

# Photonic Technologies for Mobile and Global Health

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## **Abstract**

Smartphones and other mobile technologies will be transformative to the deployment of molecular diagnostics both domestically and worldwide. In this talk, I will review the existing commercial and technical roadblocks to the deployment molecular diagnostics to the consumer market and how they can be fundamentally altered by taking advantage of the now ubiquitous installed base of smartphones. In addition to covering the basic engineering science advancements that led to the development of these technologies, I will also discuss our strategies for deployment and commercialization. I will discuss two technologies in this talk.



**Figure 1: (Left) Nutriphone technology (Right) KS-Detect on display in Kitale, Kenya.**

**KS-Detect: Solar-Thermal PCR for Nucleic Acid based diagnostics in limited resource settings.** Kaposi's sarcoma (KS) is one of the most common cancers in men and women in sub-Saharan Africa. KS is difficult to distinguish from other diseases, particularly in Africa where access to trained pathologists is limited to a few hospitals and immunohistochemistry is practically non-existent. Recent studies have suggested that PCR based nucleic acid identification of high levels of the Kaposi's sarcoma-associated herpesvirus (KSHV) in skin biopsies represents the best method of performing an unambiguous diagnosis in the absence of immunohistochemistry. KS-Detect is a PCR based point-of-care diagnostic system that uses solar power (when operating in infrastructure free mode) or LEDs (when stable electrical power is available) and smartphone technology to enable diagnosis of Kaposi's sarcoma in limited resource settings. The advantages of the system are that (1) it can be operated with or without access to electrical or other fixed infrastructure, (2) it is much cheaper and easier to repair than comparable technologies, and (3) it is ultra-low power enabling a much larger number of tests to be run. We have conducted pre-clinical trials with users at sites in Kenya and Uganda and have already added additional features based on user feedback such as indoor lighting use. The

system will be the first technology that allows for field based identification of viral content of skin biopsies without reliance on external infrastructure.

**NutriPhone – Nutrition Diagnostics on your smartphone.**

Vitamin and micronutrient deficiencies are responsible for a multitude of adverse health conditions including: anemia, rickets, scurvy, adverse pregnancy outcomes, infant growth inhibition, osteoporosis, and cancer. Worldwide a large number of people die every year from vitamin A and zinc deficiencies alone. Domestically as many as half of patients with hip fractures are thought to be vitamin D deficient. Fortunately, many deficiencies and their symptoms are reversible through changes in diet or by taking supplements, particularly if detected early. Very few people however have information as to their own personal micronutrient status, what the potential outcomes of their deficiencies are, or the recommended treatments. Our “NutriPhone” technology will be the first system that allows users to accurately track an element of their personal nutritional status using direct biomarker analysis rather than relying on infrequent physician’s visits or guesses based on diet. The system comprises of: an accessory that attaches to the back of the smartphone, custom test strips that accept a blood sample and conduct the detection assay, and a software app. The app operates the smartphone’s imaging system, interprets the test strip results, displays the results to the user in an intuitive fashion, and provides therapeutic suggestions if needed. Development of a simple, cost-effective, and familiar technology that would provide this information to users could significantly enable healthier living.