

The program for cancer detection, diagnosis, and treatment technologies for global health: A pathway for the translation of affordable, minimally-invasive point-of-care technologies to less-resourced settings

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Program/Project Purpose: Cancer kills more people worldwide than HIV/AIDS, tuberculosis, and malaria combined, and low- and middle-income countries (LMICs) bear the majority of this burden. While success in detection, diagnosis, and treatment has been reported in LMICs through the use of low-cost, point-of-care technologies, this area has largely been overlooked by the medical device industry and venture capital, as low-cost/affordable solutions offer less financial incentive for investment. The program presented here simplifies the pathway to market by funding investigative teams to adapt and validate existing technologies in low-resource settings. This program specifically supports the translation of these technologies, prioritizing patient outcomes in a manner not typically seen in other programs.

The program, currently in its second year, will soon support 13 technologies for cancer detection, diagnosis, and treatment (e.g., in vitro assays, imaging devices, ablation devices). It is anticipated that by year seven of the program, at least nine projects will have progressed through optimization, clinical validation, and business planning for dissemination and commercialization, uniquely leveraging these devices for success in clinical translation.

Structure/Method/Design: Each project consists of an adaptation phase (2 years: \$500k total costs/year) and validation phase (3 years: \$1M total costs/year). Projects are selected through NIH peer review with a carefully selected special emphasis panel briefed on the goals of the program. These projects are subsequently competitively selected for phase 2 funding based on completion of first-phase milestones.

All teams contain expertise in engineering, oncology, business and manufacturing, and are partnered with in-country global health organizations, positioning them for success in the validation and translation of their technologies.

Outcome & Evaluation: The seven preliminarily-funded projects are making strides in optimization, and several have initiated field validation via their in-country partners. The presentation will detail each project's specific outcomes.

Going Forward: It is anticipated that teams will experience similar yet distinct challenges, with each site presenting unique institutional (e.g., IRB) and regulatory issues. However, the program's structure will enable collaboration and information exchange through an active steering committee.

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Benefits of teleconference case discussions for residents on a global health elective

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Program: Telemedicine and international collaboration are promising avenues to improve healthcare services and medical education in low-middle income countries. Telemedicine conferences can be used to bridge the gap between residents training abroad and their home institution. The role of teleconferences in global health training has yet to be evaluated.

Methods: Each year, eight to ten residents from the University of Pittsburgh Medical Center Internal Medicine Residency Program travel to designated training sites including Kamuzu Central Hospital in Lilongwe, Malawi, and Sao Lucas Health Center and Hospital Central in Beira, Mozambique. At these sites, residents spend two consecutive months providing healthcare services to the local community and precepting medical students. To discuss global health cases, telemedicine conferences are held weekly between Pittsburgh and the abroad sites. Residents present clinical cases encountered during the week with accompanying photographs of physical examination findings, x-rays, or ultrasound to global health faculty including infectious disease physicians and generalist with clinical experience in sub-Saharan Africa. Host trainees are encouraged to join the discussion. Residents are expected to discuss diagnostic dilemmas, management decisions, and treatment options within the confines of limited resources. For this study, residents that traveled abroad between 2013 and 2015 were administered a 10-question survey regarding the benefits and drawbacks of the weekly telemedicine conferences.

Outcomes: 93% (14/15) of residents in the study completed the survey. All residents reported that feedback from faculty during the teleconferences was helpful. Most residents cited the benefit of advice obtained on management plans, diagnostic approaches, and clinical reasoning. The majority of residents (86%) reported that the teleconference altered their management plan in greater than 75% of cases. Residents also cited that emotional support and regular contact with mentors and home institution were an invaluable asset of the conferences. Residents recommended increasing the frequency of the sessions to biweekly.

Conclusions: Weekly telemedicine conferences provide global health residents an opportunity to discuss interesting as well as challenging cases encountered while abroad. These discussions are integral to the resident's training and may increase the educational yield of the global health experience for both the US and host country trainees.

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Establishing sickle cell diagnostics in Malawi using hemoglobin electrophoresis

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Background: Sickle cell disease (SCD) is highly prevalent in sub-Saharan Africa; however, resources for accurate diagnosis and treatment are largely unavailable. Prior to December 2014, neither neonatal screening nor standardized methods for SCD diagnosis were routinely available in Malawi.

Methods: We initiated alkaline hemoglobin electrophoresis (HbE) for SCD diagnosis in the capital city of Lilongwe in November 2014. Alkaline HbE is an affordable and reliable diagnostic test for hemoglobinopathies including SCD. Site-specific standard operating procedures and protocols were developed and incorporated into an existing laboratory facility maintained by UNC Project Malawi, A 20 year old collaboration between the Malawi Ministry of Health and UNC. An imperative of this work was to train local Malawian laboratory technicians and clinicians on how to use and interpret the test results to ensure long term viability of the test.

Findings: Between January and May 2015, a total of 137 sequential patients with clinically suspected SCD were enrolled. Of those enrolled, 117 patients were confirmed to have HbSS, two were HbAS, 12 were HbAA, and the diagnosis was uncertain in six patients. Of 125 children who were chronically cared for as SCD patients prior to enrollment, 107 (86%) were confirmed to have HbSS. Patients were principally from the central region of Malawi with most living within the Lilongwe city limits. However, 9% of patients presented from non-Lilongwe districts and some patients were from up to 500 km away. Alkaline HbE was easy to set up and operate, inexpensive compared to other gold standard tests, and reliably delivered prompt and clinically meaningful results to patients and clinicians. We found that HbE was easily accommodated within existing UNC Project Malawi laboratory infrastructure. Our estimates put the cost per test at 3-4 USD, accounting for equipment and reagents but not indirect costs such as electricity, space, and personnel.

Interpretation: The implementation of decades-old technology now provides a foundation for future studies to understand the natural history of SCD in Malawi and develop intervention strategies appropriate for the setting to improve outcomes.

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An assessment of essential maternal, newborn and child health equipment at Kenyatta National Hospital: Filling critical knowledge gaps to inform program design

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Background: WHO guidance on essential interventions for the management of reproductive, maternal, newborn and child health includes the availability of high-quality medical equipment that is

accessible, affordable and context appropriate. However, medical equipment is often unavailable in low-resource settings, exacerbated by human resource shortages and training capacity. This paper presents findings from a needs assessment conducted at Kenyatta National Hospital to assess gaps in the availability of equipment in the labor and delivery and neonatal units and to identify the factors that contribute to the limited availability of equipment.

Methods: We employed a descriptive study design and collected data from clinical, engineering and administrative staff in the procurement, labor, and delivery, neonatal and biomedical departments. Data collection included hospital statistics, thirty key informant interviews, and twelve clinical observations. Key informants were selected using convenience sampling. The study was approved by the KNH Ethics and Research Committee and written informed consent was obtained from all interviewees as well as patients and guardians (where applicable) participating in the clinical observations.

Findings: While hospital statistics revealed a 6% increase in the number of deliveries between January 2010 and December 2013, there was a 46% increase in the number of low birth weight infants delivered at KNH. Examination lights and delivery beds were found to be insufficient in number and often had limited functionality due to defective components like missing light bulbs or faulty hydraulic systems. Suction machines, resuscitation tables, vacuum extractors, and incubators were reportedly regularly unavailable due to frequent breakdowns owing to overuse and irregular maintenance schedules. The difficulty in locally procuring spare parts was a significant finding across all pieces of equipment.

Interpretation: Based on these findings, Kenyatta National Hospital and University of Nairobi will co-design prototypes that take into account the unique needs of clinicians and hospital engineers working in low-resource settings with a special focus on the availability of spare parts locally. The first batch of prototypes will be for suction machines, vacuum extractors, examination lights and phototherapy machines.

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Technology and innovation in global health leadership education: A new model

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Program Purpose: From addressing outbreaks to climate change, global health professionals increasingly require leadership skills, training, and diverse professional networks to successfully work across teams and cultures. Advances in technology provide opportunity to innovate and transform global health education into virtual global learning experiences where the above can be gained. This study presents an innovative educational model of global health leadership launched in Fall 2015 - "Global Health Live" - which