Innovation

From laboratory to market

NCCR Bio-Inspired Materials researchers are currently developing a new diagnostic method for malaria at the University of Fribourg's Adolphe Merkle Institute. This new tool could lead to fewer false positives, improve treatment protocols for patients, and help reduce healthcare costs.

The World Health Organization (WHO) estimates that in 2016, there were over 200 million cases of malaria globally, while nearly 450,000 people died because of the illness. Current WHO practices recommend diagnostic testing for all suspected cases of malaria before treatment is administered. "There are different reasons for this," says Dr. Jonas Pollard, head of the Hemolytics project. "You want to avoid overtreatment, boosting the resistance of the malaria parasite, and wasting resources, especially in countries where funding is scarce."

Rapid diagnostic testing, which was introduced in recent years, helps to distinguish between malarial and non-malarial fevers. Medical staff can then decide on an appropriate course of treatment. This inexpensive testing-strip solution has become a favored method of testing for malaria, especially in Africa, with around 270 million test kits sold worldwide in 2015. Nevertheless, this type of testing fails to detect infections in subjects whose blood contains only a low concentration of parasites, which is typical in asymptomatic carriers.

Mosquito bites are responsible for the transmission of the malaria parasite.

For countries where malaria has almost disappeared, the biggest concern is totally eradicating the disease. A person can be a carrier without displaying any physiological signs of infection. These untreated asymptomatic patients risk transmitting the disease further through mosquito bites, leading to fresh outbreaks of malaria. It is these carriers who are the prime target of the diagnostic method being developed. "You want to be able to check if someone is an asymptomatic carrier," Pollard points out. "That way you can stem the spread of the disease by further contamination, for example by carrying out checks at a border. Our method aims to be far more sensitive than the rapid diagnostic tests which are currently on the market."

The test developed by the NCCR researchers is based on a simple but ingenious principle: first, a blood sample is obtained, which in the case of infected patients contains a biomarker that the malaria parasite produces at every stage of its life cycle and that is present even if the patient displays no symptoms of infection. This biomarker also happens to be an efficient catalyst for polymerization reactions – just one molecule is enough to initiate and mediate the formation of many polymer molecules. Thus, when combined with a monomer, an appropriately worked-up blood

sample from an infected patient will, unlike blood from healthy patients, catalyze the formation of polymer molecules, and because the reaction is conducted under conditions where the polymer formed precipitates from the mixture, the initially clear test liquid turns opaque. This optical change can be observed with the naked eye and also quantified by simple measurements.

The advantages of the method do not end there. The biomarker's concentration in a sample can be estimated quickly. This could be employed to determine if the condition of a patient being treated for malaria is improving. Another advantage is the stability of the products used for the test. Most rapid diagnostic tests that are currently on the market contain antibodies and require refrigeration to avoid rapid degradation, which is not always available in some regions where the disease is most common. The new diagnostic method has been tested with temperatures up to 50 degrees Celsius for several months and the relevant compounds remained stable. Its estimated cost is not more than other tests already in use.

> "The Hemolytics project is an example of how good ideas with properly-secured intellectual property can flourish with the appropriate mentoring and financial support." Eliav Haskal

With the active support of the NCCR, the researchers have been able to obtain funding from different sources to cover salaries and development costs, including a Bridge grant of CHF 130,000 from Innosuisse and the Swiss National Science Foundation as well as a grant from the Gebert Rüf Foundation for CHF 290,000. "The NCCR's support has been crucial in getting backing for this project," Pollard reveals. "I received help defining a preliminary business plan and finding initial business contacts, and coaching to refine my pitching. This work, particularly with the NCCR's Knowledge Transfer and Innovation Manager, Dr. Eliav Haskal, has also considerably facilitated the change of my mindset from scientist to entrepreneur."

"The Hemolytics project is an example of how good ideas with properly-secured intellectual property can flourish with the appropriate mentoring and financial support," explains Haskal. "With this project's focus on a solution with significant benefits for poor countries where malaria is widespread, as an example of 'social entrepreneurship,' it depends on support from foundations and government agencies. The NCCR, with its soft-skills training, innovation coaching, and a rich and vibrant local network, can provide an environment where these novel solutions can be refined and supported long enough to succeed."

Further seed money from the Swiss government has allowed the team to test their first prototype, developed in collaboration with Fribourg's engineering school, in a clinical setting in Brazil to see if it meets the needs of local laboratory technicians.

Pollard is optimistic that there is a market for this new technology, which is why an application for patent protection was filed in May 2016. "There are currently no tools on the market which allow for accurate and sensitive malaria diagnostic with high throughput," he adds. "Our product would fill a crucial niche in the elimination of this parasitic disease." Governments of affected nations and non-governmental organizations are among the potential clients. However, they will be only interested in a finished product says Pollard, given that they cannot afford to finance development work. "Ideally, the next stages of our research will lead to a device that can be used in the field, where it is needed most."

NCCR Bio-Inspired Materials spin-offs

Nanolockin (incorporated) – nanoparticle detection, Adolphe Merkle Institute
Hemolytics – malaria diagnostics, Adolphe Merkle Institute
Microcaps – uniform microencapsulation, ETHZ
Spectroplast – silicon 3D printing, ETHZ
FenX – highly porous foams for building insulation, ETHZ