msBME NEWSLETTER

MCMASTER SCHOOL OF BIOMEDICAL ENGINEERING

Issue 15 | Summer 2023

IN THIS ISSUE:

McMaster School of BIOMEDICAL ENGINEERING

McMaster University

Congratulations to all recently graduated students:

Alex Amador Tejada, MASc
Louis Garber, MASc
Gaha Gunash, MASc
Mason Kadem, MASc
Anneli King, MASc
Jonathan L'Heureux-Hache, MASc
Monica Malek, MASc
Fiona Madden, MASc
Mahnaz Tajik, MASc
Melissa Temkov , MASc
Abdullah Biran, PhD
Tamaghna Gupta, PhD
Sarah Mishriki, PhD
Ziqi Wang, PhD
Michael Zon, PhD

In recognition of excellence in graduate programs and postdoctoral studies:

Seyedaydin Jalali
Andrew Lofts
Mahnaz Tajik
Mehraneh Tavakkoli Gilavan

Are rewarded this year's Faculty of Health Sciences Graduate Programs **Outstanding Achievement Award**.

12th Annual Biomedical Engineering Symposium

April 27-28, 2023

McMaster School of BIOMEDICAL ENGINEERING

We are delighted to share the tremendous success of the 12th Annual Biomedical Engineering (BME) Symposium in this year's newsletter. Once again, our department came together to host an outstanding event that surpassed all expectations. The symposium brought together globally recognized leaders in the BME field, who graced us with their inspirational lectures. A highlight of the symposium was the opportunity for our graduate students to present their own research through both oral and poster presentations. This platform allowed them to share their latest advancements and accomplishments with their peers and faculty. The enlightening panel discussion facilitated informal and inspiring discussions between the BME graduate students and aspiring BME leaders. It provided a unique setting for exchanging ideas, sharing experiences, and envisioning the future of our dynamic field. Their insights, experiences, and wisdom left an indelible impression on us and played a vital role in shaping our career trajectories.

We extend our sincere appreciation to all speakers, participants, and organizers who made this event a resounding success. The enthusiasm and dedication demonstrated by our BME community reaffirmed our commitment to excellence in research and education. We eagerly look forward to future symposiums and the continued growth of our field.

Invited speakers

Dr. Edmond Young (University of Toronto)

Advances in Organ-on-a-Chip Barriers and Interfaces with Floating Hydrogels and Matrix-derived Membranes

Dr. Paula Foster (Western University)

Imaging Cells In Vivo Using Magnetic Particles, MRI and MPI

Dr. Howard Ketelson (PA Consulting)

The Future of Topical Ocular Dosing Innovation

Dr. Cheryl Quenneville (McMaster University)

Injury biomechanics: new techniques to investigate and protect against challenging traumatic events

12th Annual Biomedical Engineering Symposium

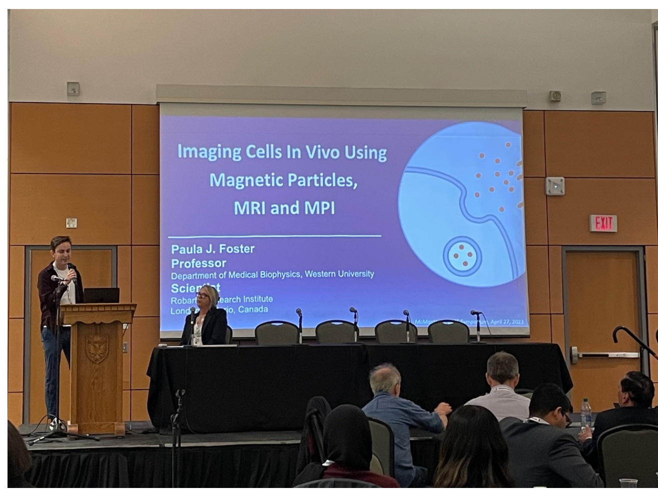
April 27-28, 2023

Oral Presentation Winners

1st place: Liam Burrows, "Quantifying the effect of user size on injury tolerance of the upper extremity subjected to behind-shield blunt trauma"

2nd place: Enas Osman, "Electrochemical study of hybridization kinetics and dynamics on nanostructured electrodes vs. planar"

3rd place: Cole Jeffrey Dennis, "Characterization of soft tissues and their role in impact attenuation for injury assessment applications"

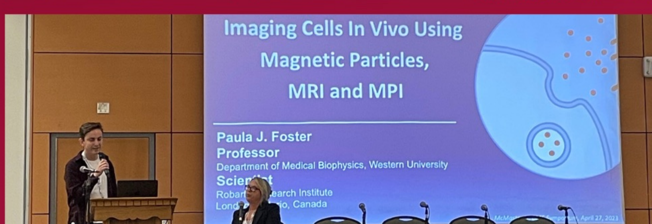


Poster Presentation Winners

1st place: Aidee Arizpe Tafoya, "PEGDA-CBP bioinks for extrusion multi-material 3D bioprinting"

2nd place: Alexander Sotra, "Colon epithelium barrier with vascularized crypts to model inflammatory bowel disease"

3rd place: Andrew Lofts, "In situ-gelling and hydrophobic starch nanoparticle (SNP)-based nanoparticle network hydrogels (NNH) for the intranasal delivery of Olanzapine as a safe and effective schizophrenia treatment"



12TH ANNUAL BME SYMPOSIUM

APRIL 27 & APRIL 28, 2023


MAKE SOME NOISE!
SING YOUR HEART OUT!
KARAOKE
NIGHT
JUNE 15, 2023

PROFESSOR SPOTLIGHT
Prof. Gitanjali Kolhatkar

McMaster School of BIOMEDICAL ENGINEERING

Dr. Gitanjali Kolhatkar is an assistant professor in the department of Engineering Physics and a new associate member of the McMaster School of Biomedical Engineering. Her expertise includes photovoltaics, memory devices, smart sensors, and artificial synapses, to name a few. Dr. Kolhatkar has carved an impressionable reputation for herself in the Digital and Smart systems industry as she has collaborated to publish more than 40 research articles. Additionally, she has won many prestigious awards including the Alexander von Humboldt research fellowship and an Honorary fellowship at Munich University of Applied Sciences. For this professor interview, we invited Dr. Kolhatkar to join us and share her experiences and expertise on her journey in the field of biomedical engineering.

1. What was your greatest inspiration that made you pursue your current field?

“Nowadays, we all use deep learning in our everyday lives. This has become an incredibly useful tool. However, the energy requirements of these deep learning algorithms are very high, resulting in a high carbon footprint, which is detrimental to climate change. Developing smart materials that can be integrated in a new computer architecture, known as neuromorphic computing, will provide a means to reduce the energy requirements of deep learning algorithms to those of our brains. Additionally, our brains perform cognitive tasks much faster than current computers, something which we can emulate using the right computer architecture. The greatest motivation for me to pursue my current field is to help with the current climate crisis, while simultaneously making everyday life easier for everyone by making faster devices for computers.”.

2. What are “smart materials” in the context of computing? And why are they of interest?

“Smart materials are materials that can mimic the learning process of the human brain. A neural network is composed of both neurons and synapses. Our brain’s ability to learn happens through a change in our synapses’ conductivity following the release of a voltage pulse by the neurons. This change in synaptic conductivity, also referred to as synaptic weight, is reproduced in smart materials. These smart materials can be exploited to develop the next generation of highly energy efficient computers and smart sensors, that will be able to learn like we do.”

3. How can smart materials be used for biomedical applications?

“Smart materials can be exploited to develop smart tactile sensors. Using the same learning principle as for artificial synapses, smart tactile sensors can adapt and detect features such as texture and pressure, like natural pressure sensors in human skin. Developing these devices promises to revolutionize prosthetic technology by incorporating artificial pressure sensors that our brains can understand via our neural network.”

4. Do you think it is possible to fully recapitulate the neural power of the human brain “in silico”?

“There is still a lot of work to be done to optimize the materials suitable for neuromorphic computing. However, seeing all the promising results that have already been reported in recent research, I think it is possible to fully reproduce the neural power of the human brain in silico.”

Dr. Kolhatkar (extreme right) pictured here with her research group.

Prof. Onaizah Onaizah

Dr. Onaizah Onaizah is a new assistant professor in the Computing and Software department with an associate membership in the School of Biomedical Engineering. Her expertise encapsulates robotics, magnetics, manufacturing, and medicine. Dr. Onaizah's research focuses on developing and integrating microrobots for the improved treatment of some of the most challenging medical problems faced by current healthcare systems. She has collaborated to publish several ground-breaking research articles that are highly cited and celebrated within many research circles. Read the interview below to learn more about Dr. Onaizah's incredible contribution to and presence within the biomedical space.

1. Your research has covered a diverse range of applications, what is the coolest project you have developed microrobots for?

"The coolest project that I have done is developing a prototype of a completely untethered, magnetically actuated pair of scissors that was able to cut in a remote environment. This project was in collaboration with SickKids and we were working to develop prototype tools for pediatric neurosurgery. Cutting or penetrating tissues through minimally invasive robotic surgery is often a challenge because it requires high forces. These are hard to generate using remote actuation techniques. We were able to overcome this through some clever mechanical design techniques. This pair of scissors was also remotely operated using a Sony game controller. Watch the video here:

https://drive.google.com/file/d/1bLEir_UM-KvSzrvFRPnhcl5OJ_VKAjc1/view

Check out Dr. Onaizah's lab website for many more incredible projects:
https://heartlab.cas.mcmaster.ca/

2. What is the most urgent gap in the healthcare space that you think can be overcome through the incorporation of microrobotic technology?

"Minimally invasive robotic surgery would benefit many areas in healthcare but having worked in the area of pediatric neurosurgery, I see both the unique challenges and advantages here. I think magnetically actuated robotic tools are especially advantageous in this area because magnetic actuation allows us to miniaturize our tools for these very small workspaces. That said, adoption in this area is still decades away. Microrobots in the GI tract have a much higher chance of being deployed over the next few years and there are many exciting developments happening here related to wireless capsules for virtual biopsies, microbiome sampling and drug delivery."

3. You were featured as one of nine women in U of T Engineering's Grads to Watch 2020 list, what is one piece of advice you would give to young women wanting to pursue STEM careers?

"Be resilient! It is not only an important life skill, but it will also help you persevere and achieve your STEM goals. As an academic and roboticist, I am used to failure. I have many videos of my robots not behaving as I expected yet each of these videos helped me to understand the problem and move towards a solution. Having a great mentor is always helpful and can help you navigate these unique challenges. Taking risks both with your research and your career is important for growth and in pursuing exciting scientific discoveries. As female academics, we tend to be more risk averse, and we should actively take steps to challenge the status quo."

4. What was your greatest inspiration/motivation that made you pursue your current field?

"I come from a family of science enthusiasts; my mom is a surgeon, and my dad is a mathematician. I did always envision myself following their career paths. I fell into my specific research area quite accidentally but sometimes luck is on your side. That said, there are many things I have learned along my journey. I am always inspired when I see people doing amazing work in the field or a cool robot video. My primary motivation is of course doing my part to develop surgical robots so that someday we can improve access to healthcare and create a more equitable system both in Canada and worldwide."

Dr. Onaizah (second from left) photographed at the annual Toronto Robotics Conference where she was invited as a panelist [July 2023].

Student Research SPOTLIGHT

McMaster School of BIOMEDICAL ENGINEERING

Noor Abu Jarad is a 4th year PhD student in the School of Biomedical Engineering. She is working under the supervision of Dr. Tohid Didar and Dr. Leyla Soleymani.

1. What is the field of your publication?

My research focuses on surface engineering to create smart coatings from bioinspired materials with a focus on particle fabrication.

2. How does your paper(s) address knowledge gaps in the field?

Currently, the prevention of pathogen transmission is performed through the use of active methods such as antiseptics, detergents, or antibiotics. However, such methods aggravate antibiotic resistance and pose harmful health effects such as respiratory complications, long term damage to DNA, and eye irritation. In response, the design of a multifunctional coating consisting of structured PDMS microparticles with hierarchical wrinkles decorated with biocidal nanoparticles can synergistically repel and kill pathogens via it's antifouling (passive) and antibacterial/anti-viral (active) properties.

3. What is the impact of your work?

The high-performance repellency and killing activity of the coating can instantaneously repel pathogens to surfaces and kill any adheres ones over time. The ease of fabrication of the spray and its substrate-independence substantiates its widespread use for the prevention of disease transmission on frequently-touched surfaces in public settings such as hospitals, grocery stores, and airports.

4. What are the next steps for future work?

I am currently working on integrating a biosensor into the coating to detect the presence of bacteria through a color change from blue to yellow. This can potentially alert the user when a surface is contaminated with biofilm or even when a skin wound is infected.

If you are interested to learn more about Noor's work, you can refer to her papers:

- https://doi.org/10.1021/acsami.2c23119
- https://doi.org/10.1002/smll.202205761

Interested in sharing your research project with the BME community? Scan here!

Student Research SPOTLIGHT

Ali Ammar is a 4th year PhD student in the School of Biomedical Engineering. He is working under the supervision of Dr. Cheryl Quenneville.

1. What is the field of your publication?

This recent publication showcases the results of my undergraduate research in the fascinating field of Orthopaedic Biomechanics. The focus of this research was to develop an innovative technique that employs motion capture technology to effectively analyze fracture gaps and movement within broken bone fragments. By utilizing this technique, we were able to estimate the healing potential in fractured models after surgical repair.

2. How does your paper address knowledge gaps in the field?

Complex fractures need surgical reinforcement using fracture plates due to the multiple breaks in the bone and the inability of the bone to heal on its own. Fracture plates are usually assessed using overall stiffness, which doesn’t actually represent whether it encourages bone growth. In several studies, researchers have used optical tracking to figure out the best conditions for bones to heal after a fracture. A significant limitation has been the inability to measure the motion of fracture sites in various types of fractures, such as line and wedge fractures. To address this limitation, this paper introduces a novel technique that tracks the three-dimensional movement between the bone fragments at a fracture site and analyzes it into anatomically relevant motions.

3. What is the impact of your work?

Overall, in this study, a technique was developed to track the movements of bone fragments in three dimensions at various fracture sites and separate them into anatomically relevant motions. This technique was applied to a repaired bone construct under loading conditions that simulated the immediate post-repair condition. The study showed that this technique is cost-effective and can be implemented in biomechanical laboratories to assist in the development and evaluation of fracture treatments in the future.

4. What are the next steps for future work?

The next phase of this work involves the publication of the application of our technique on biomechanical models simulated with fractures. These models are surgically repaired using fracture plates, enabling us to evaluate and compare various plating techniques, using not only overall stiffness but also tracking the motion of the bone fragments to ensure that the repair encourages healing and bone growth. This step aims to provide valuable insights into the effectiveness of different approaches for treating these complex fractures.

If you are interested to learn more about Ali’s work, you can refer to his paper:

- https://doi.org/10.1007/s10439-023-03265-3

Interested in sharing your research project with the BME community? Scan here!

Alexander Sotra is a 1st year PhD student in the School of Biomedical Engineering. He is working under the supervision of Dr. Boyang Zhang.

1. What is the field of your publication?

The field of my publication is organ-on-a-chip engineering. In essence, it combines microengineered structures at a very small scale with cells to create miniature tissues to mimic native human organs. We use these engineered tissues to perform human drug toxicity screening as well as disease modelling.

2. How does your paper address knowledge gaps in the field?

Current tissue models of the colon lack blood vessel networks that are crucial for talking to the colon cells. This communication is implicated in colon diseases like Inflammatory Bowel Disease (IBD), with little known about why IBD is becoming more prevalent in Western countries. We decided to use our vascularized human colon model to investigate the impact of the presence of blood vessels during disease progression.

3. What is the impact of your work?

We found the presence of blood vessels provided instructive chemical cues to potentially recruit inflammatory cells and allow them to infiltrate into inflamed colon tissues. The results underscore the importance including blood vessels in colon models for investigating complex diseases like IBD.

4. What are the next steps for future work?

We plan to include colon cells of both male and female sources and eventually perfuse immune cells directly in this system to gain a deeper insight into the IBD microenvironment compared to healthy tissues.

If you are interested to learn more about Alex's work, you can refer to his paper:

- https://doi.org/10.1039/D3LC00211J

Interested in sharing your research project with the BME community? Scan here!

Dr. John-Paul Oliveria

Dr. John-Paul Oliveria completed his B.Sc. in Biology specializing in Genetics (2011) and Ph.D. in Medical Science specializing in Physiology and Pharmacology (2017) at McMaster University. His doctoral work focused on the immunobiology of B cells in allergic asthma. He then completed a postdoc at Stanford University in the Department of Pathology (2021) studying the heterogeneity of astrocytes and the blood brain barrier in Alzheimer's disease. Dr. Oliveria is an Adjunct Faculty Member at McMaster University in the Department of Medicine in the Division of Respirology and actively supervises undergraduate students for project courses and honours theses. Currently, he is a Principal Biomarker Scientist and Group Leader at Genentech in the Department of Translational Medicine. He enjoys mentoring students and leads advocacy initiatives taking inspiration from his Filipino, 2SLGBTQIA+ and First Gen intersectionalities.

1. What research did you conduct at McMaster University?

"I did my Ph.D. research at McMaster University under the supervision my Dr. Gail Gauvreau. I spoke about my research in a podcast called "Immunology and Beyond" episode 7 and 8, so tune in if you want some more details about my research journey.

Briefly, I conducted research on understanding B cell biology within the context of allergic asthma. The lab had very specific expertise in inducing a well-controlled, allergic lung response in mild asthmatics. For several decades the lab used the human inhaled allergen challenge model to the study the immunological response locally in the lungs through airway samples like sputum and bronchoalveolar lavage, and the immunological response elsewhere in the body like the blood and bone marrow. I was particularly interested in rare types of B cells called immunoglobulin E (IgE) B cells that are important in allergic pathogenesis and a novel type of B cells called regulatory B cells which have the potential to dampen the allergic cascade. My research gave the field knowledge on the levels of these cell types in healthy individuals, and people with allergies with and without asthma. Additionally, I was able to contribute to the understanding of the levels of these cells before and after allergen challenge in sputum, blood and bone marrow. I barely scratched the surface on this topic and there are so many more research questions that could be asked and tested regarding IgE and regulatory B cells."

Industry Talk **SPOTLIGHT** Dr. John-Paul Oliveria

McMaster School of BIOMEDICAL ENGINEERING

2. How was your research experience like?

Overall, my experience during my Ph.D. was nothing less than excellent. My training environment was top notch and that's mainly driven by my advisor, Dr. Gail Gauvreau and the wonderful group and lab environment that she's built with Dr. Paul O'Byrne and Dr. Roma Sehmi, who were also close mentors. I was also lucky to be mentored by Dr. Mark Larche and Dr. Martin Stampfli. My biggest advice for anyone wanting to go into graduate school is to find a supervisor and lab environment that does interesting and impactful research, and is kind, fair and supportive of trainees. I was very lucky to have that not only for undergraduate and graduate school but also during my postdoctoral fellowship with Dr. Sean Bendall at Stanford University

3. How did you decide to go into industry? Was being in academia ever an option for you?

Academia was the only option that I was striving for throughout my training. Going into graduate school, I wanted to be a professor at a university so that I could conduct my own research and mentor students. However, I always knew there was a potential career in industry because I have several friends who finished their Ph.D. and subsequently pursued various roles with vastly different responsibilities in pharma and biotech.

While completing my Ph.D. at McMaster University, we collaborated with Genentech during my first project on IgE B cell kinetics after allergen inhalation challenge, and we published the data in The American Journal of Critical Care Medicine

(DOI: 10.1016/j.jaci.2017.11.013).

Also, Dr. Gail Gauvreau allowed me the privilege to be involved in meetings and email correspondence with Genentech scientists for several projects. These experiences were memorable and showed me the synergies between biotech and academia.

I ultimately decided to work at Genentech after chatting with many mentors and conducting informational interviews. I really wanted to know what working in industry looked like day to day. After chatting with scientists at Genentech and other similar companies, I learned two things: (1) people had a positive outlook on Genentech and the work the company does, and (2) there are a lot of parallels in the work being done by scientists within the company and researchers in academia.

4. How did you find the opportunity to work for Genentech?

A little bit of skill and a lot of luck and good timing. On a very random December 2020 morning, I got a message on LinkedIn from a hiring manager at Genentech saying that I have the right skillsets and training background for a position in her group and to reach out if I was interested in the position. I was about 3 years into my Postdoctoral Fellowship, very excited about the next year of work ahead of me and waiting to hear back on whether I got the CIHR Banting Fellowship. I wasn't planning on looking for my next steps until the Fall of 2021 because that was when I was anticipating I would be wrapping up my main paper from my postdoc. I had a very supportive postdoc mentor and was encouraged to learn more about the position and apply.

Fast-forward through a long story, I interviewed for the scientist role at Genentech and was offered the position, and within a couple of weeks I also got the CIHR Banting Fellowship. I ultimately decided to start my career at Genentech in June 2021 and the hiring manager that messaged me on LinkedIn, Dr. Rebecca Bauer, is now my current manager.

5. How has your experience working in the biotech industry been?

I started working at Genentech with an open mind, full of curiosity and the willingness to soak up and learn as much as I can about development of medicines for patients. After two years of working full time as a scientist in the Department of Translational Medicine, I have barely scratched the surface of what it takes to be an effective biomarker scientist that really drives decision making by following the best and rigorously generated data.

I was very happy to learn that being a biomarker scientist at Genentech encompassed work in both research and clinical development. Additionally, work is very collaborative, and I get to work in very dynamic teams full of people with vast and diverse skills, training, and perspectives. From a biomarker standpoint, my work involves biomarker discovery which is the identification of novel biomarkers that helps us understand our medicine's mechanism of action and whether we are targeting the correct biological pathways of interest in the various disease indications we work on.

I am very fortunate to have the best tools to do research, from utilizing in vitro, preclinical and clinical models, to implementing novel techniques like high dimensional transcriptomics, metabolomics, proteomics and imaging. I have to emphasize again that working with the best internal and external collaborators and being the manager to brilliant scientists is the best part of the job, especially since we all share the goal of bringing the best medicines to patients.

6. What advice would you give graduate students looking to work in industry?

Internships, internships, internships!
I never had the opportunity to do any internships, let alone industry internships, during my graduate and postdoctoral training, but I think they are the best way to get your feet wet and get experience being a contributor in the work force. Since joining Genentech, I've had the pleasure of managing and mentoring undergraduate and graduate student interns. It's been great exposing the interns to the research and development we do and giving them projects that integrate them into the cross-functional teams I work with on a daily basis. In addition to internships, graduate students should also consider the option of doing a postdoctoral fellowship offered by biotech companies. I've interacted with excellent postdocs at Genentech who do very novel and impactful science.

7. What is your favourite memory of McMaster University?

Hands down my favourite memory at McMaster was when I was in undergrad back in 2008 winter! Me and a few friends sneaked out meal trays from Commons and used them for tray sledding at Faculty Hollow. We went all the way down and decided it was a good idea to trek through the trees, snow and icy water to get back to Bates. After almost getting frostbite and barely making it up the steep and icy trails, we finally made it back. The first and only time I did this!

A new treatment for rheumatoid arthritis!

Treatments for rheumatoid arthritis (RA) mainly target the symptoms that manifest but often not the underlying cause of the disease. RA is an autoimmune disease that leads to inflammation in various body parts, but most commonly the joints. Recent work published in *Nature Reviews Bioengineering* explored targeting the pathogenic activity of CCR7- effector memory T cells, which are found in the synovial fluid of individuals with RA. An anti-inflammatory peptide blocker of Kv1.3 was leveraged in the development of a treatment for RA in this work. What's different about this treatment when compared to a Kv1.3 blocker, is that it was shown to stop the progression of RA through an oral medication rather than an injection, which is how Kv1.3 has been previously used for the treatment of other autoimmune diseases. The researchers engineered a bacteria strain that is able to produce the anti-inflammatory peptide. Once it's absorbed in the intestine and makes its way to the bloodstream, it targets the inflammatory immune cells. Despite this recent work being performed in a rat model, clinical translation to humans is currently in the works, which can revolutionize RA treatment!

See the related article to learn more here:
https://doi.org/10.1038/s44222-023-00034-8
https://www.nature.com/articles/s44222-023-00034-8

Organ-on-a-Chip Replacing Animal Testing in Canada

Following in the footsteps of the US, the Canadian Government has recently passed amendments to the Canadian Environmental Protection Act aimed to phase out animal models for toxicity screening. The news came out less than a year after the Modernization Act was passed by senate in the US to eliminate the need for animal models for in vitro drug screening before entering clinical trials. On June 13, 2023, the Canadian Government made a similar amendment to expedite in vitro toxicity testing where organ-on-a-chip could step into the fold to bridge the in vitro toxicity screening gap in Canada. Animals do not predict human clinical trial outcomes well, spurring the push towards reducing and replacing animals with more sophisticated human-based models. These human-based models referred to as organs-on-a-chip could have significant impacts for drug discovery in a new age of Canadian healthcare.

See the related article to learn more:
https://www.hsi.org/news-resources/victory-canadian-government-passes-provisions-to-phase-out-the-use-of-animals-in-chemical-toxicity-testing/

RECENT GRADUATE STUDENT PUBLICATIONS

Abdelkhalek, M., Daeian, M.A., Chavarria, J., … & Keshavarz-Motamed, Z. (2023) Patterns and Structure of Calcification in Aortic Stenosis: An Approach on Contrast-Enhanced CT Images. J Am Coll Cardiol Img.

Abu Jarad, N., Rachwalski, K., **Bayat, F., Khan, S., Villegas, M.,** … & Soleymani, L., Didar, T.F. (2023) An Omniphobic Spray Coating Created from Hierarchical Structures Prevents the Contamination of High-Touch Surfaces with Pathogens. Small, 19, 2205761.

Abu Jarad, N., Rachwalski, K., **Bayat, F., Khan, S., Villegas, M.,** … & Soleymani, L., Didar, T.F. (2023) A Bifunctional Spray Coating Reduces Contamination on Surfaces by Repelling and Killing Pathogens. ACS Appl. Mater. Interfaces, 15, 12, 16253–16265.

Ammar, A., Koshyk, A., Kohut, M., Alolabi, B., Quenneville, C. E (2023) The Use of Optical Tracking to Characterize Fracture Gap Motions and Estimate Healing Potential in Comminuted Biomechanical Models of Surgical Repair. Ann Biomed Eng.

Biran, A., Jeremic, A. (2023) ECG bio-identification using Fréchet classifiers: A proposed methodology based on modeling the dynamic change of the ECG features. Biomedical Signal Processing and Control 82, 104575.

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Prasad, A., Khan, S., Monteiro, J., Li, J., Arshad, F., Ladouceur, L., Tian, L., Shakeri, A., Filipe, C., Li, Y., Didar, T. (2023) Advancing in Situ Food Monitoring Through A Smart Lab-in-a-Package System Demonstrated by The Detection of Salmonella in Whole Chicken. dv. Mater. 2023, 2302641.

Sotra, A., Asadi Jozani, K., Zhang, B., (2023) A vascularized crypt-patterned colon model for high-throughput drug screening and disease modelling. Lab Chip, 23, 3370-3387.

Zon, M., Ganesh, G., Deen, M.J., Fang, Q. (2023) Context-Aware Medical Systems within Healthcare Environments: A Systematic Scoping Review to Identify Subdomains and Significant Medical Contexts. Int. J. Environ. Res. Public Health, 20(14), 6399.

Wang, Z., Zhitomirsky, I. (2023) Bile Acid Salt as a Vehicle for Solubilization and Electrodeposition of Drugs and Functional Biomolecules for Surface Modification of Materials. Biomedical Materials & Devices.

ComicRelief

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