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Automated disease diagnostics for low-resource areas using mobile phones

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Background: Technology that enables disease diagnosis is fundamentally complex. In low resource areas, the degree to which a diagnostic technique can shield the user from that complexity largely determines its usefulness. RDTs, which convert an intricate chemical reaction into an easy-to-visualize readout, have become widespread and popular. Diagnostic microscopy, which is needed for both screening and confirmation of many diseases, continues to be limited by the need for support from a well-equipped clinical environment. While a microscope sufficiently simplifies the act of *microscopy* it does not adequately address the complexity of performing a *diagnostic*, as experts are needed to both acquire and analyze images before a result can be provided to a patient, dramatically reducing the impact that diagnostic microscopy could have in disease diagnosis and elimination efforts in low-resource settings. It is time to rethink how we perform diagnostics with microscopy.

Methods: Our approach is to use automation and algorithms to construct fully integrated microscopy-based diagnostics. By leveraging the mass production of consumer electronics such as mobile phones, we can design inexpensive automated devices with extremely low recurring costs for low-resource areas. By using state-of-the-art algorithms, we can provide rapid, quantitative diagnoses without the need for expert microscopists. And by analyzing large quantities of data collected by the automated devices, we can continuously improve the algorithms to provide quality-controlled diagnostic capabilities.

Findings: Here we present an approach that utilizes automation and integration to quantitatively diagnosis *Loa loa* infection at the point-of-care to allow resumption of MDA campaigns. We use hobby electronics to actuate a sample of whole blood in a glass capillary, and a mobile phone mated to inexpensive optics to both image and analyze the sample, providing a quantitative diagnosis in only 2 minutes.

Interpretation: These devices illustrate a framework for the expanded use of diagnostic microscopy in low-resource areas that we are extending to tuberculosis, malaria, soil-transmitted helminths, and other infectious and noncommunicable diseases.

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Abstract #: *1.013_TEC*

Implementation of an electronic surgical registry in a low-middle income country: Assessing organizational readiness using the theoretical domains framework approach

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Background: While the benefits of using electronic health records (EHRs) in both developed and low-middle income countries (LMICs) are known, the barriers and facilitators to implementing EHRs in LMICs have not been characterized. Through an implementation science approach, we assessed organizational readiness for EHR implementation on a surgical service in an urban LMIC hospital.

Methods: 6 semi-structured focus groups were conducted with 4 hospital administrators, 3 faculty surgeons, 20 surgical residents, 6 interns, 10 nurses, and 12 medical students in a large urban hospital in Paraguay. Focus groups were conducted over the course of three weeks during the pre-implementation phase to identify barriers and facilitators to implementation. Focus group data was coded using the Theoretical Domains Framework (TDF), which are 12 validated domains related to behavior change, in order to evaluate organizational readiness for adaptation of the EHR tool in place of paper records. The study was approved by the University of Pittsburgh IRB.

Findings: Reinforcement, environmental context and resources, and roles and responsibilities were the three most relevant TDF domains that emerged from the data. Residents asked fewer questions about technical aspects of the tool than interns and students. Department heads were more confident about successful, widespread use of the tool than junior-level trainees. Residents, interns and students were more uncertain than faculty and department heads about who would enforce the use of the tool in place of paper charting. Triage nurses were more concerned than other stakeholders about the feasibility of learning to use the novel tool given the frequently rotating shifts among triage nurses. Internet quality was a concern raised by all groups.

Interpretation: Uncertainties about reinforcement, roles and responsibilities for using the novel EHR tool are important potential barriers to be addressed in the pre-implementation phase of introducing an EHR to an LMIC surgical service. Concerns about environmental context and resources, including hospital workflow and Internet quality, were key points raised. The findings are limited to implementation of an EHR on a surgical service of an LMIC hospital, and generalizability may vary based on hospital and country.

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Point-of-care drop-based microfluidics platform using isothermal amplification for the quantitative detection of *Mycobacterium tuberculosis*

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Background: Tuberculosis (TB) is a serious global health problem with 9 million new cases and approximately 1.5 million deaths worldwide every year. A majority of TB deaths are caused by late or unavailable diagnosis. Given the availability of effective treatment strategies for TB and the extremely frequent airborne transmission of the pathogen *Mycobacterium tuberculosis*, it is vitally important