Partnership for Global Health Technologies

BOSTON UNIVERSITY

February 2018, Issue 8

OUR VISION

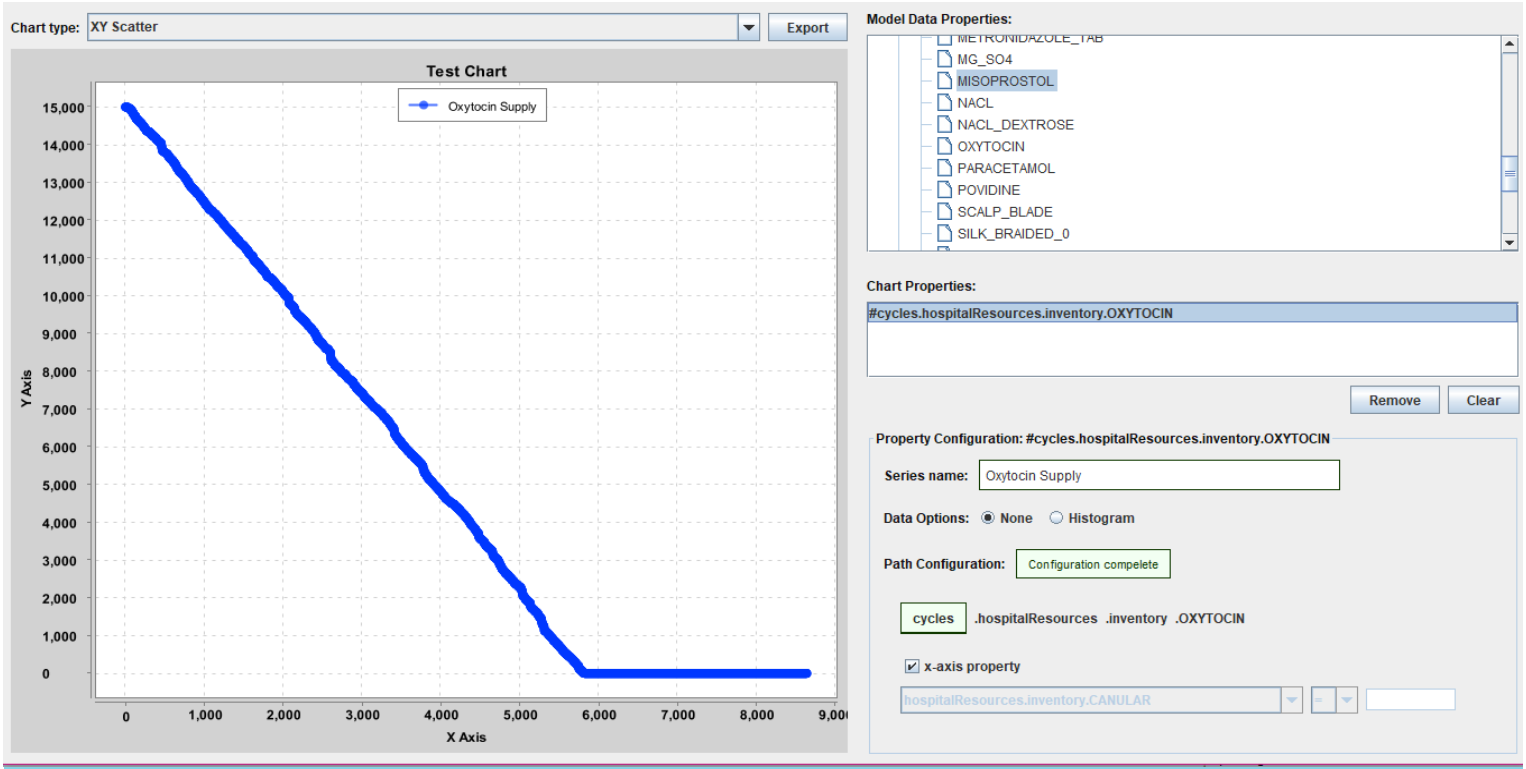
The Partnership for Global Health Technologies (PGHT) is a collaboration between medical students from the State University of Zanzibar (SUZA), Mnazi Mmoja Hospital, Muhimbili University, and Boston University students. PGHT aims to improve the quality of health care in Zanzibar by applying biomedical engineering principles within a public health context. We use an interdisciplinary approach to address the most pressing issues in healthcare delivery in East Africa.

The lab team is currently working to design an affordable and robust diagnostic to address pre-eclamptic liver failure. This semester, they focused on testing and validating their assay in the lab.

The mathematical modeling team uses dynamic health system modeling to model patients' access to quality health commodities, identify bottlenecks and inequities that hinder the system's responsiveness, and build capacity of health delivery. Following submission of our first manuscript on the project, the modeling team is now focusing on modeling how access to material and human resources at Mnazi Mmoja Hospital impacts maternal morbidity and mortality.

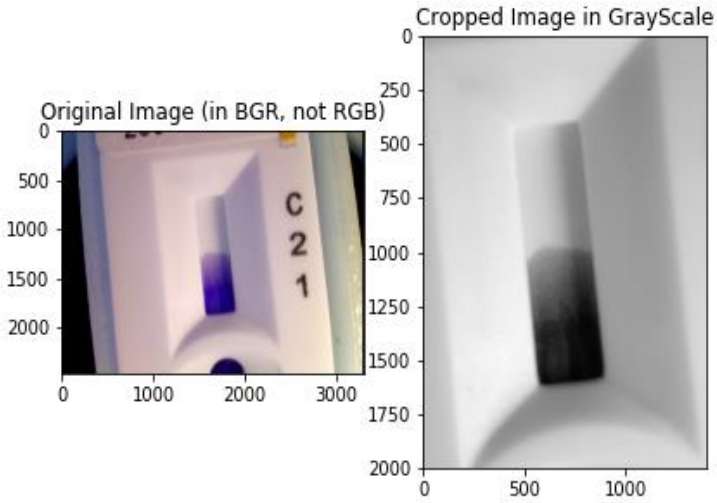
The public health team examines socio-ecological drivers of public health challenges to ensure adoptability and utilization of proposed technology and anticipate potential obstacles .

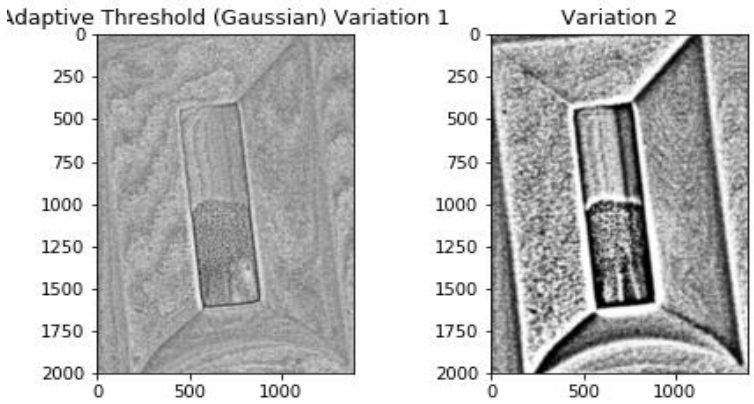
The quality control team is examining image processing techniques to distinguish between quality and defective malaria rapid diagnostic tests (RDTs) . This semester, they began using Python to develop techniques for image recognition.

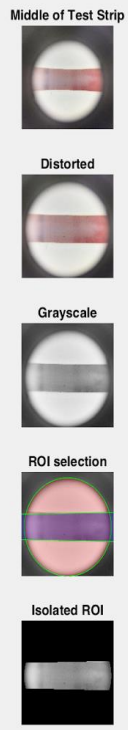


Mathematical Modeling of Maternal Health at Mnazi Mmoja Hospital

The modeling project has made significant strides the last four months. Leading up to the semester a few of our team members travelled Zanzibar to collect data that would go a long way to contextualize and validate the model, and ensure that it be be an accurate simulation of the maternity ward at Mnazi Mmoja Hospital. In order to utilize and implement the data we identified three work-streams – Coding, Clinical Data Analysis and Testing and Calibration. Through these three work-stream's we refined the model algorithm to run faster and ensured, using test case scenarios, that the functions that we had written were working as intended. With the model running smoothly we further developed it by including a secondary application that allows users to manipulate the large amounts of data that are kept track of within each model simulation and display it in a clear format (see above). The model now has the capabilities to run for a treatment plans for a number of conditions and comorbidities. Our efforts will now be focused on making the model as location specific as possible. This will entail continuing our clinical data analysis and identifying critical values like initial probability of mortalities of conditions and condition incidence rates. Our approach to this has been to query the database we developed with patient records from our data collection over the summer (database photos). With these final touches applied we hope to deliver this powerful tool to the hospital administrators ber of cycles that are defined by the user and parse through an excel worksheet that defines the hospital resources and the allowing them to make improvements in resource allocation and more importantly improve maternal health outcomes





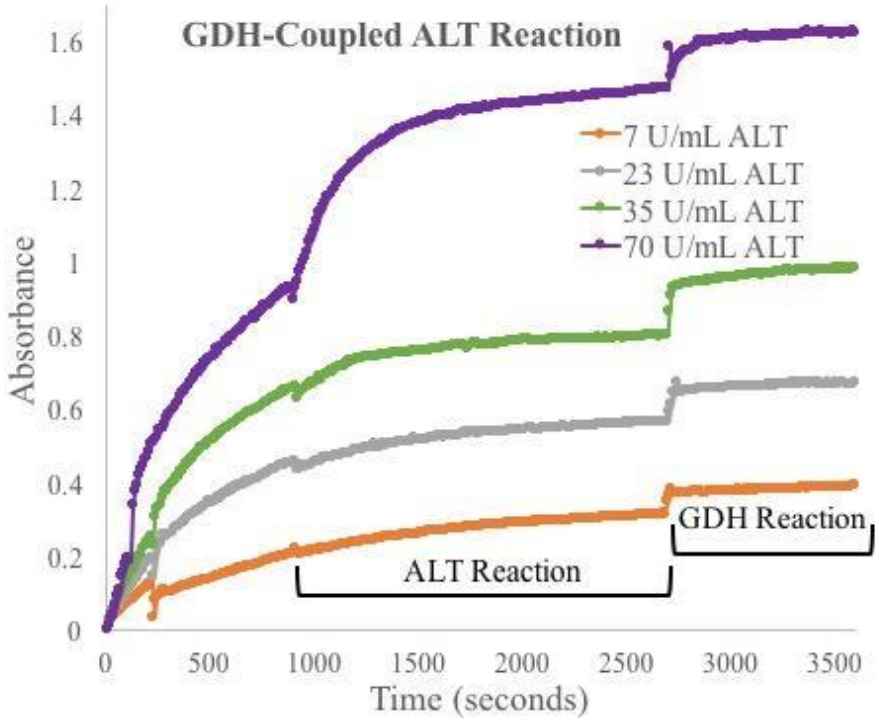


Quality Control of Malaria Rapid Diagnostic Tests

The QC team is currently focusing on performing analysis on mRDT images collected during the summer in order to extract features that help distinguish between true and false mRDT results. Specifically, the team is employing algorithms such as edge detection to extrapolate information that will be useful in determining the skewness of the flowfront, capillary flow rate and intensity of test bands. The team is also looking into procuring PCR results for blood samples collected during the summer for a comparison between results from mRDTs, microscopy and PCR. This will help with gaining further insight into the relative accuracy of each method of diagnosis.

Water Quality Testing

With our new partners at the American University of Beruit we have begun a project to develop a portable, low cost technology to quantitatively detect heavy metals in water, which will be based on existing assays and coupling these with probes to successfully test for metal contaminants. The device will be used to test water quality in refugee camps. Our team has analyzed the literature and selected assays to test for cadmium, lead, and manganese, three of the most dangerous metals found in the water on location. During the upcoming semester our team will continue two prongs of research, feasibility experiments on the assays and design of the overall device. We will also have students do an analysis of how this project and device can be applied in Zanzibar.



Point-of-Care Liver Function Monitoring

Our team has been continuing the effort to fully characterize and optimize the ALT and GDH reactions using absorbance spectroscopy, adjusting the reaction rates both independently and while coupled so that the final NADH concentration is proportional to ALT concentration.

As shown below, the GDH-coupled ALT reaction yields an equilibrium level dependent on initial ALT concentration. With increasing ALT concentration, more NADH is produced. This data will help us with device design as we decide appropriate parameters to measure current due to NADH.

We are currently focusing on three main components of the design of an inexpensive diagnostic device for pre-eclamptic liver failure: reverse engineering, filtering, and parameters for the electrode design. The lab team has procured a CVS TRUETrack glucometer to collect information for the test strips and inks. The team has also begun the process designing the filter paper and wax printing the test trips. Additionally, the lab team is currently researching other paper-based devices to seek help in determining the pros and cons of using whole blood glucometer versus a plasma glucose glucometer, as well as to determine the conductivity for the electrodes and the benefits of a single layer filter versus a multi-layer filter. Moving forward, the team will be working on a preliminary electrode design and wax print.

Student Voices

“As an engineering student at Boston University, it can be difficult to think beyond academics and about the real-world applications of the things that I am learning. Not only has the Partners in Global Health Technologies program has helped me to do so, but it has also encouraged me to learn new things that do not relate to my major. This process has taught me that every project requires a diverse group of disciplines, from engineering and computer science to chemistry and human physiology. Every week, I am inspired by the passion and dedication of my fellow team members, and I speak on behalf on the team when I say that we are all forever grateful for this incredible opportunity. Each of the projects has great potential, and I am so excited to see what the future holds. It is programs like this that influence change in a world that needs it.”

- Erin Thomas, Computer Engineering ‘18

Alumni Voices

“Taking part in the Partnership for Global Health Technologies cultivated my interest in engineering and design for global development. After graduating I knew I wanted to continue such work, and I am excited to be joining the Peace Corps next summer to serve as a Maternal and Child Health Volunteer in Rwanda. As I start the next chapter in my post-graduate career, I look forward to applying the lessons I learned in PGHT: the knowledge that small changes can have immense positive impact on patient outcomes, the value of understanding health care as a system, and the importance of genuine cultural exchange. ”

- Maya Saint-Germain, Computer Engineering ‘16

Harshit Harpaldas
B.S. Biomedical Engineering

Grace Kim
B.A. Neuroscience

Helen Lindsay
B.S. Mechanical Engineering

Sarem Rashid
B.S. Biomedical Engineering

Randy Yee
M.Eng Biomedical Engineering

Anna Helfrich
B.S. Biomedical Engineering

Maisha Savani
B.S., Biochemistry

Ashray Mohan
B.S. Biomedical Engineering

Erin Thomas
B.S. Computer Science

Avijit Minocha
B.S. Biomedical Engineering

Sung Yeon Kim
B.S. Mechanical Engineering

Hakeem Angulu
B.A Statistics & Computer Science

Megan Calfas
B.A. English

Seif Abas
MBBS, Medical Sciences

Fatma Saif
MBBS, Medical Sciences

Amina Ramadhan
MBBS, Medical Sciences

Collaborators

Dr. Tanneke Herklots, University Medical Centre Utrecht
Dr. Benoit Jacod, Radboud University Medical Centre
Dr. Tarek Meguid, Mnazi Mmoja Hospital
Dr. Salum Mchenga, State University of Zanzibar School of Health Sciences
Dr. Billy Ngsala, Muhimbili Univeristy of Health and Allied Sciences

Message from the Director

Dear Friends,

The continued growth of our program is both humbling and exciting. It is a reflection of the commitment of the students and the support of the partners. Over the last quarter, we have had the opportunity to not only make progress on our existing projects but have also been able to extend our work to refugee health. In this regard, three students (Devika, Helen and Anna) worked with the American University of Beirut and Johns Hopkins University, along with local NGOs in Lebanon, to improve refugee health and well-being. The opportunity to work in the field, learn from experts on the ground, and contribute to one of the most complex challenges of our time provided us with a unique experience. As our program continues to grow, you will see the reflection of our commitment to refugee health and well-being featured regularly in our efforts and our newsletter.

The success of the program is due to its people, the students. Many of our students have now gone on to the next stages of their career and contributing to the well-being of the society through their professional contribution. Starting this newsletter, you will see not only student voices but also voices of our alums. Their voices, reflections and experience will always be a guiding light for us.

I look forward to hearing from all of you about our current work and future directions, and will always be eager to hear your thoughts, critique and advice.

Yours,

Muhammad

Muhammad H. Zaman
Howard Hughes Medical Institute Professor

Generously Supported By:

hhmi UROP BUEngineering

CONTACT US:
Katie Clifford, Program Coordinator: clifford@bu.edu
bu.edu/globalhealthtechnologies
@GHTPartnership