Dear M-HEAL community,

M-HEAL has continued to grow and thrive in surprising ways this past semester. We’ve grown to over 170 members and ten project teams. Each of these teams continues to engage with partners from around the world, the Dominican Republic to Ghana, to develop solutions to unmet needs. Our teams shared their progress and plans at one of our most-attended design reviews, this December, and received feedback from their peers and stakeholders.

This year, we’ve also launched our Incubator, a figurative space, in which members can explore and develop new ideas. Twelve members are now working in the Incubator, developing different ideas by learning and applying front-end design skills.

Our board has also been busy. We shared M-HEAL with the national and international community: presenting at the BMES Annual Conference in Minneapolis and soon presenting at the ITT Bombay Techfest in Mumbai. We’ve also continued to engage with our partners: planning workshops with Autodesk and National Instruments and developing mentorship roles with Stryker.

This semester, M-HEAL has begun to draft and develop towards our 2020 vision, developing ideas on topics such as our culture, our membership, and our partner engagement. We continued to strive to ensure that every member has an equal opportunity to engage through a new recruitment system and financial support structure. In the coming semester, we hope to create opportunities for all members to develop their understanding of human-centered design and M-HEAL’s mission and vision.

As always, we hope to keep everyone in the M-HEAL community informed on our progress and continue to look for new unique relationships to build. Check out M-HEAL’s website, mheal.engin.umich.edu, and blog, mhealatumich.tumblr.com, to stay informed and feel free to reach out at anytime with comments and questions.

Regards,
Kevin Jiang
After a great trip to the Dominican Republic this summer, the PeriOperative team was ready to get back to work this semester. We started out by going through all of the feedback we received from our partner doctors and nurses, updating our user requirements and engineering specifications as needed, and creating a timeline of goals for the year. The main feedback that we received was that our controller was somewhat bulky, hard to read, and should have an alarm system when the patient's temperature goes out of the normal range.

The main focuses for this semester were brainstorming and selecting a new design for our next prototype as well as preparing to participate in design and business competitions. Using Fusion 360, we created 3-D models of the new mattress and controller design, with models of the surgical drape designs and heat transfer models in the works. Some of the design changes include a smaller, stylized controller, and updated elastic connectors between the mattress cushions, which should make the mattress more flexible for patient positioning.

To prepare for competitions, we presented at the BME Career Day and competed in the first round of the Michigan Business Challenge. Though we did not continue on to the second round, we had a good feel for what was lacking in our design and business plan, and we plan to enter more competitions next semester with a better developed plan. We also were lucky enough to participate in the Multidisciplinary Design Program (MDP), and were given a mentor from Stryker. Our mentor, Bruce Henniges, has been an amazing resource and has helped to keep us on track with our goals. He also has been very thorough in his feedback ... making us think about many considerations that we had not thought of previously. Mr. Henniges even drove all the way out to Ann Arbor to meet the team and get acquainted with the current prototype! We're excited to be continuing with the MDP program next semester as well - whether with Mr. Henniges or another Stryker mentor. Next semester, we will be bringing on new team members, further developing our heating circuitry and controls, creating a comprehensive DFMEA for risk analysis, working on a regulatory path, and creating a business plan. We look forward to getting back to work soon!

- Hannah Soifer; Junior, Electrical Engineering
PROJECT MESA

Making Examinations Safe and Accessible

This semester, Project MESA members have been busy building on our previous work by finishing the design and manufacture of our Epsilon 1.0 prototype, designing a website to showcase our team’s information and accomplishments, and designing additions to our table to complete our holistic mobile exam mission. All of our accomplishments thus far would not be possible without such a motivated and hardworking team.

Our semester began with the extremely exciting news that our team was one of the recipients of a $25,000 grant from the Ford College Community Challenge. Our business team worked tirelessly on our application, including an amazing video about our team and our mission. Winning this grant was not only a great reward for our previous work, but an incentive to achieve great things going forward. It was the perfect kick start to our semester to get our members excited and motivated to focus on the team.

Due to the work of our summer design committee, the table committee was able to begin the semester with a preliminary design for our next prototype – Epsilon 1.0 – with the hopes of building two iterations throughout the year. After solidifying our design concepts, the table committee began working hard to manufacture the table and plans to test the design at the end of the semester. After analyzing the table’s performance, the team will make adjustments to the design and begin designing and building Epsilon 2.0 next semester.

Our business committee has not let our major accomplishment stall their progress this semester. As eager as ever, they have been focusing on our business model to scale up our design and implement it in global markets moving forward. As an established team, our business team is vital to the expansion of our team and the use of our table in countries worldwide.

Additionally, our ideation committee has been working on designing supplementary devices and features to create the holistic examination experience that we envisioned. They have focused on building collapsible curtains for patient privacy, a stool for the clinician to sit so that he or she is more comfortable and properly positioned for exams, a step for patients to get on the exam table more safely and easily, and a tray to hold clinician instruments. Our hope is that these designs create a safer and more comfortable exam experience for both the patient and clinician.

As the semester draws to an end, we are extremely proud as we reflect on all that we have accomplished these past few months, and we look forward to what the next semester will bring.

- Keely Meyers, Sophomore, School of Information

TEAM INFORMATION
Creating SMS Accessible Patient Databases

With this semester being our first semester as a full project team within M-HEAL, there was a lot of team organization to sort out right off the bat. We gained two new members who have been great additions to the team. With these new members, our team totals six members. Since we are still pretty small, we have been taking a very collaborative approach to things. We are all involved in all parts of the process. Our main focuses this semester have been two things: first, reestablishing our community partners. The issue that we are tackling is so broad, we will need to focus in on one specific region and its specific needs before we can really get into the nuances of what our program will do. We have found many helpful contacts in Ghana and we are pursuing them as our potential partner. In the meantime, though, we are continuing to work on a proof of concept prototypical model. This model can, at the moment, receive text information and store it as a .csv (spreadsheet) on a computer. The next steps in developing our prototype will be getting it to not only receive information but receive queries as well. As we move into next semester, we will continue to refine our needs statement based on feedback from potential partners.

- Maria Roma, Sophomore, Mechanical Engineering
THE INITIATIVE
Combining Kangaroo Mother Care with an Infant Incubator

The World Health Organization has said that 60 to 80 percent of infant deaths are due to the low birth weight. This high mortality rate led to the formation of The Initiative, an M-HEAL project team that aims to combine kangaroo mother care with an infant incubator, providing low birth weight infants in underserved countries the heat they need to survive. We hope to create a product that is not only accessible to those in underserved countries with limited access to medical training, but is also a medical device that can heat an infant from skin to skin contact or function independently if the caregiver isn’t available. This semester, our team welcomed 11 new members and formed four sub-teams in order to efficiently reach our goal to travel to Ethiopia this summer. Our four sub-teams include Kangaroo Mother Care, Bassinet, Heating, and Public Relations. Each sub-team focuses on their part of the product and meets together during team meeting to discuss what they have learned and what progress they have made with prototypes. We have team meetings every Monday at the UGLi and sub-team meetings at different points of the week. Currently, we are in the prototyping phase of our product, and we are conducting a thorough risk analysis to see how to make the prototype void of any danger to the infant or the wearer. We have also reached out to several mother groups in Ann Arbor, many of whom are excited to try our final prototype and give us their input next semester. Additionally, we have started to work out the logistics for travelling to Ethiopia to meet our community partners at Soddo Christian Hospital. Next semester, we hope to refine our prototype to reduce risks and increase efficacy so we can conduct tests on every component of the final product to ensure that it will keep an infant safe, warm, and healthy.

- Asavari Rajpurkar, Freshman, LS&A

SOLAR FRIDGE
Designing a Solar-Powered Refrigerator to Store Vaccines

As the Fall 2016 semester comes to an end, we continue to work on accomplishing our goals that we have set for the team. So what has Solar Fridge been up to? First a little background knowledge on what our team does ... we build fridges! But let’s be a bit more specific. Our main goal lies in the prevention of diseases that are often times preventable with the use of vaccines. Well that doesn’t sound too difficult, except for the fact that the storage and transportation of vaccines can be a very challenging task. Cold-chain management is the distribution chain that the vaccines or other medications travel through to be delivered from the manufacturer to the patient. Not only is this process high cost, but clinics in rural regions are unable to maintain these vaccines due to lack of proper resources. So as a possible solution, our team has been developing a prototype of an absorption refrigerator that can be easily built on site, needs very few resources to function, and is safe for the environment.

And now onto our progress this semester. Our initial step was to obtain a general idea of what a possible working community looked like. This allowed for the creation of a rubric that would be used to pinpoint specific communities that are safe to travel to, have the capacity to host our team, and have similar project missions. Once this portion of the research is complete, Solar Fridge will then be able to build a relationship with the organization in preparation for our needs assessment trip next summer. Although a lot more work needs to be done before the fridge can be put to use, our team is excited for what’s to come in the upcoming year!

- Ryuji Arimoto, Freshman, Biomedical Engineering
THE GUATEMALA TEAM

Preventing Pressure Ulcers in Hospital Environments

The Guatemala Team is working on creating a device to prevent pressure ulcers in the San Juan de Dios hospital in Guatemala City. Pressure ulcers are caused by sustained pressure on the skin resulting in impaired blood flow and damage to the surrounding tissue. Infrequent turning of patients due to limited nursing staff and Guatemala’s humid environment aggravate conditions for long-term bedridden patients. The goal is to design a solution that is relatively cost-friendly, caters to Guatemala’s social and cultural environment and of course, is effective in reducing the number of pressure ulcer cases.

This semester, the team has expanded to 20 members and divided into two sub-teams. The Concept Generation sub-team has been using different tools and strategies such as design heuristic cards, mind mapping and functional decomposition to generate ideas specific to addressing portability, pressure dispersion and moisture control. The sub-team has also focused on conducting patent research to gain a better understanding of current solutions already being used in healthcare settings and aid in the development of concepts. The team is in the process of putting sub-concepts together to generate full, multifunctional concept designs, and currently has about 60 ideas complete with a description and picture. The Design Specifications sub-team has focused on reaching out to pressure ulcer experts, physicians, and medical students to gain a comprehensive understanding of patient demography, hospital environments, patient conditions and root causes of pressure ulcers.

Next semester, the design specifications team will focus on integrating all of the information from interviews with medical professionals to refine our current user requirements document and have a final, complete design specifications document. The concept generation team will continue to generate full concepts and then, begin the down selection process to three concepts upon completion of the design specifications document. The team aims to develop a computer-aided design model of our final concept by the end of the next semester.

- Vanisha Amin, Senior, Movement Science

PROJECT PERU

Addressing Needs Acquired through On-Site Observations

One of my favorite aspects of M-HEAL is the vast ocean of opportunities and the potential for unique experiences. This team has certainly been a prime example of both. It started when in Spring 2016, a team of 15 students traveled to Cusco, Peru to volunteer in mobile clinics and conduct a needs assessment. This was both an opportunity to travel, and a unique experience of conducting a needs assessment as an undergraduate student.

After that, forming the team was both an opportunity to travel, and a unique experience of conducting a needs assessment as an undergraduate student. After that, forming the team was both an opportunity to be a part of the making of a new project team, and a unique experience of analyzing and using raw data from a needs assessment. For those reasons, and many more to come, I truly enjoy being a part of Project Peru.

At this point in time, Project Peru is working to compile the data from the needs assessment and generate problem and needs statements. Our goal is to use observations, literature review, and interviews with doctors and patients to generate at least 60 problem statements and 60 needs statements. From there, we will use a selection rubric to narrow the statements to 3 that the team can feasibly pursue. With these statements, we will check with our in-country and on-campus contacts to gain their approval on a final problem and needs statement pair. A problem that we have encountered this semester is the small size of our team. To that end, we are looking to recruit new members next semester to take charge on these tasks and be a part of deciding and taking the next steps.

I suppose this is the part where I shamelessly reach out to members of M-HEAL! One of the best ways to get involved in this organization and gain leadership skills is to join a newer team. We would love to have you!

- Saumya Gupta, Sophomore, Biomedical Engineering
Our overarching goal is to develop a device that uses hypothermia therapy to treat neonatal asphyxia, a condition that affects newborns who do not get enough oxygen before, during, or immediately after birth. We are currently working with Dr. Young, a physician in Honduras, to develop our device. Neonatal asphyxia is one of the top three causes of death and morbidity in Honduras, and Dr. Young is eager to assist us in developing a functional solution. We are also working with Dr. Meurer, a UM physician, to understand hypothermia therapy. The treatment involves lowering body temperature, which slows the cell death that occurs when cells are deprived of oxygen and waste products build up. Studies have shown that hypothermia therapy can stop and even reverse the damaging effects of oxygen deprivation in patients with neonatal asphyxia.

We aim to develop an affordable medical device that is capable of bringing a newborn’s body temperature down to 33°C, the optimal temperature for hypothermia treatment. In order to accomplish this, we formed three sub-teams: Health and Clinical, Materials and Cooling, and Mechanics and Electronics. Each sub-team has established its own goals and is working towards them. At our weekly team meetings, the sub-teams update one another on their individual progress, and ask questions to encourage further brainstorming.

The Health and Clinical sub-team is currently working on setting design specifications for the device. We met with Kevin, M-HEAL's president, to get some advice on how to determine design criteria and create a rubric for grading ideas. He introduced us to the concept of a Pugh Chart, also known as a selection rubric. His assistance was invaluable; we met immediately to determine some user requirements for our device. For instance, we decided it was extremely important for our device to be inexpensive, portable, easy to operate, durable, and reasonably quiet. It needed to use local resources, and, most importantly, be able to regulate infant body temperature. Determining these requirements brought to our attention questions that we needed to ask Dr. Young in order to proceed with our design. We needed to know details like the average size of the babies, how they would be able to clean the device, and the temperature and availability of the tap water at his location. As soon as we receive a reply to our questions, we will be able to determine how exactly we plan to achieve our design goals. We have also scheduled a meeting with an Insitu consultant to make sure we’re on the right track!

Meanwhile, the Materials and Cooling sub-team is brainstorming methods to enable temperature regulation in the infants including using a refrigerated material, a waterbed or a water bath, a device that utilizes thermoelectric cooling, or creating a swaddle blanket with tubing. As a team, we agreed with the Material and Cooling members that the swaddle blanket seemed to be the best idea. The team is currently researching how to make the design possible, exploring optimal tube layout, maintenance concerns, and possible materials, as well as how water velocity and kinematic viscosity will impact temperature, and tube thickness and diameter will impact the efficacy of heat transfer. They plan to bring in a professor to help them navigate these questions.

Finally, we have our Mechanics and Electronics sub-team and they are currently concerned with the issue of water circulation within our device. Brainstorming has produced several ideas: we can use air pressure, pumps, a vacuum, or even gravity. Pros and cons have been considered for all ideas. Some methods have the advantage of using no electricity—a desirable design feature for our team—but then require constant monitoring. Others are inexpensive, but could introduce maintenance issues. As our design specifications become clearer, we will be able to more accurately rank circulation methods to determine what will best fit our device. Determining a material and method of cooling will also help this team move forward.

NAP has accomplished a great deal this semester. We are finalizing our design specifications (though they will of course be open to adjustment for the duration of our project) and researching ways to create a device that will fit them. We cannot wait to move forward and finalize an initial device design so we can begin CAD modeling and prototyping by the end of next semester!

- Aria Thakore, Freshman,
Biomedical Engineering
TEAM PNEUMONIA

Diagnosing Pneumonia in Under-Resourced Countries

On a global scale, pneumonia is the largest contributor to child mortality (between the ages of 0 and 5). While in wealthier countries pneumonia is not as prevalent, in developing nations the cases of incidence for the disease is amplified. This problem is slightly worsened by the fact that in many of these developing countries pneumonia is often misdiagnosed or left untreated due to a lack of resources necessary to diagnose pneumonia within hospitals. To help improve the ability to diagnose pneumonia and combat this issue in these developing countries, we formed Team Pneumonia.

The primary goal of Team Pneumonia is to create a diagnostic tool or device to aid those in underdeveloped countries to more accurately diagnose pneumonia. Currently, we think the best device to help diagnose pneumonia would be one that analyzes coughing sounds through the use of a microphone. More specifically, the microphone would input the sound frequencies of the coughs into the device, which would then analyze these frequencies in comparison to expected coughing sound frequencies of both healthy patients and patients with pneumonia. The tool we are making should be cost-effective, as many of these countries lack monetary resources.

Our team was formed recently, and so, the vast majority of our work this semester has been to establish a foundation for the team and obtain information necessary to produce a prototype. One of the first things we did this semester was to reach out to University of Michigan faculty to find an advisor. Two professors at the University of Michigan have agreed to help us: Dr. Jenna Wiens, who works in the computer science department, and Dr. Alberto Figueroa, who works in the field of biomedical engineering. We also have researched the best model to create a prototype; we decided that machine learning would be an essential tool necessary in creating a better diagnostic device for pneumonia. In addition, to help prepare for building the prototype we have started to parse through databases for relevant pneumonia data and have reached out to several researchers to see if they would be willing to share their data with us to help us start building the device. This relevant pneumonia data includes recordings of coughing sounds of patients with pneumonia, general information on pneumonia (global statistics and other background information), and data on how to record sounds of patients.

For the next term, our primary focus is on building a prototype of the device to help diagnose pneumonia. In order to do this, we must continue in trying to obtain data on breathing and coughing sounds of pneumonia patients and establishing a database of these sounds. This could be done either by collecting our own sound data from patients or obtain data from researchers. Another item necessary to help achieve our goal of building a prototype is to decide on the most effective way of transmitting sound data from the lungs to our device, as this process is rather complicated. To achieve these goals, we are splitting into hardware and software sub-teams to more efficiently create this prototype.

- Jawad Aqeel, Freshman, Neuroscience

BLUCIRCLE

Identifying Diabetes Non-Invasively

The end of the semester came quickly, and BluCircle is looking forward to what we will start during the upcoming year. Our newly formed Casing sub-team is looking to make big strides. They will decide what materials and design specs the housing unit must have. The unit will be home to our Raspberry-Pi and camera, the system that captures images of a patient’s glucose strips, compares the color change to a calibration curve, and outputs a numerical approximation of glucose concentration. The casing therefore needs to have a light source, and an external place for the monitor to be visible.

Our EECS sub-team has been working hard all semester and is hoping to continue the momentum into next semester. Currently, members have written code to capture the image
and analyze the circular portion of the strip only. The next steps include using actual strips to read the RBG profile of the color change, along with comparing these results with a calibration curve.

The calibration curve will be produced by our Chemical sub-team. This semester, the sub-team has been working to produce the glucose binding strips that are the heart and soul of our design. The strips have a glucose immobilizer and are made from filter paper, so they change color with a pH change. When we started producing the strips, the work was tedious and slow; since starting, we have increased production by tenfold. To ensure that the accuracy of each strip was not impacted by the increased production efficiency, we made sure all the strips were of uniform quality.

By the end of next semester, BluCircle is looking to have our first prototype complete! This would allow us to travel in the early summer months to test the prototype and receive feedback. Currently, we are looking into traveling to Belize or the Dominican Republic based on our research into which countries would have use for a device like ours. We are looking forward to the upcoming months and we’re glad our new members will experience such an exciting time!

- Brianne Hovde, Junior, Chemical Engineering

THE INCUBATOR

Exploring and Developing New Ideas

This semester, twelve members formed into three teams in the Incubator. Team 1—Chris Hill, Ashish Kamath, Aditi Mylavarama, and Maddie Wilson—is developing a method to detect and diagnose infections. Team 2—Joey Costello, Jiaqi He, Bryan Meade, and Alex Ramer—is exploring unmet needs identified by Ryan Thomas, former president and member, during his needs assessment in the Dominican Republic. Team 3—Dipika Krishnaswami, Jahnavi Muralidharan, Abhay Vora, and Austin Wang—is developing a disposable medical kit that can be used in clinics.

All three teams are currently learning to craft problem and needs statements through learning blocks developed by Insitu, UM’s center for socially engaged design. In the near future, they plan to use what they’ve learned to craft their own problem and needs statements. Each team will move at its own pace through the design process in the coming years. They will leverage resources such as Insitu to develop skills such as user requirement and design specification definition, concept generation, and prototype development and apply these skills to their projects. They will connect with stakeholders on and off UM’s campus and develop partnerships to better understand their project and the people who support it.

- Kevin Jiang, Junior, Bio-medical Engineering
Thank you to everyone who contributed to M-HEAL this semester to make our vision possible. Special thanks to the Department of Biomedical Engineering, the College of Engineering, Engineering Student Government and Central Student Government for their contributions to our organization. M-HEAL would also like to thank Stryker, AutoDesk, National Instruments, and Insitu for their mentorship and dedication to our organization. Thank you to all members of M-HEAL, our advisors, and all contributors within the University of Michigan and beyond for your participation in M-HEAL's success this year.

GIVING TO M-HEAL

M-HEAL greatly appreciates all financial contributions of materials, supplies, and time. Your contribution is invaluable to M-HEAL as it continues to advance healthcare in the communities it serves across the globe. Your donation will be directly used to fund our teams’ trips abroad, trips to conferences and design competitions across the country, and materials for prototyping.

If you or your organization would like to make a tax-deductible contribution to M-HEAL, you can do so at: giving.umich.edu/give/932001. Feel free to indicate the direct purpose of your donation in the comments section of the form. If you have any questions, feel free to contact us at: mheal-contact@umich.edu.

M-HEAL is a student organization at the University of Michigan and is sponsored by the Department of Biomedical Engineering with 501(c)3 status as not-for-profit.

Thank you for your support!

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