GAVI CSO Project Fact Sheet No.6

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Is there a malaria vaccine?

How to make a vaccine

When you get a vaccine, you get the very same pathogen you want to prevent. As it is not the whole, functioning pathogen, you do not get sick from it. Instead, your immune system learns to recognize and kill that pathogen in the future. A vaccine can be a live, weakened pathogen; an inactivated pathogen; or parts of the pathogen. For example:

- **Live, weakened pathogen:** measles, mumps, oral polio, rotavirus, rubella, chicken pox, shingles, intranasal influenza, yellow fever
- **Inactivated pathogen:** polio, hepatitis A, rabies, injected influenza
- **Part of a bacterium:** Diphtheria, tetanus, pertussis, *Haemophilus influenza* (Hib), pneumococcal, meningococcal
- **Part of a virus:** Hepatitis B, HPV

In order to test a vaccine and make sure it is safe and effective, researchers try it out in the laboratory – in test tubes and then on animals – for a long time. Eventually, and very carefully, they give it to a few humans. If results are positive, they give it to more and more humans. This is the standard sequence of human trials:

- **Phase I trials:** Researchers test the vaccine in a small group of people for a very short period of time (usually up to three months) to answer (1) Is it safe? (2) What dose is effective? (3) Are there side effects?
- **Phase II trials:** Researchers test the vaccine in a larger group of people for a longer period of time, looking at safety, dosage and side effects.
- **Phase III trials:** Researchers test the vaccine in even larger groups of people for even longer periods of time (years and years) and compare it to commonly used treatments.
- **Phase IV trials:** Once the vaccine is publically available, researchers study its effects on different populations, including long-term side effects.

Why malaria is special

According to the 2013 World Malaria Report (WHO), there were an estimated 207 million cases of malaria in 2012. Of these, 627,000 people died – the vast majority of whom were children under five in Africa. Malaria is among the top three leading causes of death worldwide. **A malaria vaccine, therefore, would quickly save millions of lives.**

Unfortunately, malaria is a parasite: a complex organism. Most vaccines target bacteria and viruses, which are single-celled and far simpler. No one has ever created a vaccine that can attack a multi-cellular organism.

PfSPZ phase I trial: 100% effective

In August 2013, the US pharmaceutical company Sanaria announced they had finished phase I trials of their experimental malaria vaccine PfSPZ.

- **PfSPZ is a weakened form of the parasite *plasmodium falciparum*.**

Sanaria gave 40 volunteers different doses of PfSPZ and then infected them with malaria. Of the six who received five intravenous injections of PfSPZ, **none contracted malaria**. In mid-September 2013, the company began phase II trials with 54 volunteers in Tanzania.

RTS,S phase III trial: 56% effective

In October 2013, the British pharmaceutical company GlaxoSmithKlein (GSK) announced they had finished phase III trials of their experimental malaria vaccine RTS,S. Phase III trials are more informative than phase I trials because they show the effects of a vaccine in the real world, over time, and on many different people.

- **RTS,S contains: (1) a protein identical to one on the surface of the malaria parasite; (2) an antigen for hepatitis B; and (3) an immune-system booster. Together they target the parasite while it is in the patient's liver and prompt an immune response that kills it.**

GSK and PATH (a US-based NGO) gave RTS,S to 15,000 infants and children in seven African countries. They found that after one year the vaccine was **56 percent effective** in children aged 5-17 months when vaccinated, and **31 percent effective** in infants aged 6-12 weeks when vaccinated. Efficacy decreased over time, however – after eighteen months it was 46 percent and 27 percent effective, respectively.

GSK and PATH gave the children a fourth booster at 18 months and in 2014 will report the results of their 32-month follow up. The European Medicines Agency and the WHO may recommend the vaccine for public use as early as 2015. If it comes on the market, GSK has pledged to price it at the cost of manufacture plus a five percent margin that will be reinvested in malaria research.

For more information

- The World Malaria Report (World Health Organization)
- The Vaccine Education Center (The Children's Hospital of Philadelphia)
- Three Ways to Make a Vaccine (The Washington Post)
- Malaria vaccine candidate reduces disease over 18 months of follow-up in late-stage study of more than 15,000 infants and young children (GSK press release)
- Sanaria's malaria vaccine yields unprecedented protection in phase I clinical trial (Sanaria press release)
- Malaria Resource Pages (The Guardian)

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