

Portable Microscopes in the Developing World

Many vets take it for granted that they can send a sample to the lab and get a diagnosis in a few days. However, for most of the world, this is not practical. So, how could the latest generation of portable microscopes provide faster, more reliable, diagnoses far from the lab?

Leaving the Laboratory Behind

In May 2015 a BBC camera crew watched horrified as 200,000 Saiga Antelopes died in just a few days on the steppe of Kazakhstan¹. This sparked off a major research collaboration led by the Royal Veterinary College, meticulously working through the evidence to uncover the cause of such a shocking event.

Munib Khanyari of Bristol University describes conditions in the field: "Working in remote and harsh locations such as the Kazakh Steppe or the Indian Trans-Himalayas means doing fieldwork many kilometres away from basic necessities and comfort. It is a logistical nightmare to store and safely transport samples, frequently resulting in their contamination or loss. Often it is difficult to obtain permits to transport samples out of the study area. In such cases having a portable microscope enables in-field analysis of samples, improving efficiency and ease of robust science." His colleague, Hannah Vineer, adds: "When working in extreme weather conditions samples can perish quickly. I have found having a portable microscope with image capture really useful to get a second opinion. It also came in handy when our main laboratory microscope fell apart as soon as we arrived at our camp in Kazakhstan after several bumpy days on the road to reach the site!"

A microscope is an essential tool for research, but as scientists monitor the global impact of climate change, they increasingly operate in remote parts of the world. It is often impossible to get samples to a lab without significant degradation and just as hard to use a fragile



Schistosomes, courtesy of Liverpool School of Tropical Medicine and ioLight

and cumbersome bench microscope in the field. There is an interesting history of field microscopes such as the much loved MacArthur microscope². In the past, these have been fiddly to use or simply not good enough for serious field science. Furthermore, they did not record images of sufficient quality for scientific reports and analysis. However, the latest devices use the same sample preparation as a lab microscope – usually a flat or concave microscope slide or a standard counting chamber. They offer all-day battery life and can be charged from a solar charger. They typically interface to a standard mobile phone app with a wireless connection, so images and videos are simple to save and share using standard photo apps or social media. These microscopes are already in use on expeditions in Kazakhstan and other remote sites of scientific interest and look set to become an essential tool for veterinary research.

Microscopes for the Many

However, it is not just research scientists that benefit from the new technologies. The latest microscopes use mobile phone components and technology so there is the potential to make these cost-effective instruments available to anyone.

The University of Surrey's digital animal health group, vHive³, has been exploring the potential impact of the new diagnostic tools in Uganda and Nigeria. Veterinary Epidemiologist, Dr Abel Ekiri, said: "Due to limited diagnostic capacity in rural settings, animal samples requiring basic lab diagnostics have to be shipped long distances, which can increase costs and lead to delays in diagnosis, impacting health outcomes in both human and veterinary patients." Ekiri adds that: "The use of conventional light microscopes as a diagnostic tool requires a facility with electricity and a skilled laboratory technologist." Portable microscopes are simple to operate and battery-powered. They can be carried easily in a clinician's bag on a motorbike to remote rural areas and



Munib Khanyari on site in Kazakhstan



A lab in The Gambia, courtesy The Gambia Horse and Donkey Trust

to urban clinics. Mobile microscopes help to diagnose helminths in farm animals, which impair productivity, and schistosomes, which infect hundreds of millions of people with schistosomiasis (bilharzia) every year⁴. Potentially, malaria could also be detected.

The presentation of images and videos on the screen of an iPad® is invaluable. Heather Armstrong, Director of The Gambia Horse and Donkey Trust, adds: “what I think is helpful is that farmers can see for themselves if their animal has worm eggs in their samples and they are really fascinated by it. In addition to helping us, it is really helping to increase the owners’ understandings of the problems as well.”

The Gambia Horse and Donkey Trust works with farmers to help keep their animals healthy. A healthy working animal can increase a farming family’s income by up to 500%⁵ and buying an animal is a big investment for a family. If the animal becomes sick or dies, the owners suffer too. This work, therefore, sustains families that might be unwilling to accept charity for themselves. “For a small charity where every penny counts, it saves a great deal of money to be able to do blood and stool tests on the spot and to treat accordingly. Working in The Gambia we often travel large distances with our mobile clinics and being able to test and treat saves us a great deal of time, fuel and wear and tear on the vehicles.” Armstrong is also keen to use portable microscopes to learn from the mistakes made at home: “they will also ensure that we do not contribute to creating the worm resistance problems that we see in the UK⁶.”

Impact in Research Expeditions and Global Health

The availability of portable, high-resolution microscope technology has the potential to make a really big difference to field researchers, local clinics and charities globally. Current devices are not yet as flexible as

laboratory microscopes. Nevertheless, the ability to record images and videos of subjects as small as 10 microns on a mobile phone from a device that fits in a jacket pocket has already helped expeditions in the Amazon, Alaska and Antarctica for which it would not have been practical to use a conventional microscope. There is every possibility that these portable instruments will also prove valuable in remote health applications.

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Andrew Monk

Andrew Monk is passionate about getting scientific innovation to the forefront of animal health and into the veterinary community. With Richard Williams, he is a co-founder of iolight Limited. Together, they realised that

there was an opportunity for a high-quality portable microscope using the latest developments in smartphone technology. Previously, Andrew was CEO of semiconductor fab Innos Limited and Président of GLOphotonics SAS. He has a masters degree in physics from the University of Oxford.

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