August 31st, 2016
Re: Meeting with Dr. Clive Shiff
Location: Johns Hopkins University – Bloomberg School of Public Health
Persons: Dr. Clive Shiff (Parasitologist, Professor, Researcher – Johns Hopkins University)
Shivali Barot (Policy & Practices Team Lead)

Objective

We created this set of questions for the purpose of gaining more knowledge to enrich our research project from an expert that has first-hand experiences in the areas of public health and epidemiology. All of the information we will learn will help attribute to our synthetic biology.

Interview Questions & Answers

1. *What is your advice on how to lower malaria prevalence? Are there any difficulties?*

There are several ways to lower malaria prevalence that we are currently studying today. A problem that exists is that current methods aren't sustainable because they depend on money from donors. Donation and funding is difficult to obtain which is one challenge in research involving malaria.

2. *Do you think our biosensor [or Malaria Kit] would increase the speed of malaria detection amongst gold miners? If we were to introduce it, can you think of any problems which may arise?*

[Not much specific knowledge and statistics/facts known on the correlation between artisanal mining and malaria and the biosensor] but in terms of introducing the "Malaria Kit" to miners:
No, it would be misused because they are not as well educated or as literate as the scientists these tests are designed for. The process requires malaria testing to be done in a sequence, and there are results that can be seen on it (dotted line – reagent control, bars, other indications) and you need training for using them appropriately. In Brazil for example: there are 2 different species of mosquitos that spread malaria and you have a third line for detecting the 3rd species. Interpretation needs to be precise (not a plus/minus, much more precise than that). The way miners and others deal with it now is symptomatically (e.g. person has a fever → give them this drug)
ARTIMISININE DRUG: This is a new, very strong drug used to treat severe cases of malaria (within 2 tablets, 90% of parasites are destroyed) and it is very costly (before it had to be extracted from a plant but has recently been synthesized). However, a major problem is the Selection for Resistance that will emerge. Resistant strain to this powerful drug means there will be thousands of deaths occurring until a stronger drug is introduced.

3. *Can you tell me more about the link between artisanal mining and malaria prevalence? What do you think of our "Labs on Wheels" idea?*

Labs on wheels: the mining sites are deep down in the river banks, not on flat land – they are on eroding banks. People that work there live in camps, you could have a lab on wheels → but it would be ideal to place it based on where they sleep. Local governments are trying to control this. If you can identify where they sleep at night (communities, individuals) and strategically place the "Lab on Wheels" there, it would be beneficial. Look for "mining communities" to train.

4. *Do you think our biosensor [or Malaria kit] would assist in the mapping of malaria in endemic regions?*

RDT diagnosis can detect malaria → you can text the number of cases. Where they sleep is important because that's where malaria is transmitted (miners sleep at night in a community).

5. *What is the biggest barrier to rapid detection/diagnosis of malaria and what has been done to address this issue?*

Biggest barrier: To be able to make diagnosis on-site. RDT's are good, we have shown recently that 70% of malaria cases (low infection rates) are not detectable. Then you have to use PCR and lab methods. You can take blood and dry it on filter paper and take it to the lab. GPS helps to locate it. You can get satellite data where you're working that can be used to predict if malaria is there or not. The data is revolutionizing how we study malaria in our labs in Zambia.

6. *Do you think our biosensor will reduce the financial burden of malaria control in African and South American countries where gold mining occurs?*

Looking for gold in river banks → provide an indicator that helps them do it. The government won't allow you to even bring it in because it will completely destroy the environment because it will lead to erosion and there have been droughts in the country which may have been correlated to an increase in artisanal mining. It's very difficult to get a government to allow this tool but some governments (from bribery) may allow you to do it. The biosensor will allow miners to see exactly where the gold is and they will go right for it and start digging up and the environment will get destroyed because it's a very harmful process to the soil.

7. *Challenge: It's difficult to get this 'camera app' out of the lab and into real life, do you have any possible solutions for a way around this problem?*

Everyone does have cellphones and accessing this is fairly easy but could they really benefit much? The camera app may not be their priority. Would need to train them. People may be reluctant because that's their source of income and they may not accept modern

technology as easily and prefer to continue working the way they have. There is also the issue of Land Ownership. People will find lots of land and will start digging it up and the farmers will be upset and government may punish people. They are mining their soil and the biosensor will lead to more damage and issues.

8. *The Malaria Kit needs to be sent back to the clinic to identify results, which may be an issue in some developing areas, so how do you think we can develop this idea farther so that we can solve this issue?*

RDT's work fast. Diagnoses 80% of cases. Asymptomatic malaria is something it won't pick up. No labs are needed and no time is wasted "waiting for results". You only need a clinic and a trained person who can analyze and read the results. Another issue that occurs is that the miners may not use the Malaria Kit because 2/3 of the world actually doesn't know that malaria comes from mosquitos. They believe the disease is caused by some sort of witchcraft and it's a very primitive concept as many of the miners are uneducated. They would have a difficult time accepting modern technology so it would not be a great idea to give the miners the kits directly.

9. *From a miner's point of view, how good would diagnosing malaria be for someone who is working for a living, would it even do any good?*

It would be likely to give rise to resistance which would be a crime against humanity. It would be better to not give drugs in the hands of people who don't understand how to take them.

10. *Formalization of artisanal mining and framework for policy-making.*

Currently artisanal mining is unregulated and the government needs to regulate it. There is no regulation now and resources are being exploited. Even water is becoming a scarce resource. The biosensor could help "catch the criminals" but formalizing it would be a big project to direct. The government would benefit from taxation however, but that would be a large project and lots of change needing to be made.

Dr. Shiff welcomed me warmly and I went into his office and was surrounded by a large bookcase with a plethora of books. On his desk sat two boxes (two different brands) of RDT kits and he was kind enough to show me and explain how they worked. He also spoke to me about the development of the kits, and how he was actually one of the first ones to use

them in malaria research and see them develop and grow from the beginning! I saw the tiny kits (not bigger than vaccine packages) and was able to see their function/usage. He mentioned how one RDT kit was about 50 cents USD and there are various types and the difference between different brands is the ease of which they can be read. They expire based on manufacturing dates. He spoke about his research on malaria in Zambia and his life's work devoted to this field. He was born and raised in Africa and told me about the past and current issues the countries face in terms of malaria, mining, and policy-making. Overall, he expressed the concerns of artisanal mining and how negatively it impacts the environment. It used to be controlled (you could not cultivate in streambanks, etc.) but the current conditions are different. His overall opinion was that this biosensor would lead to an increase in artisanal mining which is detrimental to the environment and so the government probably would not allow it. He gave plenty of insight on malaria prevention methods and current drugs and issues that they countries face.