1. Using Smartphone Microscopes for Detection of Parasites

Around the globe, 760,000 deaths are recorded annually among children under five years of age due to diarrhea. In Nepal as well, Diarrhea is one of the major causes of death and morbidity among children of the same age group (Budhathoki et al., 2016). Diarrheal diseases are mostly caused by the consumption of food and water that are contaminated with parasites namely giardia and cryptosporidium. There are various methods that are in use to detect these parasites such as by use of a fluorescence microscope, ELISA test and PCR kits. Brightfield microscope has been one of the most common methods that is used to detect parasites and is commonly available in diagnostic laboratories. But, in a geographically diverse region like Nepal, the aforementioned methods cannot be suitable in all kinds of settings, particularly in resource-constrained ones. In order to make these methods functionable, we need expensive lab setups, experts to analyze the samples and there are also other costly reagents.

Cost of traditional microscopes range from US$ 1,500 to US$ 75,000. Our partners from Kathmandu Institute of Applied Sciences (KIAS) have developed a smartphone microscope for detecting diarrhea parasites that will cost just US$15 (Shrestha et al., 2020). Its utility has been validated in vegetables and water samples for the two most common parasites that are usually detected by using microscopy: Giardia and Cryptosporidiumile this low-cost and portable microscope can be easily made available in low-resource rural areas, for countries like Nepal another challenge remains: lack of experts to detect parasites from images captured by the microscopes. In this project, we intend to address this challenge by building AI-assisted parasite detection tool so that non-experts working in health care and community care settings can use the smartphone microscope to test for parasites.

The first step of building an AI-based tool is creating a large annotated database of images that contain parasites. There aren't any publicly available datasets for the two parasite cysts using microscopic images in different types of samples such as water, raw vegetables and stools. With support from Lacuna Fund, we are building a large annotated database of microscopic images, both traditional brightfield and our low-cost smartphone microscope, where Giardia and Cryptosporidium cysts are identified in water, vegetables and stool samples. Moreover, the annotations will be done by both experts and non-experts so that it can be used later to assess the performance of AI models in both the contexts of experts' availability or unavailability. The proposed dataset will enable a much more comprehensive evaluation, for instance, comparison on challenges of domain shift (change in slide matrix from water, food and stool). We have already developed a web-based platform where multiple centers can upload microscopic images, and annotators can login and annotate images. We are in the data collection phase.

This multidisciplinary project has included people from different dimensions including researchers and professionals including AI researchers, microscopy and optics experts, chemistry and low-cost device experts, clinicians, pathologists and public health experts.

Our clinical partners will help us collect datasets, provide stool samples and also make these datasets and images available to us for further research and exploration.

PROJECT IN SUMMARY

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