 2024**. If the Serum Institute can deliver 120 million doses by the end of 2024, then the expectation must be that forty million children will be vaccinated with the initial three-dose course.

Because there are many different institutions that will need to work together to achieve this and none can force the issue on their own, it is critical that all commit to a common expectation of distributing all possible doses and to identify the obstacles to achieving that outcome. Even if the target cannot be hit in 2024, sharing information about the critical path and causes of failure will save lives in 2025 and beyond. The bar must be set high.

### **Steps to catalyze more rapid mass rollout of R21**

From 2021-2023 more than a billion COVID vaccine doses were distributed in Africa,<sup>109</sup> showing that rapid rollout can be achieved. The following are some of the policy steps that could enable optimal malaria vaccination in 2024.

**Using the Collaborative Procedure for Accelerated Registration (CPAR),<sup>110</sup>** which can shorten the time-to-approval for new products by months. The WHO has initiated CPAR meetings with 37 countries that will result in authorization of the R21/Matrix-M malaria vaccine in these countries by the end of May. However, there remains a need to allow overlap with ongoing RTS,S rollout. This will increase vaccine access and widen coverage beyond the narrow age range and beyond the highest transmission areas.

**Gavi application review windows should be converted to a rolling system.** During the COVID-19 pandemic, Gavi changed its typical window-based application review process to a rolling process. They should again take this measure to ensure no African countries miss an application window and have to wait ~3 months until the next window opens.

**Expediting Indian batch testing:** The R21 vaccine needs to be batch-tested by the Indian government for domestic approval before it can be exported. This process normally takes several months for new drugs, which would push R21 delivery into June or July. This review and approval ought to be undertaken on an expedited basis by reducing regulatory hurdles required and prioritizing R21 approval.

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<sup>107</sup> Collins et al. (2021), '[Learn from the lessons and don't forget them': identifying transferable lessons for COVID-19 from meningitis A, yellow fever and Ebola virus disease vaccination campaigns](#)', *BMJ Global Health* 6(9):e006951.

<sup>108</sup> Current life expectancy in Sub Saharan Africa is 61 years, or about 3,200 weeks. [United Nations: World Mortality in 2019](#).

<sup>109</sup> [Africa CDC COVID-19 Vaccine Dashboard](#), accessed November 21, 2023.

<sup>110</sup> [Collaborative Procedure for Accelerated Registration](#), WHO.

**Public WHO commitment** to ensuring all doses produced are distributed before the end of 2024, including a commitment to achieve the 120 million doses target and identify obstacles and enablers for this goal.

**A new Gavi forecast** for malaria vaccine demand that articulates what would be needed to achieve a 120 million dose target. Additionally, a transparent process is needed for regular public updating of the forecast in response to African government requests, which should be allowed on a rolling basis similar to that used for COVID-19 vaccines.

**Demonstration rollout programs in select African countries:** Nigeria, Burkina Faso, and Ghana approved R21 prior to the WHO's recommendation, and Burkina Faso both conducted clinical trials of RTS,S and R21 and have led early rollout of RTS,S. Making Burkina Faso (or another African country) the first one with a clear and funded plan to vaccinate all its eligible population would set a valuable precedent for other countries and global institutions to follow.

**Advanced Market Commitments (AMCs) to subsidize distribution:** Because the costs of distribution may be unpredictable and funds may be scarce, one potential way to help countries provide vaccination would be to create a fund that pays countries for each vaccine dose that is distributed in 2024 (possibly with a diminishing subsidy in later years).

**Western technical assistance:** The U.S. government help was important to the rollout of COVID vaccines over the last two years. USAID and the CDC can play a role in providing technical assistance to help African countries plan their R21 vaccination campaigns, as can European Union institutions. This would be especially useful as a public-private partnership in tandem with new philanthropic funding to support distribution efforts or other technical assistance from groups like PATH.<sup>111</sup>

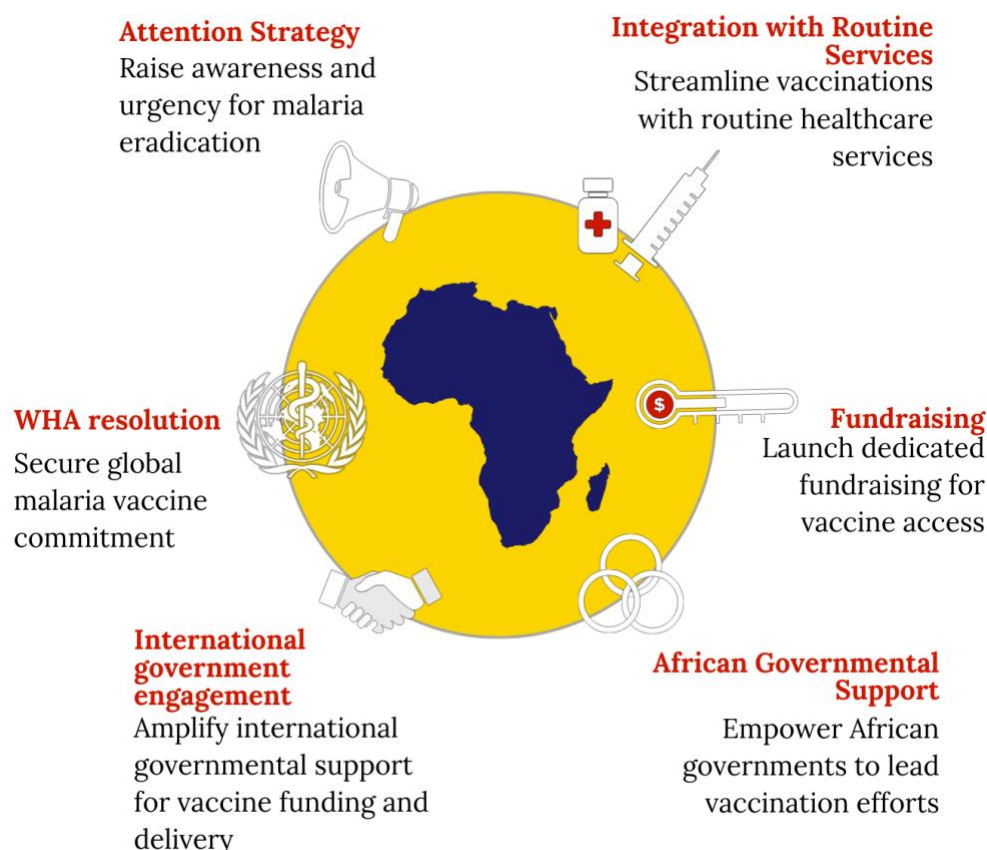
**Confirm the resources needed for purchase and distribution of doses:** Western funders must commit to provide the financial resources needed to enable the vaccination of 40 million children in 2024.

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<sup>111</sup> [PATH — RTS,S Malaria Vaccines in Pilot Comparison Areas \(January 2022\)](#), GiveWell, January 2022.



## Intermediate advocacy targets to help achieve maximum vaccine coverage



**Figure 5. Intermediate Advocacy Targets.** An infographic delineating six pivotal advocacy approaches to bolster malaria vaccine dissemination in Africa, emphasizing African governmental leadership, global resolutions, and international support, complemented by strategic public messaging and fundraising.

**African governmental support and planning:** Malaria vaccination cannot succeed without African governments leading the way. Therefore, it is critical to build expert networks and advocacy campaigns within each affected nation to ensure that the countries are motivated and enabled to (a) plan for and implement vaccination campaigns and (b) make the case to western governments, international institutions, and the global public to treat this issue with urgency.<sup>112</sup>

**WHA resolution:** The World Health Assembly convenes on May 27th, 2024.<sup>113</sup> Member countries can propose resolutions for the Assembly to vote on.<sup>114</sup> A resolution calling for a malaria dose distribution commitment would serve as a useful rallying point for countries around the world and ensure a WHO commitment if successful.

<sup>112</sup> Because 50% of malaria deaths occur in Nigeria, the Congo, Tanzania, and Niger, these countries are especially important to mobilize. Uganda and Mozambique are other countries with a major malaria disease burden.

<sup>113</sup> [Dates of Constitutional Meetings](#), WHO.

<sup>114</sup> [Basic documents: forty-ninth edition \(including amendments adopted up to 31 May 2019\), Rule 12](#), WHO, 2020.

# Malaria Vaccine Status Report: March 2024

**U.S. government inquiry:** As a member of the WHO Executive Board and major funder, U.S. government inquiries (possibly via the President’s Malaria Initiative or HHS’s Office of Global Affairs) can drive global attention and engagement on the issue.

**Fundraising:** An extraordinary vaccine deployment process will require additional resources. Drawing funding from existing sources runs the risk of pulling funding from current priorities and robbing Peter to pay Paul. A fundraising campaign that brings in new sources of funding to global health would help mitigate this risk.

**Attention:** Setting a broad expectation of using all available vaccines will require persistent and pervasive public messaging across Europe, the Americas, and Africa. This will require a range of strategies for a range of audiences but promoting African experts and public health officials is one promising tactic.

**Integration with routine services:** All 22 countries that participated in COVAX recommended better integration of vaccine delivery with routine services to minimize required infrastructure and improve vaccine uptake. R21 rollout should be conducted as quickly as possible while also paying attention to opportunities to integrate it with existing services that may increase uptake.

## **What are 1Day Africa and 1Day Sooner doing?**

1Day Africa and 1Day Sooner publicly launched our campaign to accelerate R21 vaccine deployment in December 2023. Our campaign aims to make progress on three different fronts:

1. Persuade international institutions — primarily the WHO, UNICEF, and Gavi – to set a public expectation that at least 40 million children will be vaccinated in 2024.
2. Collaborate with and support civil society groups within African countries to advocate for and enable comprehensive R21 malaria vaccination on a country-by-country basis.
3. Recruit resources (funding and technical assistance) from the West — including governments, NGOs, and philanthropies — to give African countries and global institutions what they need to make these plans work.

## **About 1Day Africa and 1Day Sooner**

[1Day Sooner](#) is a US-based nonprofit that aims to accelerate the development and deployment of life-saving medical research and policy interventions. A core focus of 1Day Sooner is human challenge studies, a form of clinical research where adult volunteers are deliberately exposed to a pathogen, often to test a vaccine (as was done with R21 and RTS,S during their early stages of development).

[1Day Africa](#) is the African chapter of 1Day Sooner. 1Day Africa focuses on global vaccine equity and building scientific capacity for medical research and production on the continent.