Mobile phone and handheld microscopes for public health applications

Microscopes are crucial for diagnosis of both communicable and non-communicable diseases, and are an essential tool in public health laboratories; unfortunately, these are not available to more than a billion people who live in resource-constrained settings.[1] Over the past decade, there have been several important advances in the development of low-cost, portable microscopy tools designed for use in resource-limited environments. Handheld microscopes, particularly those interfacing with a mobile phone, hold promise for facilitating the provision of equitable health care to those living in underserviced setings.[2–4]

Mobile phone microscopes have several attributes that could make them useful in public health practice. The microscopes are portable and battery-powered, hence they can be easily transported to multiple settings and do not require stable grid electricity.[3,4] Images can be digitised and software or off-site experts can support the diagnostic process.[5] Global positioning system coordinates can be linked to diagnostic results to map disease burden in real time. Cases in which mobile phone microscopes have been successfully used include for detection of malaria,[6] *Loa loa*,[7] schistosomiasis, and soil-transmitted helminths,[8] a set of diseases that disproportionately afflict those living in settings with limited access to conventional diagnostics. Also, initial results on applications related to diagnostics of non-communicable diseases show promise and can address the paucity of experts in low-resource settings through remote diagnostic support.[9]

Still, several hurdles lie ahead that must be overcome before implementation and scale-up of mobile microscope technology: validation, durability, sample preparation, and last mile problems. First, before implementation, validation of these devices in real-world conditions—by individuals who will use these devices in their day-to-day public health practice—is crucial to ensure appropriate design and diagnostic operating characteristics. Second, mobile phone microscopes, much like conventional light microscopes, should be durable, and capable of a broad range of diagnoses, rather than being designed for a single purpose, such as malaria diagnoses. Furthermore, a critical limiting factor to the reach of portable microscopes is availability of infrastructure for sample preparation. Even ideal, affordable microscopes will have limited use without similar engineering advances in sample preparation, performed under austere laboratory conditions. Finally, devices must have the ability to overcome the so-called last mile problem in their translation into global health practice, by development of viable strategies for manufacturing, intellectual property, regulation, and business commercialisation to reach the intended population.[10]

Mobile phone microscopes are an exciting addition to our public health toolkit. Cooperation between diverse stakeholders—engineers, clinicians, public health providers, government officials, business leaders, and policy makers—can ensure proper design, validation, and implementation of these tools, to enable their translation from the research laboratory to public health uses.

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