

further training, and perceived barriers to expanded use. In addition, eight focus group discussions (FGDs) were conducted with both current EM residents and various faculty members to gather additional qualitative insight into current practice patterns and perceived barriers.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): Eighty clinicians completed the survey, 69 of whom were EM residents and are included in the analysis. The response rate for our study among all current EM residents in Colombia at the time of administration was 85%. Fifty-two percent of resident respondents had previously used an ultrasound machine during their training; however, of these, 58% indicated that they had performed <10 scans and only 17% reported >40 scans. The most frequently used applications indicated by respondents were trauma, obstetrics, vascular access, and echocardiography. Only a quarter indicated that they had ever received any formal ultrasound training, but all indicated interest in learning more. Significant barriers to ultrasound training included lack of trained faculty teachers (indicated by 78% of respondents), absence of ultrasound machines (57%), and limited time (41%). In FGDs, additional barriers identified were inter-specialty conflicts over the control and charging of ultrasonography, both institutionally and nationally, as well as program-specific curricula decisions regarding the importance of POC US within EM practice. **Summary/Conclusion:** While currently limited, EM residents in Colombia have a strong interest in integrating POC ultrasound into their practice and training. The many current barriers to its expanding use reflect both traditional barriers such as a lack of equipment seen in many lower income developing nations as well as inter-specialty conflicts typical of more high- and middle-income developed countries. Further collaboration is underway to overcome these barriers and further integrate POC ultrasound as a standard of care into Colombian EM residency training.

The role of mobile health technologies in improving community health seeking practices in rural Uganda

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Background: Recent studies have shown that mobile health (mHealth) technologies have become increasingly integrated into health care delivery systems. Systematic reviews of previous studies on mHealth in developing countries have demonstrated that mobile technologies may be a useful platform to deliver messages not only to track health behavior change, but also to improve behavior change communication. The objective of this study is to identify how current mHealth programs are being utilized in rural clinics and what improvements can be made to connect the community health care infrastructure via mHealth in order to augment health care delivery. **Structure/Method/Design:** Key informant interviews and focus groups were conducted over a 3-week period in seven villages surrounding Engeye Health Clinic in Ddegeya, Uganda. Local stakeholders included, Volunteer Health Team personnel (VHTs), health care providers, and local leaders. Focus groups incorporated a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis strategy with VHTs. Questions were grouped into categories of VHT job description, perceptions and challenges as a VHT, interactions with Engeye Health Clinic and attitudes regarding the government-sponsored mHealth program, “mTrac.” Translation was provided from local trained interpreters. Qualitative analysis through iterative-grounded theory was used to code and develop themes.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): Seven focus groups were conducted, with a total of 19 key informants participating in interviews. Key findings from data demonstrate that VHTs function primarily as “front-line” community health workers in remote, low-resource communities. They provide access to medications and referrals to government health care facilities. They also operate as the ground-level surveillance team for the national health system, sending weekly mTrac text message reports to the Ministry of Health. VHTs are a main source of health education to the community. Challenges include a need and demand for more VHT training, inadequate assistance from the local government, maintaining medication availability, lack of consistent electricity for mHealth reporting, and transportation restrictions. These results indicate critical gaps in the local health care infrastructure that need to be addressed in order to establish more efficient delivery of health care services.

Summary/Conclusion: Ensuring flow of accurate and timely health information, education, and supplies encompass the primary challenges faced by VHTs and the health system. Engeye may serve as a linchpin in connecting mTrac and other government health programs to the provision of health care at the community level. Through proximity and the services that Engeye already offers, the clinic may strengthen the roles that VHTs have in empowering the communities to take charge of their health and well-being. Further work is needed to assess how this can be accomplished.

iNurse: Intelligent, low-cost pediatric vital signs monitoring system

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Background: Within the developing world, hospitals and clinics operate with low resources, lack of health infrastructure, and an insufficient number of physicians and nurses—particularly in pediatric wards. As a result, health staff are chronically overwhelmed, and unable to adequately monitor infant patients due to high patient-to-nurse ratio common in such low-resource settings. With no effective vital signs monitoring system, poor health outcomes are rampant, since these medical staff are unable to be alerted during acute infant distress and cannot track pediatric health outcomes over time.

The iNurse is a medical device that addresses this critical health care need by providing continuous, low-cost, and intelligent vital signs monitoring for neonates. Specifically, this system allows for the short- and long-term tracking of infant heart rate, respiratory rate, and body temperature, coupled with an alerting system to notify medical staff of distress and a feedback mechanism to wake neonates from apneic episodes. All vital signs data is transmitted wirelessly to an Android tablet computer, allowing for the tracking of up to 30 patients from a single “central hub.”

Structure/Method/Design: This iNurse consists of a dual belt system, and employs two embedded stretch sensors in parallel that capture respiratory expansion and contraction in both the infant chest and abdomen. The lower belt also contains an embedded surface thermistor to provide accurate abdominal skin temperature measurements. Both belts contain electrocardiogram (EKG) probes in a standard three-lead configuration, from which heart rate data is extracted. At scale, we project the iNurse to have a manufacturing cost of under USD 75.

The iNurse has undergone preliminary testing on both adult patients and a simulated neonatal test bed platform. In current trials, the device demonstrates greater than 95% clinical accuracy for all vital signs.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): Rice University: Departments of Bioengineering, Electrical Engineering, and Institute for Global Health Technologies. **Summary/Conclusion:** The commercialization of a technology in the developing world is a formidable barrier, and we have spent significant time analyzing the business-related factors necessary for implementation of our project.

We project a conservative market demand of 600,000 units in Africa and South Asia, and believe that iNurse has vibrant commercial potential in developing countries, but also in developed settings as an “at-home” baby monitor. Our next steps will be to refine the iNurse design and achieve clinical validation.

mPheresis: Dialysis-like device for magnetic filtration of ring-stage Plasmodium falciparum-infected and methemoglobin-carrying red blood cells

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Background: The Plasmodium falciparum malaria parasite causes nearly 1 million deaths per year across more than 100 countries. The parasite invades the host's red blood cells (RBC), feeding off of the RBC's hemoglobin and then creating a small magnetic crystal byproduct called hemozoin. After 48 hours, the parasite multiplies, the invaded RBC bursts, and the parasite lifecycle repeats in a new cell. In a short period of time, the amount of infected red blood cells (iRBCs) can reach 30%-50% of the total RBCs. Severe malaria occurs when the concentration of iRBCs is above 5% and can lead to death in less than 24 hours. Therapies include parental quinine or artesunate treatments. However, parasites can become resistant to these drugs limiting their effectiveness. Exchange transfusion (ET) has been proposed as an adjunct treatment to rapidly reduce the iRBCs count. The treatment remains the subject of clinical research to establish its effectiveness.

Structure/Method/Design: mPheresis, a magnetic dialysis-like device, has been developed to remove the patient's iRBCs without removing the healthy RBCs while minimizing the loss of the patient's plasma. mPheresis, therefore, is a safer alternative to ET, which is more accessible than ET to low-resource setting where blood supply is limited. Here, preliminary data on the first device prototype is reported. Experiments were conducted using in vitro malaria-infected RBCs as well as a blood analog composed of a mixture of normal RBCs and methemoglobin RBCs (metRBC). Methemoglobin is a modified form of hemoglobin (metHb) that occurs naturally in low percentages in humans. metRBC has similar magnetic properties as iRBCs, acts as a safer iRBC analog, and can be created on a bench top. Tests were conducted with multiple hematocrit percentages and flow rates.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): Accel Diagnostics

Summary/Conclusion: The concentration of metRBC was reduced by as much as 14% in a single pass at a flow rate of 0.05mL/h. Ongoing works include design modifications to increase efficiency and capacity. In addition to the application for cleansing malaria infected blood, the mPheresis could potentially be used as an alternative to ET in other disease management, such as sickle cells disease, which also affects people in developed countries.

Efficacy of technology-driven interventions targeting hospital equipment breakdowns in Zanzibar, Tanzania

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Background: Clinical engineering is often a secondary priority in resource-poor hospitals, where securing trained medical staff is more pressing. An estimated 70% of hospital machinery in the developing world is broken.

This not only deprives patients of access to medical technology, but also gives rise to systemic hospital inefficiencies: Earnings are lost when procedures cannot be done, and expenses increase when major breakdowns require internationally procured parts and service representatives. The solution lies in reducing dependency on internationally sourced expertise and materials, and building in-house technical capacity for clinical engineering.

This project investigates the causal factors behind breakdown rates in hospitals in Zanzibar, Tanzania. It quantifies the impact of breakdowns on the ability of hospitals to provide care. Finally, two technical solutions are developed and implemented to target these causal factors, and their efficacy is evaluated.

Structure/Method/Design: Baseline equipment utilization and breakdown rates are established in Zanzibar's two largest public hospitals. Over the course of a 3-month needs assessment, key informant interviews and observational studies are conducted to identify gaps in the procurement, maintenance, and repair strategies of these hospitals. Based on these findings, two solutions (a 4-month repairs training program and an inventory management software) are developed and implemented in both hospitals. Efficacy of these solutions is evaluated based on changes in breakdown rates, cost savings on repairs, and revenue from services.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): Health Care Engineering Unit, Ministry of Health, Zanzibar

Ministry of Health, Zanzibar

Office of the Second Vice President, Zanzibar

College of Health Sciences, State University of Zanzibar

Summary/Conclusion: The two major gaps identified in mobilizing broken equipment include: lack of expertise in repairs and maintenance, and lack of organizational structure by which to identify and prioritize repairs. As a result, two solutions are developed: a 4-month in-hospital training program for local technicians that targets repairs for the most common types of breakdowns each hospital's respective inventory, and a workflow management software for technicians.

Evaluation of the combined impact of both solutions reveals that USD 308,953.00 of broken medical equipment was put back into service at a cost of only USD 518.00 in parts and tools, compared to industry-standard maintenance costs of 10% (USD 30,895.30). Impact on breakdown rates by department, hospital revenue, and cost savings are discussed. Strategies for cost-effective clinical engineering in resource-poor hospitals are suggested.

The African trauma chain of survival: Proposing a model of integrated care

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Background: The low- and middle-income countries (LMICs) of sub-Saharan Africa (SSA) bear a disproportionate global burden of