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.

mPharesis: 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 cells. 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: mPharesis, 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. mPharesis, 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 mPharesis 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