RevoCap: a revolution in global capnography

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Program/Project Purpose: Worldwide, over five billion people have minimal access to essential surgical and anesthetic care. One significant hindrance is the lack of reliable anesthesia technology. Currently, there is an unmet yearly need of 143 million surgical procedures (Lancet 2015; 386: 569). Functional operating theaters that include proper anesthesia services are not available in many developing countries. (Bharati et al., 2014) Consequently, anesthesia-associated mortality in low and middle income countries (LMICs) is estimated up to 1000 times the rate reported in high income countries (Gawande et al., 2009). Capnography has been adopted universally in the developed world, with most of these countries mandating its use (Gawande et al. 2009). The RevoCap will improve monitoring, enable safer anesthesia and thereby reduce mortality.

Structure/Method/Design: The RevoCap is a small, cheap, and durable capnograph that does not rely on the electrical grid. RevoCap enables anesthesiologists to monitor carbon dioxide output of patients under anesthesia to assess cardiovascular and pulmonary status. The RevoCap will cost less than $350 and will use standard AA batteries, thereby overcoming the issue of unreliable electricity. Its simple replaceable components make this device affordable, robust and reliable. RevoCap's path to market is through licensing to local manufacturers to reduce supply chains. Monitoring of surgical outcomes will be conducted at regional and general hospitals.

Outcome & Evaluation: The RevoCap technology has been in development for 2 years, and is currently in the prototyping phase.

Going Forward: Our primary challenge and goal is to obtain funding for development. In addition we seek connections with medical facilities and/or health ministries interested in using the product.

Funding: Prototyping funds of $500 awarded through University of Utah Bench to Bedside program. We are currently looking for funding through medical device, engineering and business competitions.

Abstract #: *2.018_TEC*

Seeking to make global health an integral part of the medical school training: an initiative of the Medical Students' Association of Kenya

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Program/Project Purpose: Global health is an area of study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide (Koplan et al [10]). Despite this, it is a discipline rarely emphasized in our Medical schools' curriculum in Kenya. It is for this reason that we, through the Medical Students' Association of Kenya (MSAKE), a member of the International Federation of Medical Students' Association (IFMSA), initiated annual joint short course training in Global Health for medical students around the country.

Structure/Method/Design: The first training was a two-day event held on the 14th and 15th of August 2015. It involved 44 medical students representing all the medical schools in the country. The training was open to all who were willing to participate by paying a subsidized amount of registration fee. The programme comprised of 12 intensive sessions on key global health topics, interspersed between tea and lunch breaks. Sessions were facilitated by Don Eliseo-Prison, MD a professor of Global health and Public health, Jiaotong- Liverpool University, China; Dr. Adragbemi, a member of the board of trustees at Liverpool School of Topical Medicine, UK and Kennedy Opondo, an MSc Global Health student at Duke university.

Outcome & Evaluation: The trainees were enlightened on the basics of Global health including perspectives to global health, global health architecture and instruments, disaster and humanitarian emergencies and economic evaluation in global health among others. They were then encouraged to disseminate the knowledge to those who were willing but unable to attend. Certificates were awarded, courtesy of the hosting university.

Going Forward: We have an aim of making the global health training an annual event on the MSAKE calendar, develop a curriculum and with time have over 80% of medical students trained. Limited availability of funds was a major challenge. We are however working towards forming collaborations with various health sector stakeholders to make this a reality.

Funding: The project was partially funded by the facilitators and the remaining amount was covered by the delegates' registration fees.

Abstract #: *2.019_TEC*

3D-printed, $20 video laryngoscope designed for resource-constrained settings

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Background: Video laryngoscopy has become an important tool for teaching laryngoscopy and managing difficult airways. Access to commercially-available video laryngoscopes is limited in low and middle-income countries due to costs that can exceed US$20,000 per unit. Even practice settings that have video laryngoscopes may restrict access for educational and clinical purposes due to the high value. We hypothesized that a low-cost video laryngoscope could be made and used to teach video laryngoscopy under simulated conditions and eventually be developed into a universally-affordable clinical tool.

Methods: Video laryngoscope handles were created using free software from Tinkercad (tinkercad.com), and 3D-printed with polylactic acid (PLA) plastic. A flexible, waterproof, 5.5mm diameter, 640x480 charge-coupled device (CCD) camera with six LED lights was used for the camera. Video input is compatible with Android

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phones, LCD screens, Macs and PCs. These video laryngoscopes were used to teach laryngoscopy during a first-year anesthesia orientation training course in Uganda with good reception.

Findings: Creation of functional video laryngoscopes for less than $20 per unit is feasible and may be able to increase access to this technology for educational and clinical purposes in LMICs. More formal testing and development of these low-cost video laryngoscopes is planned.

Funding: None.

Abstract #: *2.020_TEC*

A Novel, low-cost intraoperative fluorescent imaging system for surgical use: Opportunities for research capacity in low- and middle-income countries

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Background: Capacity-building efforts to train surgeons in low- and middle-income countries (LMICs) have increased the population of surgeons in these countries. Some of these surgeons may be interested in pursuing research but face prohibitive resource obstacles. For example, intraoperative fluorescent molecular imaging has emerged recently as a promising surgical adjuvant to better identify tumors, metastatic disease and diseased lymph nodes. The technology involves using a light source, filters and camera during surgery to view cancer-selective fluorophores that absorb and emit specific wavelengths of light. This growing area of research would welcome contributions from LMICs, but imaging systems remain expensive and not readily available. Our objective was to design a low-cost, easy-to-use fluorescent imaging system compatible with any traditional endoscope. Demonstrated efficacy of such system indicates that surgeons in LMICs can be not just recipients of training and resources but also drivers of research and innovation.

Methods: The imaging system was constructed solely from readily available commercial materials. We performed verification testing of three design iterations to incorporate an LED light source, minimize loss of light output, and develop an effective filtering system for fluorescence detection. The device was tested in vitro and in an animal model (chicken) using fluorophores known as quantum dots of different concentrations.

Findings: Criteria for an effective imaging system were satisfied. First, the system's "white light" intensity was comparable to that of standard clinical xenon light sources. Second, the viewing lens provided the magnification and resolution required for intraoperative imaging. Third, the system distinguished fluorescent tissue from non-fluorescent tissue with appropriate sensitivity and specificity, both *in vitro* and *in vivo*. Finally, the entire system was constructed for under 500 U.S. dollars.

Interpretation: Prohibitive cost remains an obstacle to surgeons in LMICs who pursue basic science and translational research. In the field of intraoperative fluorescent molecular imaging, we demonstrate that an imaging system can be designed at low cost and with applicability to preclinical testing. The system is compatible with standard clinical endoscopes and accommodates various fluorescent molecular contrast agents. This study represents a successful effort to potentially broaden the surgical research capacity in LMICs.

Funding: None.

Abstract #: *2.021_TEC*

Community education program developed with community members for emergency referral in northern Ghana: Lessons about active community participation for innovation and ownership of interventions

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Project Purpose: Ghana has a maternal mortality ratio of 380/100,000 live births and a neonatal mortality rate of 28/1,000 live births. Although most of these deaths could be prevented by timely access to quality care during medical emergencies, the country lacks a functional emergency referral care system. The most common options for emergency transportation in Ghana's Upper East Region (UER) are foot, bicycles, donkey carts and motorbikes. In 2012, Sustainable Emergency Referral Care (SERC) Initiative—a comprehensive system of transportation and communication for emergency referral—was launched in UER to address this need. However, the absence of an educational component to enhance utilization of SERC's transportation services was an identified implementation gap. This project focused on developing context-specific and culturally-tailored community education materials required to facilitate community members' capacity to recognize signs of obstetric and neonatal emergencies, and consequently utilize SERC's transportation services to access medical care, promptly.

Methods: The project was in three parts. The first was a qualitative study to describe community members' ability to recognize and respond to signs of obstetric and neonatal emergencies, and to elicit recommendations for effective community education. Seven focus group discussions conducted among community members in three districts were audiotaped, transcribed verbatim, coded in NVivo 10.2 software and analyzed using framework analysis. Findings guided the second part, which comprised production of educational videos in the local dialects; conceptualizing, developing and compiling educational illustrations; and organizing local groups to compose educational songs. Training of trainers and developing a curriculum to guide educational activities formed the last part.

Outcome: Qualitative study revealed mistaken beliefs and detrimental practices that merit specific focus in an educational program. Educational materials produced include two educational videos, a 40-page flip chart and jingles. Two implementation assistants