2019 BCREGMED Health Hackathon Recap

The genesis for holding a health-related hackathon came from a planning session for the BC Regenerative Medicine Initiative back in November 2017. Dr. Stephanie Willerth (Director of the Centre for Biomedical Research, and Professor at UVIC), Laila Abelseth (assistant to the Director), and Lisa Borecky (Program Manager for BCREGMED) began planning this event through the Centre for Biomedical Research, UBC's Biomedical Research Centre/School of Biomedical Engineering. Fort Tectoria (UVIC) and the BRC graciously agreed to donate their spaces for holding the hackathon in September/October 2019. Our team solicited the regenerative medicine, cell therapy, and health fields for challenges and received a dozen challenges in total that were categorized into the following topics: regenerative medicine device/application (3), sustainability in health care (1), ergonomics (2), and accessibility (2). The challenges were assessed by the organizing team based on feasibility, quality of support available, and on-campus resources. 8 challenges were selected to be hacked (more info presented in Appendix one)

- Challenge #1: Biofilmn prevention on filtration membranes
- Challenge #2: All in one microfluidic culture system for generating organoids
- Challenge #3: Waist brace design and coupling mechanism for mechanical lift for severely disabled persons
- Challenge #4: Reductions of single use plastics in healthcare
- Challenge #5: Victoria Hand Project : Child amputee writing aid
- Challenge #6: Maker's Making Change: mouth input to control RC model planes and drones
- Challenge #7 Ergonomic alternative for the Goldmann Perimeter
- Challenge #8: Mechanical dissociation kit to enable unmanipulated cell therapies

The proposers of the winning challenges were notified the first week of August and they were asked to provide an expanded information sheet on their challenge along with generating a PowerPoint presentation for the kick-off event. We offered registration through BCREGMED's platform for hackers, mentors, and judges which we launched on July 30th. The format of the hackathon consisted of a kick-off event held at both the University of Victoria and the University of British Columbia on the evening of September 6th where hackers would choose their challenge and assemble into interdisciplinary teams. The Hackathon event took place over the weekend of October 4th to 6th. The Hackathon weekend consisted of 24 hours of hacking from 6 pm on Friday until 6 pm on Saturday. The Sunday event allowed all the teams to present their solutions to our distinguished panel of judges (Appendix Two) based on the following four criteria - Quality of the solution (25%), Originality of the solution (25%), User experience (25%) and Scalability of the solution (25%).

The kick-off event was held on September 6th at the University of Victoria and on September 12th at the University of British Columbia. Catering included pizza and a variety of beverages provided by BCREGMED. During the kickoff, teams were presented with the available challenges, resources, and mentors, and were given an opportunity to form teams. They were given a three-week period to seek out these resources and mentors, as well as establish new connections on campus. Due to the

interdisciplinary and complex nature of health problems, this three-week lead in was crucial in giving the teams enough time to have designs and prototypes ready for presentation. Registration for the Hackathon began in August and was kept open until the Hacking weekend. Between UBC and the University of Victoria, we had 200 registered!

A final 24-hour push began at 6pm on October 4th, and allowed teams to finalize their projects and determine if they would proceed with presentations. All meals were provided to our hackers. Presentations and judging took place the morning of October 6th (judging rubric can be found in Appendix three).

We selected winners from both UVIC and UBC!

First Place ($750)
Team Liploft, UBC (Mohammad Reza Yousefi Darestani, Tanya Wu, Matthew Lee, Yang Yu, Gagan Bhatia, Mengyizhe Shawn He)

Second Place ($500)
The Progenitors, UBC (Logan Ingalls , Angelica Liaw , Kaitlyn Suzuki , Sree Gayathri Talluri)

Third Place ($250)
Artus Bionics, UBC (Avtar Mandaher, Satish Stefansson, Balhar Mandaher)

Team LipLoft created open-source software that links with the LipSync system. They demonstrated their drone in action, by using the LipSync to control a drone in real life! They have already connected with Jim and Don, two quadriplegics in BC who desired to fly drones, in getting the technology to them! Artus Bionics created a fully functional prosthetic hand, that allows for fine motor movements. They have touched base with our IP experts, and are well on their way to getting their innovative solution to market! Dr. Willerth is looking into the microfluidic devices proposed by the winning teams, and Island Health is exploring how to implement the plastic reduction strategy!

Promotional Partners

- Vancouver Island Life Sciences
- University of Victoria Faculty of Science
- University of Victoria Research Partnerships and Knowledge Mobilization Unit
- University Industry-Liaison Office
- entrepreneurship@UBC
- VPRI
- School of Biomedical Engineering
- Biomedical Research Centre
- Stem Cell Network
- adMare BioInnovations
- InnovateBC
- Engineers in Scrubs

Sponsors

- University of Victoria Biomedical Engineering
- Michael Smith Foundation for Health Research
- Starfish Medical
- Victoria Hand Project
- Island Health
- University of Victoria Faculty of Engineering
- UVIC Vikes
- Victoria Makerspace
- Fort Tectoria/VIATEC

Appendix One: Health Hackathon Challenges

Challenge 1: Biofilm prevention on filtration membranes

Membrane filtration is a critical technology for water purification, dialysis, and other public health and medical applications. A major cause of efficiency loss around membranes is that they chronically suffer from pervasive biofouling by microbial communities that will feed on any carbon source and then grow robust films. Fouling reduces the efficiency of membranes. While chlorine kills most organisms, it also destroys membranes. An alternative approach is needed to prevent and kill biofilms

Mentoring: Heather Buckley, hbuckley@uvic.ca

Challenge 2: All in one microfluidic culture system for generating organoids

The challenge is to create a microfluidic device where suspended hipscs can be infused where they will aggregate into one/multiple ebs. The ebs will remain in the device for the full term of the culture as they differentiate into organoids. This means that media is able to be removed along with dead cells, the ebs will not attach to the device, there is room to expand to organoid size, and the final organoids are easily harvestable for sectioning/imaging.

Mentoring: Stephanie Willerth, willerth@uvic.ca

Challenge 3: Waist brace design and coupling mechanism for mechanical lift for severely disabled persons

For the severely disabled the ability to stand from a sitting position, and then pivot, is critical for transferring from one seating station to another (chair, toilet, wheelchair, bed). Many patients with severe neurological disease, with weak legs, such as stroke and multiple sclerosis, can only stand with assist from a caregiver. On top of that, patients can also have low upper body strength meaning the caregiver often has to carry the patient's full weight. This scenario frequently results in a patient fall with resulting fractures, and serious back injury to the caregiver.

Therefore, we conceived a simple 'sit-to-stand' device that does not require upper body strength, and needs only minimal, if any, assistance by the caregiver. The device consists of a lift, and trunk support that will grip and lift the patient unaided, without slippage. We currently have a mechanical lift design to work off of.

The challenge is to design an exoskeleton truck support of such shape as to be comfortable, with minimal pressure on the patient's skin and minimum slippage. Our prototype exoskeleton works without slippage, but only when tightened to be uncomfortable. We reasoned that this can be successfully achieved with a trunk support that has a larger contact area to reduce pressure at the biomechanical interface and is made of non-slip material. As well a coupling mechanism between the exoskeleton and the electric lift is required, one which will not hinder the use of the patient's arms. Improvements in the coupling between the exoskeleton and the lift should include making it easier to put on without impairing the patient's safety and comfort.

Mentoring: Christopher Atkins, catkins@uvic.ca

Challenge 4: Reductions of single use plastics in healthcare

Plastic has undoubtedly transformed the way humans live by advancing technology, transportation, and hygiene. Unfortunately, from production to disposal, plastic pollutes our natural environment and harms human health. Scientists have identified plastic particles in the food and water that humans

consume. Despite the risks to human health, plastic is widely used in healthcare. Hospitals are significant consumers of plastic, and much of it is for single-use. Drinking cups, syringes, sterile blue wrap, IV tubing, saline bags, and gowns, are just a few of the items made from plastic. Not only is plastic used in production, but many items are also packaged in excessive plastic.

Historically, most medical products were sterilized and reused. However, items like IV tubing and surgical drapes have long been disposable in order to prevent the spread of infection. Single-use disposable items have been integral in reducing hospital acquired infections (HAI). Where disposable items are necessary for infection prevention, there may be opportunities to reduce plastic packaging waste.

Regarding disposal, medical packaging and products are not accepted for recycling due to potential safety risks for recycling workers. In addition, the recycling industry has declined worldwide due to changes in global markets and is not a feasible long term solution to the plastic problem. Unfortunately, up-front costs of single-use plastic items are typically cheaper than reusable alternatives. There are also financial and environmental costs associated with reuse, for cleaning, sterilization, or transport.

The challenge is, therefore, to reduce plastic waste in hospitals, cost-effectively and without creating infection risks. Patient care, along with the safety of staff and patients, should remain top priorities. The overall environmental impact of the solution's life cycle should also be evaluated. Ultimately, reducing plastic in hospitals should aim to decrease toxicity exposure for patients and staff.
Mentoring: Rebecca Wareham, Sustainability Coordinator, Rebecca.Wareham@viha.ca

Challenge 5: Victoria Hand Project: Child amputee writing aid

The Victoria Hand Project (VHP) is a Canadian non-profit organization, with a mission to provide prosthetic care to amputees in the developing world with limited or no access. VHP works with local clinicians and technicians in developing countries to 3D print upper-limb prosthetic devices for children and adults. The Challenge for the Hackers is to design a device to help make writing with the Victoria Hand easier for child amputees in developing countries. A missing limb can create a barrier for children to receive a proper education but by designing a device to hold a pencil the hackers can make school easier for the children.

The project will involve providing concepts for the pencil-holding device, designing the device using solidworks or Fusion 360, 3D printing the device, and testing it. The VHP team will be able to provide support in terms of advising and access to 3D printers.
Mentoring: victoriahandproject@gmail.com or Michael Peirone m.peirone1@gmail.com

Challenge 6: Maker's Making Change: Mouth input to control RC model planes and drones

We currently have two different individuals living with quadriplegia that are looking to control remote machines. We currently have two individuals living with quadriplegia that are looking to control a remote control model planes and drones. They both use an open source mouth operated joystick to control a mouse on their computers, the lipsync (www.makersmakingchange.com/lipsync). As part of Microsoft's One Week hackathon, we have a working prototype of the lipsync being used to control a RC car. This "proof of concept" is something we are working to build on to get these two "into the skies." Jim used to be a westjet pilot before his injury and wants to fly RC model planes. Don works in property assessment and wants to fly a drone to perform functions for his work.

There is a forum for this challenge: https://forum.makersmakingchange.com/t/motormouth-alternate-inputs-to- control-rc-cars-planes-and-drones/127
Mentoring: Jim and Don would be happy to connect about their needs with this design, please ask Laila Abelseth (cfbr@uvic.ca) for their contact info.

Challenge 7: Ergonomic alternative for the Goldmann Perimeter

A Goldmann visual field test is an examination performed in the Department of Ophthalmology used to measure field of view and identify any medical disorders that may affect central or peripheral vision. This test utilizes a device known as a Goldmann Perimeter, which resembles half of a sphere, and features a chin rest for the patient to place their head. In this test, a clinician would shine a small light around the periphery of the sphere to evaluate a patient's range of peripheral vision and identify any regions of vision loss due to glaucoma.
The Goldmann Perimeter is an older device but is still considered the standard for measuring a patient's visual field. Unfortunately, the device was designed at a time where the ergonomic needs of the operator were not prioritized, leading to many neck and shoulder injuries when performing visual field examinations. The goal of this project is for the Engineers in Scrubs students to look for ways to improve the design of the device to reduce the potential for technician injury. A well thought-out and constructed solution for the existing piece of medical equipment would ideally provide a significant impact on the users, leading to an improvement in operator experience, and a reduction in the potential for injury.
Mentoring: Inderpallndy Diocee, inderpalindy.diocee@vch.ca

Challenge 8: Mechanical dissociation kit to enable unmanipulated cell Therapies

It has been proposed that benefits exist in extracting cells from specific anatomical locations and transferring them to disease affected anatomical locations. If the cells are unmanipulated this can be done without seeking regulatory approval, because it falls under surgical procedure and therefore outside of Health Canada regulation. However, in many cases the only commercially available option to extract cells from tissue is digesting them with enzymes, which represents a manipulation.
We challenge you to create a mechanical dissociation kit that can be used in an outpatient clinic to dissociate human adipose into a single cell suspension without using enzymes.
Mentoring: Fabio Rossi, fabio@brc.ubc.ca

Appendix Two: Additional Mentors

Eric Lin
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Rachel Luu
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Biofilms, tissue culture (organoids/microfluidics), plastic reduction
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Stem cell science, tissue culture*, software development*
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Appendix Three: Scoring rubric for judging the proposed solutions for the Health Hackathon

Quality of the solution (25%) How well did the team understand and approach their chosen challenge? Did the group come up with a good solution to the initial problem or challenge? Was their presentation clear and understandable?
Originality of the solution (25%) How original is the solution presented in comparison to the current standard for the project? Did the team generate an original approach to hacking the challenge? Was the solution well thought out?
User experience (25%) Is the given solution easy to use by the targeted user group? Does it provide significant advantages over the currently used methods?
Scalability of the solution (25%) Can the proposed solution be implemented in a reasonable fashion? Criteria include easy of implementable as well as financial considerations.

Appendix Four: Judges who choose the winning hackers

Todd Farrell
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Appendix Five: List of the teams and their hackers

Challenge #2: All in one microfluidic culture system for generating organoids

- **The Progenitors,** UBC (Logan Ingalls , Angelica Liaw , Kaitlyn Suzuki , Sree Gayathri Talluri)

Challenge #4: Reductions of single use plastics in healthcare

- **Team Plastic,** UBC (Owen Tsai, Sophia Shen)

Challenge #5: Victoria Hand Project : Child amputee writing aid

- **Artus Bionics,** UBC (Avtar Mandaher, Satish Stefansson, Balhar Mandaher)

Challenge #6: Maker's Making Change: mouth input to control RC model planes and drones

- **Liploft,** UBC (Mohammad Reza Yousefi Darestani, Tanya Wu, Matthew Lee, Yang Yu, Gagan Bhatia, Mengyizhe Shawn He)
- **The A Team**, UBC (Matthew Davison, Anderson Chen, Melvin Dharan)

Challenge #7 Ergonomic alternative for the Goldmann Perimeter

- **Simple Solutions,** UBC (Brian Lee)

Challenge #8: Mechanical dissociation kit to enable unmanipulated cell therapies

- **Team Ivan,** UBC (Ivan Gourlay, Rashmi Prakash)