

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

disease attributable to trauma. Emergency care is a high-impact and cost-effective form of secondary prevention. In response, the World Health Organization (WHO, 2005), the World Bank (2007), and the African Federation for Emergency Medicine (AFEM, 2013) have advocated integrating pre- and in-hospital phases of trauma care to strengthen the trauma “chain of survival.” Experts reports that integrated care systems may reduce the burden of disease from trauma, but their prevalence in SSA remains unreported. The primary objective of this study is to determine the prevalence of complete trauma care systems in SSA, and secondarily, where incomplete trauma care systems exist, to categorize and describe those components.

Structure/Method/Design: Three investigators separately conducted a comprehensive review of published and “gray” literature using combinations of search terms, including “trauma, injury, trauma care, system, acute, emergency, emergency medical services, prehospital, road traffic injury, sub-Saharan, Africa.” Other inclusion criteria included publication year (2000-2013), and relevance to emergency and health care systems. Articles were categorized by country and by phase of pre- and in-hospital emergency care.

Results (Scientific Abstract)/Collaborative Partners (Programmatic Abstract): 154 and 32 reports from the published and gray literature, respectively, satisfied the inclusion criteria. Five distinct phases of care emerged from the literature review: system activation, first-responder care, formal prehospital care, emergency transportation, and facility-based emergency/definitive care. Of 47 World Bank LMICs in sub-Saharan Africa, only one country, South Africa, reported the existence of trauma care systems with all five phases of care. The literature indicated the existence of fragmented, functional components or phases of trauma care systems in several countries, including Botswana, Ethiopia, Ghana, Nigeria, Kenya, Mauritius, Rwanda, Tanzania, Uganda, and Zambia. Examples of the phases identified include system activation (SMS text messaging, public transport vouchers, centralized toll-free access numbers), first-responder care (organized and informal community-based volunteers), prehospital care/transport (two-wheel, three-wheel, and four-wheel ambulances, air ambulances), in-hospital emergency/definitive care systems (accident and emergency centers/units).

Summary/Conclusion: Our review identified five distinct phases of trauma care operational in various systems across SSA. If meaningfully integrated in a locally appropriate manner, they could comprise an African trauma chain of survival. South Africa was the only country with all five functional and integrated components. Further advocacy and development for integrated trauma care systems are needed across SSA to help relieve the burden of disease from trauma.

The wooden skull: An innovation through use of local materials and technology to promote the teaching and learning of human anatomy

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Background: The increasing numbers of medical institutions and medical professional students is a global reality which positively addresses Medical Education Partnership Initiative [MEPI] theme 1 [Increasing quantity and quality of health professionals] and more globally supporting the Mellenium Development Goals [4,5,6]. This, however, attracts major challenges particularly the facilitation of the teaching and learning processes which must deliver desired outputs like student centredness, more activity at the classroom level, and individualization among others [Harden RM & Laidlaw JM, 2012].

At present, large classes at medical institutions justify innovations like fabrication and utilization of wooden skeletal models as a sustainable mechanism in solving the problem of scarce and ethically restricted human teaching models.

Structure/Method/Design: Wood pieces [50-cm length and 20-cm diameter] were cut from a Jacaranda mimosifolia tree and prepared for the carving process. Six wooden models of human skull were fabricated by three wood carvists under guidance of one medical illustrator and three human anatomists. Two experimental groups of randomly selected biomedical science students [60 active and 60 control] were separately taught using wooden and natural skull models respectively and comparatively assessed using the standard natural skull specimen. The assessment used the standard traditional written, practical, and oral medical exams about the anatomy of the human skull.

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

1. Six wooden skull models were produced and used for the experimental study with biomedical science students

2. The analyzed comparative scores between the active and the control groups showed no significant difference [$P \geq 0.05$]

3. More than 90% of the active group participants strongly approved the validity and reliability of the wooden skull model. some of the statements of approval were:

“The model has almost 95% of all features which are prominently clear thus can be ably used for learning” [Muramagi Nathan, MBChB 2.2, BMS/0299/113/DU]

“I find the carved skull easy to study and learn” [Kiggundu Paul, MBChB, 2.1, BMS/0003/113/DU]

“All major features are visible and easily identified, therefore can be used for study purposes” [Kabatabaazi M, MBChB 2.1, BMS/0024/113/DU]

“With this model every 2 or 3 students should have a model available for practice” [Sr.M.Evelyn N, MBChB,2.1, BMS/0252/113/DU]

Summary/Conclusion: The wooden skull model can perfectly be used to facilitate teaching and learning of the anatomy of the human skull

Defining the clinical role of adapted digital light field photography as a point-of-care tool in the treatment of Kaposi's sarcoma

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Background: In Mozambique, HIV-induced Kaposi's sarcoma (KS) is the most frequent form of malignancy seen at the Maputo Central Hospital (MCH). Point-of-care diagnostic tools are currently not employed in the treatment and monitoring of these patients; the efficacy of KS treatment is currently monitored visually and documented with written qualitative descriptions. Pre-treatment photographs are rarely taken to establish a baseline. A precise, quantitative method for measuring the course of KS after chemotherapy would improve the prognostic capabilities of the treating physician.

A clinical story may be told through the lens of a camera. As a proof of concept, our study proposed to determine the utility of a digital light field camera, a novel technology made by Lytro, at the bedside to track therapeutic responses to KS treatment.

Structure/Method/Design: Digital light field photography is capable of capturing a target at different focal lengths and thereby can