



UNIVERSITY OF SASKATCHEWAN  
Office of the  
Vice-Provost Health  
HEALTHSCIENCES.USASK.CA

# 2019 LIFE AND HEALTH SCIENCES RESEARCH EXPO



ACKNOWLEDGING EXEMPLARY RESEARCH AND LEARNING  
AT THE UNIVERSITY OF SASKATCHEWAN

## Agenda - Life and Health Sciences Research Expo

*Health Sciences, D-Wing, USask campus, Saskatoon*

*THURSDAY, MAY 2, 2019*

- 8:00 – 9:00 am**      **Registration for the morning session**  
D-Wing, outside Room 1B21, Health Sciences Building
- 9:00 am – 12:00 pm**   **Morning poster session**  
D-Wing Atrium, 2nd and 3rd floors, Health Sciences Building
- **Basic Science 1,2,3**
  - **Clinical 1**
  - **Social Population Health 1**
  - **Undergraduate – Individual Research**
- 12:00 – 1:00 pm**      **Registration for the afternoon session**  
D-Wing, outside Room 1B21, Health Sciences Building
- Lunch**  
D-Wing Atrium, Health Sciences Building
- 1:00 – 4:00 pm**      **Afternoon poster session**  
D-Wing Atrium, 2nd and 3rd floors, Health Sciences Building
- **Basic Science 4,5,6**
  - **Clinical 2**
  - **Social Population Health 2**
  - **Undergraduate – Group Research**
- 4:00 – 5:00 pm**      **Keynote Speaker — Dr. Alan M. Rosenberg**  
Health Sciences Building GB03
- 5:00 – 5:30 pm**      **Keynote Speaker — Patrick Odnokon**, Chief Executive Officer,  
Saskatchewan Health Research Foundation (SHRF)  
Health Science Building GB03
- 5:30 – 6:15 pm**      **Awards and Recognition**  
Health Sciences Building GB03
- 6:15 – 7:30 pm**      **Networking Reception**  
D-Wing Atrium, Health Sciences Building

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## **Welcome from the organizing committee**

Welcome to the 26th annual Life and Health Sciences Research Exposition (Expo). The Expo is one way that the Health Sciences seek to unite future health professionals and promote collaborative research across the health sciences. This initiative acknowledges exemplary research and learning activity at the University of Saskatchewan. The Expo is a yearly showcase for interdisciplinary health science research across social population health, basic and clinical sciences. To further bridge disciplinary gaps and enhance discovery, this event is facilitated by the Office of the Vice-Provost Health.

As our University seeks to unlock the research and innovation potential of the university's health ecosystem and works to embrace collaboration in everything we do the Expo is designed to:

- provide an interdisciplinary showcase of student research
- present students with an opportunity to hone their skills with regard to sharing and presenting their research
- highlight the breadth of research currently underway in the Health Sciences
- create an opportunity for new networks and new collaborations to be formed as students engage with each other, faculty and industry judges and interested members of the community

A great deal of work goes into preparing an abstract and poster, so we would like to thank our students for presenting their research today. In turn, we hope all participants enjoy the Expo and have the opportunity to view posters from the various research disciplines. We would like to extend congratulations to the poster prizewinners, best paper winners, and best supervisor winner.

This day would not be possible without help from our sponsors. Thank you to the Saskatchewan Health Research Foundation, the health science colleges, and our other sponsors, for the financial and in-kind support. Another thank you goes to our keynote speakers, who took time out of their schedules to be here and share their stories with us. Our final thank you is to the poster and award judges who will help us select the winners in each category; they play a fundamental role in making the day a success.

If you have any questions throughout the day, please contact a member of the organizing committee or email [ovph.events@usask.ca](mailto:ovph.events@usask.ca).

The organizing committee:

Dr. Jane Alcorn co-chair

Dr. Marek Radomski co-chair

Curtis Larson

Crystal Maslin

Collin Semenov

## **Greeting from the Office of the Vice-Provost Health**

Welcome to the Life and Health Sciences Research Expo at the University of Saskatchewan (USask).

It is the mission of every researcher to provide insight. Much like a painter adding fine details to a large canvas, a researcher seeks to add carefully studied information into the larger “picture” that is the collaborative understanding of a subject matter.

The Office of the Vice-Provost, Health is committed to fostering collaboration within the USask Health Sciences and harnessing the potential of interdisciplinary research and interprofessional education. We exist to help leverage the unique insights and partnerships required to tackle multifaceted health issues facing individuals, communities and even the planet.



USask is in a unique position to enrich the world’s understanding of health complexities. Abundantly talented faculty, staff and students form the backbone of a full complement of health science disciplines. Our physical assets and access to Saskatchewan’s wealth of food, animal and water resources—plus our geographic proximity to a number of socioeconomically-diverse populations—provide us with the optimal components required for successful health research.

The Life and Health Sciences Research Expo not only acknowledges the exemplary research and learning happening at the University of Saskatchewan—it is also a compelling demonstration of how the USask Health Sciences can foster the synergies required to become stronger than the sum of their individual parts.

I strongly encourage our students to reflect upon their research experiences and acknowledge those moments when a supervisor, colleague or fellow academic positively impacted their work. Advantages such as these—based on collaborative education, interprofessional practice and interdisciplinary health sciences discovery—are essential to helping USask graduates become the next generation of health professionals that the world needs.

I would like to thank all of the students, supervisors, faculty, staff, and research partners who have contributed to the success of the work being presented at the expo. Today is a day to celebrate the diverse accomplishments of USask students and their contributions to the wealth of knowledge we collectively share throughout the Health Science disciplines.

May the insights and skills that have been developed through your time at the university continue to serve you well in your future work.

Dr. Steven Jones, PhD  
Interim Assistant Vice-Provost, Health  
Executive Director, School of Public Health

## **Foreword – Life & Health Sciences Research Expo**

It is my great pleasure to welcome you to the 26<sup>th</sup> Annual Life and Health Sciences Research Expo. You will have the opportunity to share in the great work that our trainees are performing at this institution. The work of our trainees is vital to the mission and vision of our university and contributes to sustaining our position as being recognized as one of the most distinguished research-intensive universities in North America.



The University of Saskatchewan is over 110 years old and is rich in history and tradition. It is the largest postsecondary education institution in the province and is recognized nationally and internationally for its creativity, its collaborations and its achievements. Our research is supported by great research infrastructures such as the CLS, Vido-InterVac and the Academic Health Sciences, in addition to the exciting research of its faculty and students. With over 3900 graduate students currently registered in the College of Graduate and Postdoctoral Studies, the health sciences trainees play a vital role as part of our graduate community. Since its humble beginning in 1946, the College of Graduate and Postdoctoral Studies has become an integral part of the institution's research endeavours. From 2000 onwards, graduate student numbers have doubled, complementing the University's mandate of becoming one of North America's leading research institutions. Graduate students now account for approximately 17% of our student body and, more importantly, bring vitality and excitement to the University through their leading-edge research, new perspectives on the future and engagement with emerging social issues.

Student-centred research conferences are very special events. They provide an opportunity for the students to experience, often for the first time, the excitement of communicating their research to a wider scientific community. These events are also a source of pride for those professors and scientists who have guided the students through their research work. Conferences are an important professional networking opportunity and often lead to links that can influence your future career as a graduate student, academic or professional.

I hope you enjoy this year's Life and Health Sciences Research Expo.

Trever Crowe, Ph.D., P.Eng.  
Dean, College of Graduate and Postdoctoral Studies  
University of Saskatchewan

## **2019 Best Paper Awards**

### *BEST CLINICAL PAPER*

## **Amy Bunyamin**

Amy Bunyamin, Kelsey Björkman, Chantal Kawalilak, Seyedmahdi Hosseinitabatabaei, Adrian Teare, James Johnston and Saija Kontulainen. Reliability of Annual Changes and Monitoring Time Intervals for Bone Strength, Size, Density, and Microarchitectural Development at the Distal Radius and Tibia in Children: A 1-Year HR-pQCT Follow-Up. *Journal of Bone and Mineral Research* (2019). doi:10.1002/jbmr.3693

### *BEST BASIC SCIENCE PAPER*

## **Zoe Gillespie**

Zoe E. Gillespie, Chenxuan Wang, Flaviu Vadan, Topaza Y. Yu, Juan Ausio, Anthony Kusalik and Christopher H. Eskiw. Metformin induces the AP-1 transcription factor network in normal dermal fibroblasts. *Scientific Reports* 9:5369, (2019). doi: 10.1038/s41598-019-41839-1

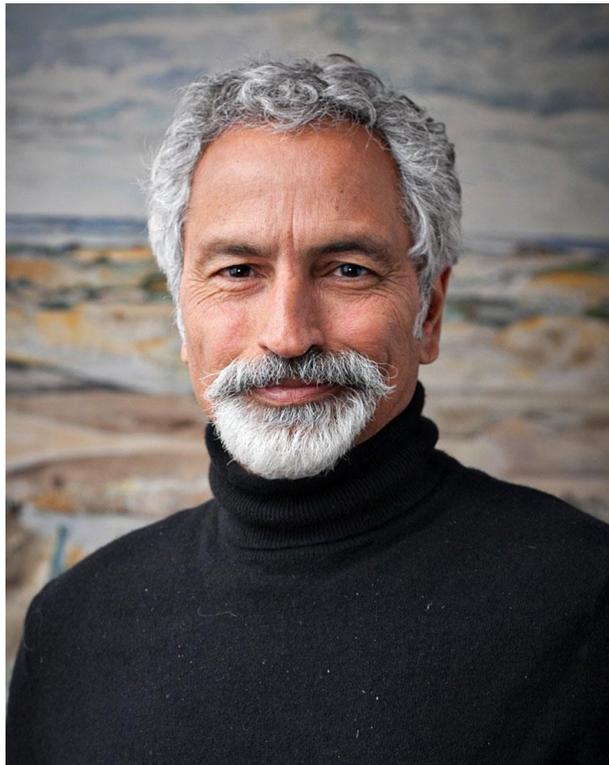
### *2ND PLACE BASIC SCIENCE PAPER*

## **Mamata Panigrahi**

Yalena Amador-Cañizares, Mamata Panigrahi, Adam Huys, Rasika D. Kunden, Halim M. Adams, Michael J. Schinold and Joyce A. Wilson. miR-122, small RNA annealing and sequence mutations alter the predicted structure of the Hepatitis C virus 5' UTR RNA to stabilize and promote viral RNA accumulation. *Nucleic Acids Research* 46, 9776–9792 (2018). doi: 10.1093/nar/gky662

**2019 Best Supervisor**

The Life and Health Sciences Research Exposition  
congratulates the 2019 Best Supervisor Award Winner



**Dr. Vikram Misra**

Professor, Department of Veterinary Microbiology  
Western College of Veterinary Medicine

**Keynote speaker - Dr. Alan Rosenberg**

Dr. Alan Rosenberg is a professor of pediatrics and the current head of the Division of Rheumatology in the Department of Pediatrics at the University of Saskatchewan. He directs pediatric rheumatology clinical service and maintains a translational research program as the director of the Pediatric Rheumatic Disease Research and Innovation Laboratory.

Dr. Rosenberg's research activities include leading and participating in transdisciplinary studies that show how genetic, lifestyle and environmental factors interact to influence the occurrence and outcomes of childhood rheumatic diseases. He leads and participates in collaborative research that contributes to:

- characterizing the utility of biomarker profiling in childhood arthritis;
- studying how inflammation occurring during pregnancy can influence the occurrence of future inflammatory-mediated diseases;
- determining the pathogenesis of uveitis associated with childhood arthritis;
- characterizing novel inflammatory pain pathways;
- exploring pathogenic implications of interactions between DNA and collagen; and
- developing new methods to image growing joints using synchrotron-based technologies.

Dr. Rosenberg strongly advocates for interdisciplinary collaborations in order to maximize research excellence, productivity, and efficiency.

**Keynote speaker - Mr. Patrick Odnokon****Chief Executive Officer, Saskatchewan Health Research Foundation**

As CEO of Saskatchewan Health Research Foundation (SHRF), Patrick works with the SHRF Board and staff, partners and stakeholders to strengthen research capacity and competitiveness; increase investment in research and innovation; and align research with stakeholders' needs. In addition, Patrick works closely with government to determine how Saskatchewan's world-class research environment can best respond to a transformed health system and be leveraged into the province's innovation agenda.

Patrick joined SHRF in October 2007 as the Director of Impact and Evaluation before becoming CEO in 2017. As director, Patrick played a key role in monitoring, evaluating and reporting on the progress and impact of SHRF's work in advancing health research and innovation in Saskatchewan. His work has established SHRF as a leader nationally in research evaluation and impact assessment and has recently gained SHRF recognition internationally by the ROI Institute as one of their 2017-2018 award winners for most innovative approach to ROI (Return On Investment).

Mr. Odnokon has a B.Sc. and M.Sc. from the University of Saskatchewan and has worked in research over the past twenty years. He is an experienced collaborator and has contributed to more than thirty publications including peer reviewed papers, published abstracts and professional communications.



## Morning session

### Basic Science 1

#### 1. Assessment of novel type 1 cannabinoid receptor positive allosteric modulators in vitro and in vivo

**Presenter: Ayat Zagzoog**

Collaborators: Tallan Black, Asher L. Brandt, and Ganesh A. Thakur

College of Pharmacy and Nutrition

Supervisor(s): Robert B. Laprairie

**Background:** The human body produces endogenous cannabinoids that activate the type 1 cannabinoid receptor (CB1R), regulating several physiological processes such as locomotion, nociception, anxiety, and body temperature. CB1R is being investigated as a therapeutic target for several pathologies, including pain, epilepsy, and anxiety. However, the direct activation of CB1R by exogenous compounds, such as  $\Delta^9$ -tetrahydrocannabinol (THC) from Cannabis, is associated with intoxication, dependence and drug tolerance. CB1R positive allosteric modulators (PAM) enhance the binding, potency, and efficacy of endogenous cannabinoids, but should not themselves produce the direct activation association with exogenous compounds.

**Methods:** Previously, our group has synthesized and characterized the CB1R PAMs GAT211, GAT228, and GAT229. Here, we sought to characterize four novel derivatives of GAT211 (GAT1600, GAT1601, GAT1602 and GAT1603) that we hypothesized would have enhanced potency, efficacy, and bias for inhibition of cAMP relative to GAT211. Novel PAMs were assessed in CHO cells stably expressing human CB1R for cAMP inhibition and barrestin recruitment.

**Results:** Also, GAT compounds were tested in vivo in the tetrad screen (locomotion, catalepsy, nociception, body temperature). All compounds were more potent and efficacious than the parent compound GAT211 in vitro and GAT1601 was the most potent, efficacious, and cAMP-biased. In vivo, GAT1601 displayed the greatest anti-nociceptive efficacy.

**Conclusion:** Therefore, structural modification of GAT211 successfully enhanced in vitro and in vivo efficacy, which may lead to the development of novel therapeutics.

**Keywords:** Allosteric modulator, Cannabinoid receptors, CB1, Positive allosteric modulator (PAM)

**Self-assessment of research as interprofessional/interdisciplinary:** No

#### 2. Changes in de novo morphogenesis of testis cords after implantation of dissociated porcine testis cells exposed to EGF or GDNF in recipient mice.

**Presenter: Awang Hazmi Awang-Junaidi**

Collaborators: Mohammad Amin Fayaz, and Ali Honaramooz

Western College of Veterinary Medicine

Supervisor(s): Ali Honaramooz

**Background:** Ectopic implantation of neonatal pig testis cells under the back skin of recipient mice results in de novo formation (regeneration) of testis tissue; providing a unique model for deciphering the mechanism of testis development. The objective of the present study was to investigate the effects of EGF and GDNF on testis cords development in this implantation model.

**Methods:** Two-wk-old piglets (n=75) were used as donors of testis cells to be implanted (100 million cells/implant) under the back skin of immunodeficient mice (n=35). Immediately before implantation, testis cells were exposed to either low or high doses of EGF (20-ng/mL: EGF-L or 2- $\mu$ g/mL: EGF-H), or low or high doses of GDNF (20-ng/mL: GDNF-L or 2- $\mu$ g/mL: GDNF-H); the control group received no growth factors. Two randomly-selected implants were removed from each mouse at 1, 2, 4, and 8 wk post-implantation.

**Results:** No treatment effects were observed on the weight, recovery rate, or cross-sectional area of implants. Only GDNF-L increased the development of testis cords ( $P<0.05$ ). Morphology of the newly-developed cords was classified as regular, irregular, enlarged, or aberrant. The ratio of regular cords decreased ( $P<0.05$ ) over time in implants of the EGF-H and GDNF-H groups, which was replaced by a higher ratio of irregular cords in GDNF-H implants. Neither growth factors had any effects on the number of gonocytes in the implants ( $P>0.05$ ). The use of higher doses of EGF and GDNF did not improve the implantation outcomes when compared with the lower doses; however, implants treated with EGF-L and GDNF-H had a higher rate of structures resembling the rete testis and efferent ductules.

**Conclusion:** Pre-implantation exposure of pig testis cells to EGF and GDNF has no major effect on the de novo formation (regeneration) of testis cords in this model, but promotes rete testis and efferent ductules development.

**Keywords:** de novo morphogenesis, testis cells, ectopic implantation, testis tissue development, growth factors

**Self-assessment of research as interprofessional/interdisciplinary:** No

### 3. Structure and Function of the 3' Untranslated region of Bovine Viral Diarrhea Virus (BVDV)

**Presenter:** Juveriya Qamar Khan

College of Medicine

Supervisor(s): Joyce Wilson

**Background:** Bovine viral diarrhea virus (BVDV) is one of the most common infections found in cattle worldwide. It is responsible for substantial economic losses mainly owing to the reproductive and immunosuppressive impact of the virus on livestock. There is currently a need to improve preventive and therapeutic measures to tackle this disease. Understanding BVDV replication, its dependence on host factors, and how that can affect tropism can help us in formulating such vaccine and therapeutic strategies. The BVDV genome consists of a single strand of positive sense RNA, ~12.5kb in length that lacks a 5' cap and poly A tail. It encodes a single open reading frame (ORF), flanked by 5' and 3' untranslated regions (UTR). The UTRs fold to form secondary structures that regulate RNA translation and replication, through binding with viral and cellular proteins and with each other. In addition, the host microRNA (miRNA), miR-17, was recently found to interact with the 3' UTR to promote BVDV replication and translation.

**Methods:** Our research study aims to understand how the interaction of miRNAs with the 3' UTR promote virus replication. In our study, we found that complementary small interfering RNAs (siRNAs) that mimic miR17 can also promote virus replication once the cleavage activity of the associated Argonaute 2 protein is abolished. We are designing a collection of complementary siRNAs that can bind to the 3'UTR and promote virus replication. Further, we are testing whether the miRNA or siRNA binding have a role to play in enhancing the translation of the viral proteins in order to promote virus replication. Another aspect of the small RNA binding is to analyze the structures formed due to the interaction of the 3'UTR with siRNAs or miRNAs using in silico structural predictions.

**Results:** Using the siRNA walk, we have identified the region on the 3'UTR of the virus that regulates virus replication by interacting with miRNAs or siRNAs. Through structural predictions, we have also determined that the structure of the 3'UTR is altered due to the binding of small RNA molecules.

**Conclusion:** In order to gain further understanding of the role of this regulatory domain on the 3'UTR in BVDV replication, we will further be studying how miRNA annealing modifies the genomic RNA structures in vitro, and how it also impacts the stability of the genome and thus influence the virus life cycle.

**Keywords:** BVDV, Bovine, positive-sense RNA virus

**Self-assessment of research as interprofessional/interdisciplinary:** No

#### 4. Mechanistic analysis of Ago2 and miR-122 promotion of HCV replication

**Presenter: Michael Palmer**

College of Medicine

Supervisor(s): Joyce Wilson

**Background:** MicroRNAs are important for regulation of HCV replication and pathogenesis. With multiple host proteins, such as the Argonaute family (Ago1-4), miR-122 binds two sites in the viral 5'UTR promoting virus replication, but a mechanism has yet to be elucidated. The RNAi effector proteins Ago1 and Ago2 are required for miR-122 promotion of HCV replication, however their roles remain unknown. We also hypothesize that miR-122 modulates the structure of the 5'UTR and speculate that miR-122 annealing may also modulate association of viral and host proteins to the 5'UTR. This research project will test the hypothesis that miR-122 promotes HCV replication through specific activity of Ago2 by regulating structure and protein binding to the HCV 5'UTR.

**Methods:** We will identify if Ago2 has a similar role in miR-122 promotion of HCV replication by assessing the ability of Ago2 mutants in which these functions have been abolished. To test Ago2 mutants we have generated a complementation system in which HCV replication is attenuated by knocking out Ago1/Ago2 through Crispr/Cas9 but can be rescued by plasmids expressing wild-type Ago2. We will use this system to test Ago2 mutants for promotion of HCV replication. To characterize 5'UTR RNA structure changes induced by miR-122 annealing we will use an integrated biophysical approach in collaboration with Dr. Trushar Patel at the University of Lethbridge. Our goal is to obtain detailed insight into the structure of 5'UTR HCV RNAs and characterize its interactions with miR-122 and the stoichiometry of such complexes using small angle X-ray scattering (SAXS), circular dichroism, and analytical ultracentrifugation. At the end of these studies, we will have determined the RNA structural changes induced by miR-122. Finally, we will characterize host and viral proteins that bind the HCV 5'UTR in the presence and absence of miR-122.

We will use biotin-labelled HCV RNA and streptavidin beads to pull down proteins from HCV-infected cell extracts and identify them by mass-spectrometry. We will contrast the protein binding profiles in the presence or absence of miR-122 and the impact of the binding proteins on HCV replication will be confirmed by siRNA knockdown.

**Results:** We have demonstrated that HCV replication is severely attenuated in Ago1+2 double knockout cells. Further, we have shown that complementation of Ago2 is capable of rescuing viral replication. The RNA pulldown procedure has been optimized, and some preliminary mass spectrometry has been obtained. Some of the proteins have been tested using siRNA knockdown, showing their requirement for HCV replication. Finally, some preliminary SAXS data has been obtained, but still requires analysis.

**Conclusion:** Ago1 and Ago2 appear to be strongly required by HCV for efficient replication, however the exact mechanisms that are required are as of yet unknown. Several host proteins have been shown to affect HCV replication.

**Keywords:** Hepatitis C virus, microRNAs, protein-RNA interactions, RNA structure/function, complementation

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 5. A Comparison of Motivation for Exercise and Food in Stall-Housed Sows and Gilts

**Presenter:** Mariia Tokareva

Collaborators: Jennifer Brown, Edmond Pajor, and Yolande Seddon

Western College of Veterinary Medicine

Supervisor(s): Yolande Seddon

**Background:** The Canadian Code of Practice for the Care and Handling of Pigs permits the operation of existing stall barns after July 2024, provided that mated gilts and sows are given opportunities for a greater freedom of movement. However, understanding whether stall-housed sows are motivated for a greater freedom movement, and how this is influenced by their prior stall experience (PSE), is important for the interpretation of this requirement. The aim of this study was to determine the motivation of stall-housed female pigs to access an alleyway for movement (M), and to compare this to their motivation to receive feed (F).

**Methods:** Stall-housed gilts (n=12) and sows (n=12, parity 2-4) were trained to use a panel containing two buttons: i) an active button (AB - push counts resulted in a reward of food (30% of daily ration) or movement (three minutes in alleyway), ii) dummy button (DB – push counts not rewarded). The required number of AB presses during a 30-minute testing session increased by 50% each consecutive test day. Upon reaching their maximal AB push count for one reward, animals were retrained and tested for the alternate reward. Data were analysed to determine the influence of reward type and prior stall experience on the highest price paid (HPP- the maximum AB push counts achieved in one session).

**Results:** Results found that sows showed a greater highest price paid for feed, than movement, but for gilts the highest price paid for each reward did not differ. Sows also showed a greater highest price paid to access feed than gilts. However, the highest price paid for movement did not differ between sows and gilts (HPP Sows F: 369.25 ± 56.47 vs M: 68.5 ± 13.61; HPP Gilts F: 211.67 ± 47.73 vs M: 77.75 ± 19.47, mean HPP ± standard error of mean, P <0.05).

**Conclusion:** Results suggest that stall-housed gestating sows and gilts are motivated to access time out of their stall. The level of motivation for movement is moderate when compared to the motivation to access a feed reward, and the motivation for a feed reward increases with PSE. The greater motivation to receive a feed reward in sows may be because they are recovering from lactation during the testing period.

**Keywords:** Pig, operant, gestation stalls, welfare

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 6. Short-term diabetes decreases expression and function of TTX-sensitive voltage-gated sodium channels in mouse DRG neurons

**Presenter: Maricris N. Bautista**

College of Graduate and Postdoctoral Studies

Supervisor(s): Veronica Campanucci

**Background:** Diabetic Peripheral Neuropathy (DPN) manifests as a variety of sensory abnormalities, including exacerbated or diminished responses to pain. It affects approximately 50% of diabetic patients, yet, the underlying mechanisms linking hyperglycemia and DPN remain elusive. Voltage-gated sodium (Nav) channels play a crucial role in action potential generation during sensory transmission. Nav channels have been implicated in long-term models of DPN, however, their roles in the short-term states of the disease are still under investigation. Our group has demonstrated that sensory neurons maintained in high glucose for up to a week show potentiation of Transient Receptor Potential for Vanilloid 1 (TRPV1) currents. Whether this potentiation translates into action potential generation, which is required to transmit sensory information to the central nervous system, remains to be further explored particularly at the early stages of the pathology. Therefore, we hypothesize that short-term diabetes induces changes in Nav channel expression levels and Nav channel function in sensory neurons. We anticipate this work will aid in better understanding the underlying molecular mechanisms at play during the early stages of DPN.

**Methods:** Streptozotocin (50 mg/kg; i.p.) was used to generate diabetic mice, and neonates (P0-P4) were used to generate primary cultures of sensory Dorsal Root Ganglion (DRG) neurons. Culture neurons were maintained in either a control (5mM) or high glucose media (25mM) for up to two weeks. Nav subunit expression levels were studied using Western Blotting techniques, while Nav channel function was investigated using whole-cell patch clamp electrophysiology. Tetrodotoxin (TTX) and lidocaine were used to identify TTX-sensitive (TTX-S) and TTX-resistant (TTX-R) sodium currents.

**Results:** Exposure of culture DRG neurons to high glucose decreases TTX-S Nav currents and cell excitability. These findings were supported by significant decreases in the TTX-S Nav1.3, Nav1.6 and Nav1.7 subunits in protein samples from STZ-diabetic mice with respect to control.

**Conclusion:** Taken together, our data suggest that short-term diabetes decreases the expression and function of TTX-sensitive Nav channel isoforms in sensory DRG neurons. However, further experiments are required to validate our findings. These changes may be contributing to the underlying mechanisms involved in the onset of sensory abnormalities in DPN.

**Keywords:** Diabetic Peripheral Neuropathy, Voltage-Gated Sodium Channels, Dorsal Root Ganglion Neurons, Whole-cell Patch Clamp Electrophysiology

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 7. Developing a Microbubble-Based Contrast Agent for X-ray Phase Contrast Molecular Imaging of Breast Cancer Neovasculature

**Presenter: Ngoc Ton**

Collaborators: Una Goncin, Arash Panahifar, and Dean Chapman

College of Medicine

Supervisor(s): Steven Machtaler, and Sheldon Wiebe

**Background:** X-ray phase contrast (XPC) imaging is an emerging modality that generates contrast from X-rays that slightly change direction as they pass through objects, generating exquisite soft tissue resolution with a reduced radiation dose<sup>1</sup>. This has potential to be an excellent alternative to traditional mammography<sup>2</sup>. Nonetheless, XPC imaging still focuses on visualizing anatomical structures, similar to traditional mammography. Our goal is to develop a contrast agent for XPC imaging, based on ultrasound microbubbles (MBs), to be used for XPC-molecular imaging of breast cancer. MBs are micron-sized, vascular-restricted contrast agents that consist of shell surrounding a gas core. MBs show great potential as an XPC contrast agent due to the large change in refractive index between the gas core and the surrounding biological fluids (blood). Our goal is to determine the optimal MB size and shell material to generate the highest XPC signal for XPC-Molecular Imaging.

**Methods:** MBs were constructed from two different shell materials: lipid and polyvinyl alcohol (PVA). Polydisperse perfluorobutane-core, lipid MBs were created by solubilizing two lipids (DSPC and PE-PEG2000) in water and sonicating for 20 seconds at 4C. MBs were collected and size separated using centrifugation<sup>3</sup>. PVA microbubbles were constructed by oxidizing a solubilized PVA solution at 80C, cooling to 22C and inserting a tissue homogenizer running at 8000 RPM for 2 hours. We used two different homogenizers which gave us MBs with two different size distributions: 2-3  $\mu\text{m}$  and 3-4  $\mu\text{m}$ . To a subset of PVA-MBs (3-4  $\mu\text{m}$ ), their surface was coated with alternating layers of polymers (PEI and PSS) coating the outmost layer in 3 nm iron oxide nanoparticles (SPIONs). PVA-MBs with SPIONs integrated into their shells were created by adding a SPIONs solution during MB construction. MBs were embedded in 0.5% agar at 37C, allowing uniform MB distribution throughout the cuvettes, at three different concentrations,  $5 \times 10^7$ ,  $5 \times 10^6$ ,  $5 \times 10^5$  MBs/ml. White beam X-ray micro-computed tomography (uCT) was performed at BMIT-BM beamline of the Canadian Light Source with following parameters: detector voxels:  $3.57 \mu\text{m}^3$ , projections: 1800, exposure time: 150ms, sample to detector distance: 45 cm, source to sample distance: 26m. Minimum intensity projections were generated from 10 slices and used to count the number of XPC objects (MBs) in a defined ROI (6.2 mm x 6.2 mm) using ImageJ.

**Results:** At the highest MB concentration, the largest lipid MBs generated the largest XPC signal (12981 MBs detected/ $6.2 \text{ mm}^2$ ), that decreased as the diameter decreased (1308/ $6.2 \text{ mm}^2$ : 4-6  $\mu\text{m}$  MBs), till they were no longer detectable (9/ $6.2 \text{ mm}^2$ : 2-4  $\mu\text{m}$ ). Uncoated PVA-shelled MBs were not detectable at both size distributions (1/ $6.2 \text{ mm}^2$ : 2-3  $\mu\text{m}$ , and 38/ $6.2 \text{ mm}^2$ : 3-4  $\mu\text{m}$ ). Incorporating metal (SPIONs) into the shell did not result in an enhanced phase signal (9/ $6.2 \text{ mm}^2$ ). We did, however, see an increase in the number of MBs detected when they were coated with polymers (320/ $6.2 \text{ mm}^2$ ), with the highest number detected from SPION-coated PVA-shelled MBs (2889/ $6.2 \text{ mm}^2$ ). PVA-MBs were coated using a layer-by-layer technique, alternating charged polymers, with the final coat of a subset consisting of negatively charged SPIONs. Polymer-coated MBs loosely associate together due to uneven surface charges, forming small, easily separated clusters, which is consistent with the size of the XPC phase objects.

**Conclusion:** These data suggest that lipid-shelled MBs between 6-10  $\mu\text{m}$  are a candidate for XPC-molecular imaging of breast cancer vasculature. In addition, though individual small MBs were not

detectable with our setup, MBs in close proximity to each other increase detectability. This may be optimal for molecular imaging, since MBs will accumulate on target vessels in close proximity to each other, while individual circulating MBs will not generate enough signal to be detected.

**Keywords:** Microbubbles, X-ray phase contrast, Breast cancer

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 8. ENDOPLASMIC RETICULUM STRESS AND ENTEROLACTONE'S MECHANISMS OF ACTION

**Presenter:** Frank De Silva

Collaborators: Martin Reaney

College of Pharmacy and Nutrition

Supervisor(s): Jane Alcorn

**Background:** When a cell is under stress, it attempts to restore ER homeostasis and cellular functions, by activating several signaling pathways. However, if the stress cannot be resolved, pro-survival signaling is diverted to pro-apoptotic signaling, resulting in cell death. Evidence suggests certain similarities and interactions among diseases and conditions such as cardiovascular disease, cancer, obesity, diabetes, and inflammation. Therefore an overlapping disease-biology linking cancer prevention, treatment and disease free survival seems to exist. Anticancer polyphenolic compounds represent a wide variety of subgroups. Naturally occurring plant lignans abundantly present in flaxseed (FLN) are capable of modulating serum and hepatic cholesterol levels. Diverse plant lignanoid constituents can be precursors of enterolactone (ENL) a mammalian lignan. Despite the information gathered throughout the years, the effects and mechanisms of action of bioactive mammalian lignans and their phase II metabolites are not completely understood. As drug discovery efforts continue to move towards multi-targeted and combination effects, ENL's drug-like characteristics warrants further attention to fully grasp flaxseed enriched products' as well as ENL analogs' potential use in the clinic. A clinical trial done by our lab with an appropriate lignan enriched oral product indicates that it can provide a clinically relevant dose without significant toxicities. A link between FLNs anti-cancer effects might exist through the ability of FLNs to modulate ER stress and metabolism in dysregulated cells such as cancer. TGF $\beta$  mediated signaling is reported to be involved in the epithelial mesenchymal transition (EMT) of cancer cells especially with metastases and recurrence.

**Methods:** Various key targets involved in cell metabolism, ER stress, cell survival, and vesicular trafficking were evaluated using a battery of in vitro assays such as qPCR, western blot, ELISA, fluorescence microscopy, gene reporter assay, and substrate uptake assay using various cell lines representing cancerous and non-cancerous phenotypes.

**Results:** ENL alone did not cause cytotoxicity to non-cancerous cells at 1000 $\mu$ M, but to cancerous cells at 50 - 200 $\mu$ M. Binding assay, transactivation assay, and uptake assay revealed ENL as a PPAR $\gamma$  partial agonist/inducer. ENL modulated metabolism markers (FASN, SREBPs, LDLR, PPAR $\gamma$ , GLUT1 and PKM2), reduced EMT markers (TGF $\beta$ ) and increased ER stress markers (ATF4, CHOP, GADD34 and GRP58). ENL reduced mitochondrial redox function and caused mitochondrial toxicity in glycolytic and non-glycolytic phenotype representing cells. ENL sensitized select clinically relevant anticancer drugs (ACAD); microtubule inhibitors (Cabazitaxel and Docetaxel), and androgen-receptor / synthesis inhibitors (Enzalutamide and abiraterone) to decrease cell viability and cell motility (migration/invasion assay, cell adherent assay, wound healing assay) and increased apoptosis. Microscopy using F-actin stain revealed changes in cytoskeleton.

**Conclusion:** There seems to be a link in the ENL mediated regulation of metabolism and motility, by connecting Phase-II metabolism, PPAR $\gamma$ , and ER quality control. Interestingly, metabolism modulators such as metformin, statins and farnesyl/ geranylgeranyl transferase inhibitors, are known to interfere with GTPase activity, disrupt cytoskeleton/ intracellular trafficking, and reduce cell motility. All these suggest that enterolactone and its potential analogs may have the capability of enhancing the effects of clinically relevant drugs. Finally, lignans are safe and therefore are good candidates for combination therapy (as lignan enriched products) that could be an efficacious therapeutic strategy for the treatment of cancer and improve patient longevity and quality of life.

**Keywords:** Lignans, PPAR $\gamma$ , Endoplasmic Reticulum, Metabolism, Quality of life, Flaxseed

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 9. Nucleocytoplasmic shuttling of bovine adenovirus (BAdV)-3 protein VII (pVII).

**Presenter:** Shermila Kulanayake

School of Public Health

Supervisor(s): Suresh Tikoo

**Background:** Bovine adenovirus-3 is non-enveloped, double-stranded DNA virus, belongs to Mastadenovirus genus. The genome divides into early, intermediate and late regions. Adenovirus protein VII is a basic abundant core protein and appears to be involved in viral DNA transport to the nucleus with the help of nuclear localization signals (NLSs) of pVII. However, most of the details based on the structure and function of pVII are still unrevealed.

**Methods:** We are investigating the role of BAdV-3 protein VII in modulating the viral life cycle by characterizing the BAdV-3 pVII in detail.

**Results:** BAdV-3 pVII is expressed as 26 kDa protein between 12 to 24 hours post BAdV-3 infection and localizes to the nucleus. Bioinformatics analysis of pVII protein sequence predicted 4 potential nuclear localization signals. Additionally, identified NLS of pVII were able to direct the nuclear import of a cytoplasmic GFP- $\beta$ -gal fusion protein in transfected cells. However, deletion of individual NLS motif or substitution of each arginine of individual NLS of BAdV-3 pVII did not completely impede the nuclear localization of pVII. However, pVII nuclear localization was completely abolished when all four NLS substituted with arginine.

**Conclusion:** BAdV-3 pVII is a late protein sized 26 kDa. pVII contains 4 non- functionally redundant NLSs. pVII localizes nucleus but not nucleolus by active transportation with the help of NLS and it does not need other viral proteins for nuclear localization.

**Keywords:** BAdV-3, pVII, NLS

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 10. The effect of regulatory dendritic cell therapy on IL-10-secreting B cells in a mouse model of asthma

**Presenter: Yanna Ma**

College of Medicine

Supervisor(s): John R. Gordon

**Background:** Regulatory B cells (Bregs) have been reported to modulate T cell responses in autoimmune and allergic disease, just as does regulatory dendritic cell (DCreg) immunotherapy (IT). However, little is known in terms of whether DCreg IT induces Breg differentiation in asthmatic mice, and whether these Breg are important to the tolerance response.

**Methods:** ELISOPT, FACS, magnetic sorting, T cell proliferation and suppression assay were used.

**Results:** In this study, coculture of OVA-presenting DC10 (DC10-OVA) with CD19<sup>+</sup> B cells from the lungs of OVA-sensitized asthmatic mice led to significantly increased numbers of IL-10 producing B cells by ELISPOT. According to the literature, Bregs are CD19<sup>+</sup>CD1dhiCD5hiIL-10<sup>+</sup> cells but, in our hands, coculture of DC10-OVA and CD19<sup>+</sup> B cells led to the outgrowth of IL-10-producing CD19<sup>+</sup> as well as CD19<sup>-</sup>CD1dhiCD5<sup>+</sup> cells. Since CD5 was expressed on both CD19<sup>+</sup> and CD19<sup>-</sup> putative Breg, we sorted CD5<sup>+</sup> and CD5<sup>-</sup> cells from DC10/B cell cultures and assessed their activities; we found that CD5<sup>+</sup>, but not CD5<sup>-</sup> B cells, suppressed T cells an IL-10/TGF $\beta$  and antigen-independent manner. We also asked whether DC10 induced CD5<sup>+</sup>IL-10<sup>+</sup> Breg differentiation in vivo over 4 wk after treating asthmatic mice with DC10 or saline. We found IL-10-producing CD19<sup>+</sup> and CD19<sup>-</sup> CD1dhiCD5<sup>+</sup> B cells in the lungs of naïve, saline- and DC10-treated asthmatic mice, but saw no differences in cell numbers between the different groups. Lung B cells were also sorted using commercial B cell selection kits, and then further sorted into CD5<sup>+</sup> and CD5<sup>-</sup> populations. In T cell proliferation assay, the CD5<sup>+</sup> cells from the lungs of healthy control and saline- or DC10-treated asthmatic mice equally suppressed asthmatic T cell proliferation, while pulmonary CD5<sup>-</sup> B cells (or non-B cells) were not suppressive in these assays. We observed similar outcomes when we examined splenic B cells in asthmatic mice treated with OVA- or, as a further control, house dust mite (HDM)-pulsed DC10 (ie, there were no differences in the numbers of splenic IL-10-producing B cells), further indicating that DC10 did not induce Breg in vivo.

**Conclusion:** In summary, we detected DC10 induction of CD5<sup>+</sup>IL-10<sup>+</sup> Bregs in vitro, and found Breg activities in the lungs of asthmatic mice, but conclude that these activities are not induced as a consequence of DCreg immunotherapy.

**Keywords:** regulatory B cells; Bregs; IL-10-secreting B cells; IL-10-differentiated dendritic cells (DC10); asthma

**Self-assessment of research as interprofessional/interdisciplinary:** No

## **Basic Science 2**

### 11. Targeting CB1 type Cannabinoid Receptor with GAT Allosteric Modulators

**Presenter: Asher L. Brandt**

College of Pharmacy and Nutrition

Supervisor(s): Robert B. Laprairie

**Background:** Cannabis has been anecdotally described by many to be a wonder drug that alleviates a vast array of conditions from neuropathy to epilepsy. The main issue with this from a research perspective is that Cannabis contains greater than 120 different cannabinoids, and screening individual compounds and combinations to gather supporting evidence is difficult. This is similar to trying to listen to the notes that one instrument is playing when listening to 100 instruments in a symphony. Among the compounds found in Cannabis,  $\Delta^9$ -tetrahydrocannabinol (THC) is the most well-studied and often used as a control when studying other cannabinoids. THC does produce intoxicating effects, which may make some individuals uncomfortable when using it for medical purposes. The intoxicating effects of THC are due to it binding to the orthosteric site of the type 1 cannabinoid (CB1R) and activating that receptor. It is hypothesized that the intoxicating properties of CB1R activation could be avoided if a drug bound to an allosteric (i.e. separate or 'other') site on the receptor to promote endogenous activation but not directly activate CB1R. This is how we propose to create CB1R-targetted therapies. The allosteric modulators that will be evaluated are positive allosteric modulators (PAMS) or negative allosteric modulators (NAMS). A PAM enhances the effect of the primary orthosteric ligand while a NAM reduces the effect of the primary ligand.

**Methods:** Cell culture – CHO-K1 cells stably expressing human CB1 for the HitHunter cAMP or PathHunter  $\beta$ arrestin2 assays were maintained at 37C, 5% CO<sub>2</sub> in DMEM/F-12 containing 10% FBS, 1% penicillin/streptomycin, and selective antibiotics as necessary. Drugs– CP55,940 and THC were purchased from Sigma-Aldrich. GAT compounds were obtained from Dr. Ganesh Thakur, Northeastern University. HitHunter and PathHunter Assay – cAMP was measured in in CHO-K1 hCB1 cells stimulated with 10  $\mu$ M forskolin  $\pm$  drug alone (agonist mode) or 100 nM CP55,940 + GAT compound (PAM mode) for 30 min (HitHunter cAMP assay) or 90 min (PathHunter  $\beta$ arrestin2 assay). Luminescence was measured on a Cytation5 plate reader with an integration time of 10 sec/sample. Statistical analyses – Concentration-response curves were fit using a non-linear regression model with variable slope or the operational model of allosterism to obtain bias in GraphPad v. 8.0 (Prism). Data are Mean  $\pm$  S.E.M from at least 6 independent experiments.

**Results:** GAT591 and GAT593 show both agonist and PAM activity by inhibition of cAMP and recruitment of  $\beta$ arrestin2. GAT591 was more potent and efficacious than either GAT593 or GAT592. GAT592 showed little to no agonist or PAM activity. GAT591 was cAMP-biased. GAT593 was only cAMP biased as a PAM. GAT592 was not biased

**Conclusion:** As hypothesized, fluorine substitutions of GAT211 enhanced PAM potency and efficacy. Further studies are underway to optimize the fluorine ring position and determine the agonist activity of GAT591 and GAT593.

**Keywords:** Allosteric Modulator, Cannabinoid Type 1 Receptor

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 12. Robust Liquid Chromatography Tandem Mass spectrometry method to simultaneously quantify phytosterols and tocopherols entrapped in liposomal formulation.

**Presenter: Asmita Poudel**

Collaborators: Zafer Dallal Bashi, and George Gachumi

College of Pharmacy and Nutrition

Supervisor(s): Anas El-Aneed, and Ildiko Badea

**Background:** Phytosterols and tocopherols extracted from canola oil waste stream can be a potential component of nutraceuticals due to their cholesterol lowering abilities and antioxidant properties, respectively. We have developed lipid-based formulations, liposomes, to entrap these lipophilic and thermosensitive bioactives for their effective utilization in the food industry as a nutraceuticals. However, prior to nutraceutical development, analytical strategies should be developed to quantify these bioactives, entrapped within the liposomal bilayer. Thus, we developed and validated a liquid chromatography tandem mass spectrometry method (LC-MS/MS) to simultaneously quantify phytosterols and tocopherols entrapped in liposomes.

**Methods:** LC-MS/MS method (I) was developed and validated as per International Council for Harmonization (ICH) guideline. Chromatographic separation of the analytes was carried out on poroshell C18 column protected by a guard column of the same packing material. For fast analysis, a similar method (II) was developed but with the use of a guard column alone. For both methods, a simple isocratic elution consisting of acetonitrile: methanol (99:1 v/v) with 0.1% acetic acid was utilized. The detection and quantification were performed using an API 6500 QTRAP<sup>®</sup> quadruple-linear ion trap (QqQ-LIT) mass spectrometer equipped with an atmospheric pressure chemical ionization (APCI) source. The method is validated for selectivity, accuracy, precision, reproducibility, sensitivity, matrix effects, dilution integrity, stability were assessed.

**Results:** Method I showed a total run time of 7 minutes whereas method II was merely a 2 minute run. Both methods showed adequate linearity ( $R^2 = 0.999$  for phytosterols and  $R^2 = 0.998$  for tocopherols). Validation parameters such as selectivity, accuracy, precision, repeatability, sensitivity, matrix effects, dilution integrity and stability were within the acceptable guidelines for method I. Further, method I was applied for the analysis of liposomal formulation and the entrapment efficiency achieved was greater than 90%. Method II is currently being validated.

**Conclusion:** In sum, we successfully developed LC-MS/MS methods with analysis run times of 7 minutes and 2 minutes for method I and II, respectively. The validated method was applied to simultaneously quantify liposomal phytosterols and tocopherol. In the future, validation of method II will be conducted and subsequently adapted for regular analysis due to the short run time. The analytical method will be cost effective as solvent amount and instrument usage costs are reduced.

**Keywords:** Liquid Chromatography, Tandem mass spectrometry, Phytosterols, Tocopherols, Liposomes  
**Self-assessment of research as interprofessional/interdisciplinary:** No

### 13. The effects of pre-hatching elevated corticosterone and post-hatching restrictive food availability on HPA axis development of mallard ducks (*Anas platyrhynchos*)

**Presenter: Breanne Murray**

Collaborators: Catherine Soos

Western College of Veterinary Medicine

Supervisor(s): Karen Machin

**Background:** Environmental changes (e.g., altered habitat, food supply, climate change, etc.) act as stressors that may impose increased energetic costs in wildlife. Stressors can trigger the hypothalamic pituitary adrenal (HPA) axis to promote corticosterone (CORT) secretion. Increased CORT in laying females may increase deposition of CORT into eggs, which may alter egg viability and offspring characteristics that result in fitness consequences to females and their offspring.

**Methods:** Our objective was to investigate impacts of increased CORT in eggs on the HPA axis of developing ducklings. We assessed how in ovo injections of 15 ng/g of CORT (N=24) affected HPA function in mallard ducklings (*Anas platyrhynchos*) compared with sesame oil injected controls (N=26). At six weeks post-hatch, serum CORT was measured at baseline, following restraint, dexamethasone challenge (negative feedback), and adrenocorticotrophic hormone (ACTH) challenge (maximal adrenal capacity). To evaluate responses to a chronic stressor, ducklings were fed a restricted diet at nine weeks for six days, after which baseline and restraint CORT were re-assessed. Serum samples were analyzed by a validated radioimmunoassay.

**Results:** Maximal adrenal capacity did not differ between treatment and control birds (P=0.425). Baseline and restraint CORT concentrations did not differ between treatment and control groups at six weeks of age (P=0.880), or after six days of dietary restriction (P=0.884). Following feed restriction, baseline (P=0.001) and restraint CORT (P=0.001) concentrations were higher than observed at 6-weeks.

**Conclusion:** As samples were obtained 3 weeks apart, elevations may have been associated with feed restriction or growth and development. The dosage of CORT administered did not appear to affect HPA axis development in ducklings. The dose was extrapolated from studies conducted in smaller passerines, given that similar studies have not been done in ducks. Further research is needed to determine effects of maternal CORT on the HPA axis in ducks.

**Keywords:** stress physiology, avian, maternal stress

**Self-assessment of research as interprofessional/interdisciplinary:** No

### 14. Retinol Improves In Vitro Differentiation of Neonatal Murine Spermatogonial Stem Cells into Haploid Germ Cells

**Presenter: Fahar Ibtisham**

Western College of Veterinary Medicine

Supervisor(s): Ali Honaramooz

**Background:** One in 650 children is affected by cancer and about 20% of survivors suffer infertility due to gonadotoxic cancer treatments. Before starting treatments, testis tissue biopsies can be collected and

cryopreserved for future use to uphold biological fatherhood. Currently, the only safe approach to produce haploid germ cells in the cryopreserved testis biopsies is through in vitro spermatogenesis, because auto-transplantation/grafting of biopsies runs the risk of reintroducing cancer cells that may have remained in these pre-treatment biopsies. The aim of the present study was to evaluate the effect of retinol on in vitro spermatogenesis using immature mouse spermatogonial stem cells (SSC).

**Methods:** Testis cells were obtained from 6-8 day-old ICR mouse pups, enriched for SSC, and cultured ( $2.0 \times 10^3$ /well, in 24-well plates) for >30 days in a differentiation medium (DMEM+2%KSR+8%FBS+10ng/mL GDNF+10ng/mL bFGF), with or without retinol (0.0286 ng/mL=low-RE; 286 ng/mL=high-RE; no RE=control; n=4 replications). Eight wells in each 24-well plate represented a given media composition per time-point.

**Results:** Immunostaining of CD9 confirmed that all resultant colonies were SSC. At days 10 and 20 of culture, RE-supplemented groups had high levels of Sta8 (a meiotic stage-specific gene,  $P < 0.001$ ). Starting at day 10, Sycp3 (post-mitotic stage-specific) increased in the low-RE group ( $P < 0.05$ ), while it increased at day 30 in high-RE ( $P < 0.001$ ). Expression of the haploid male germ cell-specific gene Acrosin was up-regulated at day 30 in both RE-supplemented groups but low-RE had the highest levels ( $P < 0.001$ ). Round and elongating spermatids were observed in both RE-supplemented groups, but spermatozoa-like cells were only seen in low-RE. Flow cytometry showed that low-RE had the highest population (8.1%) of haploid male germ cells compared with high-RE (4.9%) and control (1.9%).

**Conclusion:** We concluded that supplementation of 0.0286 ng/mL of retinol is sufficient to improve the in vitro production of haploid germ cells.

**Keywords:** In vitro spermatogenesis, retinol, haploid male germ cells, mouse spermatogonial stem cells

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 15. Synchrotron-based assessment of regional and transcortical variation in osteocyte lacunae within the female human femur

**Presenter:** Gavin A. King

Collaborators: David Cooper

College of Medicine

Supervisor(s): David Cooper

**Background:** Osteocytes are the most abundant bone cells, functioning in cellular signaling and responding to mechanical loading to control bone turnover in a process known as secondary remodeling. Distribution of osteocytes, measured as osteocyte lacunar density, has been proposed to impact the ability of bones to inhibit resorption, the initial step of remodeling. Previous studies have shown that, in human males, osteocyte lacunar density in any given region of bone is dependent on the amount of loading to which that region of bone is exposed. These studies showed that osteocytes are more populous in the regions of greatest loading, in particular, the medial and lateral cortices of the femur (undergoing compression and tension, respectively). This suggests that maintenance of bone in these regions is necessary to maintain strength in high stress. Alternatively, it is supposed that osteocyte lacunar density is lower in the anterior and posterior regions of the femur, which undergo reduced strain due to their position corresponding to the neutral axis of bending. Since the previous study displayed that osteocyte patterning is defined by these axes of mechanical loading in human male femora, we hypothesized that we would also observe these patterns in human female femora. We also hypothesized that there is an

inhomogeneous distribution of osteocyte lacunar density across the cortex, with higher lacunar density at the cortical depths subject to the levels of most substantial mechanical loading. To date, this latter transcortical hypothesis has not been explored in male or female human specimens. Testing this hypothesis is extremely pertinent to understanding sexual differences of bone turnover regulation, as bone diseases such as osteoporosis primarily affect females.

**Methods:** To test these hypotheses, we analyzed three-dimensional images of bones captured using micro-computed tomography (micro-CT) at the Biomedical Imaging and Therapy (BMIT) beamline at the Canadian Light Source (CLS). The bones studied were derived from the Melbourne Femur Collection and included femoral specimens from six women (mean age 31y) with no reported confounding medical history. Images were analyzed to quantify cellular lacunar densities in transcortical femoral samples in each of the anatomical axes (anterior, posterior, medial and lateral). In each of these segments, we isolated a cylindrical region of interest with a volume of 1.77mm<sup>3</sup> at three different cortical depths (at the periosteal surface, in the middle of the cortex, and at the endosteal surface.) In each region, we isolated osteocytes based on their three dimensional size. Regions and depths were statistically analyzed using repeated measures ANOVA with Bonferroni Corrections. Regional analyses from the healthy males in previous publications were contrasted with those derived from the healthy female specimens in this experiment, a significant contrast because of differences in osteoporotic disease between sexes.

**Results:** Osteocyte lacunar density (mm<sup>-3</sup>) was significantly ( $P < 0.05$ ) decreased in the combined anterior and posterior regions (along the neutral axis of bending) compared to the combined medial and lateral regions (undergoing high compressive and tensile stresses, respectively.) In the midcortical and periosteal cortices, osteocyte lacunar density significantly varied by region. In the periosteum, there were significant differences between the anterior and medial regions. In the mid-cortex, differences were seen in comparisons between the anterior region and all other regions. No significant difference was observed in the endosteum of the regions. Overall, the anterior cortex displayed significantly decreased osteocyte lacunar density compared to the other regions. Differences in osteocyte lacunar density varied across the cortex in only the medial region. After Bonferroni adjustments, this difference was manifested in a disparity between the medial endosteal and medial midcortical depths.

**Conclusion:** The results of this study closely resemble those of previously conducted work in human males. The parallels suggest that in males and females, more osteocytes are recruited to the regions of greatest loading. Meanwhile, decreased osteocyte lacunar density is seen in the anterior cortex, suggesting that less bone is required in this region to maintain functional stability. These results could have significant implications in the study and prediction of bone diseases (such as osteoporosis) and behaviour.

**Keywords:** Bone, Osteocyte, Femur, Osteoporosis, Synchrotron, Micro-computed tomography

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 16. Development of small protein based affinity reagents targeting bio marker MUC16/CA125

**Presenter:** Hanan Babeker

College of Medicine

Supervisor(s): Maruti Uppalapati

**Background:** Ovarian Cancer is considered the 3rd common type of gynaecological cancers in women and most fatal. Due to lack of reliable screening methods, 70% of patients are diagnosed at a late stage and early detection would improve survival rates. MUC16 is a well know biomarker for monitoring the progression and regression of ovarian cancer develop small protein domain based imaging reagents for application in non-invasive imaging of ovarian cancer using techniques such as PET/CT. Small protein domains (<7 kDa) can be engineered to bind with high affinity and specificity to cancer biomarkers. Compared to monoclonal antibodies, the small size of these domains allow rapid renal clearance, better penetration of solid tumors and are able to access epitopes that may be sterically blocked for larger molecules. The MUC16 gene encodes a 12070 amino acids N-terminal domain followed by several tandem repeats (12-60 due to alternative splicing), a non-repeating C-terminal domain and a cytoplasmic domain. By generating reagents that bind to multiple tandem repeats (~60% sequence similarity) we expect the reagents to bind with high avidity on cells.

**Methods:**

**Results:** We produced several recombinant MUC16 domains and we've developed affinity reagents that bind to multiple tandem-repeat domains by screening a diverse set of small protein domain based scaffolds using phage display. These affinity reagents were expressed in bacteria to characterize their binding affinity to cancer cell lines. Flow cytometry data showed that our lead affinity reagent binds specifically to ovarian cancer cells.

**Conclusion:**

**Keywords:** Small protein domains, Affinity reagents, Ovarian cancer, MUC16, phage display, small protein library design

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 17. Shared activation in the VWFA and LOC from word reading and picture identification

**Presenter:** Josh Neudorf

Collaborators: Layla Gould, Marla Mickleborough; Chelsea Ekstrand, and Ron Borowsky

College of Arts and Science

Supervisor(s): Ron Borowsky

**Background:** Identifying printed words and pictures concurrently is ubiquitous in daily tasks, and so it is important to consider the extent to which reading words and identifying pictures may share a cognitive-neurophysiological functional architecture.

**Methods:** Two functional magnetic resonance imaging (fMRI) experiments examined whether reading along the left ventral occipitotemporal region (vOT; often referred to as a visual word form area, VWFA) has activation that is overlapping with referent pictures (i.e., both conditions significant and shared, or with one significantly more dominant) or unique (i.e., one condition significant, the other not), and whether picture processing along the right lateral occipital complex (LOC) has overlapping or unique activation relative to referent words.

**Results:** Experiment 1 used familiar regular and exception words (to force lexical reading) and their corresponding pictures in separate blocks, and showed dominant activation for pictures in the LOC, and shared activation in the VWFA for exception words and their corresponding pictures (regular words did

not elicit significant VWFA activation). Experiment 2 controlled for visual complexity by superimposing the words and pictures and instructing participants to either identify the word or the picture, and showed primarily shared activation in the VWFA and LOC regions for both word reading and picture identification, with some dominant activation for pictures anterior to the center of LOC.

**Conclusion:** Overall, these results highlight the importance of including exception words to force lexical reading, and serve to challenge modular models of reading and picture identification to reconcile the overlapping activation.

**Keywords:** reading, picture naming, fMRI, ventral occipitotemporal region (vOT), visual word form area (VWFA), lateral occipital complex (LOC)

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 18. miR-122 promotion of HCV translation is important at the initial stage of viral infection.

**Presenter: Mamata Panigrahi**

College of Medicine

Supervisor(s): Joyce Wilson

**Background:** The liver-specific microRNA miR-122 plays an important role in positively modulating the Hepatitis C Virus (HCV) life cycle. It is known to promote viral RNA stability, translation, and replication, however, the exact role of miR-122 in this process is not fully understood. Work from our lab demonstrates that, unlike the wild-type HCV genome, some full-length RNAs with mutations in the 5' UTR and bi-cistronic HCV replicons containing an additional IRES can replicate in miR-122-deficient cells. In this study, we hypothesize that miR-122 promotion of virus translation functions to establish virus replication and is important at the beginning of infection.

### **Methods:**

**Results:** We have observed that the mutations in the 5'UTR that support miR-122-independent replication also have an enhanced genome translation efficiency. In silico structural analysis of miR-122 bound 5'UTR of HCV shows that the bound 5'UTR forms an open structure in contrast to the unbound which forms a closed structure. The mutants which can replicate independent of miR-122 also forms an open structure similar to miR-122 bound 5'UTR of HCV. Thus, we speculate that the predicted structural change might be conferring an enhanced translation efficiency by altering IRES activity or by providing better stability and enabling the genome to propagate inside the cell. Analysis of cells supporting miR-122-independent and dependent HCV replication by microscopy and flow cytometry revealed cells supporting miR-122-independent replication expressed HCV proteins at levels similar to that seen during miR-122-dependent replication, but that the numbers of cells supporting HCV is small.

**Conclusion:** These findings suggest that altered translation can allow the virus to replicate independently from miR-122, and support the role of miR-122 in regulating HCV translation. These results also suggest that establishment of replication in a high proportion of cells requires miR-122, but for genomes capable of miR-122-independent HCV replication, the life cycle is efficient after establishment. Further, in time course studies we also show that miR-122 supplementation or antagonization has little influence on HCV replication after an infection has been established. Hence, we suggest miR-122 plays an important role at the initial stage of infection by promoting viral translation, but it appears to have a smaller influence on the maintenance of an infection within a cell.

**Keywords:** HCV, miR-122 independent replication

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 19. Variant Infectious Bursal Disease Virus (varIBDV)- SK09: A Potential Vaccine Candidate to Control IBDV Infection in Canada

**Presenter:** Mengying Liu

Collaborators: Shakya Kurukulasuriya, Khawaja Ashfaque Ahmed, and Shelly Popowich

Western College of Veterinary Medicine

Supervisor(s): Susantha Gomis,

**Background:** In North America, variant infectious bursal disease virus (varIBDV) strains are able to break through the immunity established by current commercial vaccine program and induce immunosuppression. Previously, we identified five most prevalent strains in Western Canada, and the most predominant strain, SK09 (60%), demonstrated good potentials to be a vaccine candidate. The objective of this study is to apply SK09 in different forms of broiler breeder vaccines to control varIBDV infections in Canada, particularly as an immune complex vaccine.

**Methods:** Five groups of breeders (n=15/group) were treated with a single dose of immune complex vaccine, immune complex vaccine twice, immune complex plus inactivated vaccine, live vaccine or live plus inactivated vaccine developed based on SK09. The control group received saline. Broiler progeny (n=15/group) from six breeder groups and another group of commercial broilers (n=15) whose parents undergone a commercial vaccine program were challenged by SK09 at day 6 of age. An additional progeny group (n=15) from breeders treated with saline was kept as no vaccine no challenge control.

**Results:** Viral load detection and fluorescence activated cell sorting (FACS) of bursa of Fabricius indicated that protection was conferred in SK09 vaccinated progenies against homologous challenge.

**Conclusion:** varIBDV exhibited great potentials to be a vaccine candidate to control vIBDV infections in Canada.

**Keywords:** variant IBDV, vaccine, Immune complex

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 20. Competition dominates the mixed communities of Gardnerella spp.

**Presenter: Salahuddin Khan**

Collaborators: Maarten J. Voordouw  
Western College of Veterinary Medicine  
Supervisor(s): Janet E. Hill

**Background:** Gardnerella spp. are a hallmark of bacterial vaginosis, a loosely defined dysbiosis of the vaginal microbiome. Gardnerella has four subgroups based on cpn60 sequences: A, B, C and D, which potentially differ in virulence. Although multiple subgroups often colonize individual women, subgroups A and C are most prevalent and abundant. Several factors including interactions between Gardnerella subgroups may contribute to their abundance in vagina. When Gardnerella are dominant in vaginal microbiomes, interactions between Gardnerella would be frequent.

**Methods:** Our objective was to characterize the types of interactions between subgroups of Gardnerella under in vitro conditions. Representative isolates of four subgroups were grown in BHI+ 0.25% maltose for 48 hours in communities of 1, 2, 3 or 4 subgroups (n = 48, 72, 48, or 12, respectively; total of 180 combinations). DNA was extracted, and subgroup-specific qPCR was performed to determine the abundance of each subgroup in the initial inoculum and the final population.

**Results:** To determine the types of interactions in the mixed communities, we compared the observed final population sizes with the expected population sizes under the null hypothesis of no interactions between subgroups. Most (70%, 92/132) of the mixed communities exhibited negative interactions, suggesting that competition between subgroups is the norm under our in vitro conditions ( $p < 0.0001$ ). Subgroup C had a growth rate that was twice that of the other subgroups. Interestingly, the effect of competition differed among the four subgroups. Subgroups A, B, and C had lower growth rates in the mixed communities, whereas subgroup D had a higher growth rate ( $p < 0.0001$ ). Moreover, the presence of subgroup D as a competitor negatively affected the growth rates of three other subgroups.

**Conclusion:** Our findings suggest that the competition among Gardnerella strains is probably a non-interfering, exploitative one, which may select for subgroup(s) with a distinct metabolic capacity

**Keywords:** Microbial interaction, Competition, Microbiome, Dysbiosis

**Self-assessment of research as interprofessional/interdisciplinary:** No

**Basic Science 3****21. Neuromodulator-mediated effects on somatosensory adaptation are associated with changes in astrocytic potassium homeostasis****Presenter: Caitlin Wotton**

Collaborators: Elizabeth Quon

College of Graduate and Postdoctoral Studies

Supervisor(s): Lane Bekar

**Background:** It is well established that neuromodulators affect cortical frequency transmission. Additionally, a recent study demonstrated that application of a cocktail of neuromodulators to the cortex increased extracellular potassium ( $[K^+]_e$ ) and changed its uptake. Given that altering extracellular potassium has the potential to alter neuronal excitability (by changing ion driving forces and depolarizing/hyperpolarizing neurons), we set out to test the hypothesis that neuromodulators use changes in  $[K^+]_e$  to produce changes in frequency transmission using extracellular field and simultaneous  $K^+$  ion-selective microelectrode recordings in acutely isolated somatosensory cortical mouse brain slices.

**Methods:** A 10-pulse stimulation protocol (20 Hz), to assess adaptation/habituation, was repeated every two minutes throughout application of the different neuromodulators with/without various pharmacological agents.

**Results:** Results indicate that the neuromodulators differentially affect frequency transmission. Serotonin (5HT) and norepinephrine (NE) increase whereas acetylcholine (ACh) decreases frequency transmission. These effects correlated with 5HT and NE showing an increase in basal  $[K^+]_e$  and decrease in the evoked response decay tau, while ACh did not. To address the role of the sodium/potassium ATPase and  $K^+$  inward rectifiers in these neuromodulator responses on  $[K^+]_e$ , ouabain and  $Ba^{2+}$  were applied before the various neuromodulators. In support of extracellular potassium involvement in neuromodulator effects, we found the neuromodulators to differentially affect both  $K^+$  homeostasis and frequency transmission with  $Ba^{2+}$  and ouabain.

**Conclusion:** This study highlights a novel mechanism through which neuromodulators can alter cortical networks in a rapid and robust manner. It also indicates a possible role for astrocytes in neuromodulator-mediated effects given that astrocytes are the main mechanism through which  $K^+$  homeostasis is maintained. These results have implications for attention and perception behaviors that rely on the principle of adaptation/habituation.

**Keywords:** Potassium, Astrocytes, Serotonin, Norepinephrine, Acetylcholine, Adaptation

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 22. Investigation of a non-invasive MRI tool to assess cartilage and meniscus in patients with osteoarthritis

**Presenter: Kirstin Olsen**

Collaborators: Ives Levesque, Lumeng Cui

College of Engineering

Supervisor(s): Emily J. McWalter

**Background:** Osteoarthritis (OA) is a degenerative disease that involves entire synovial joints and is characterized by a loss in soft tissue and bone as well as joint surface structural modification. The current lack of treatment options for OA can be attributed to an inability to measure changes in the tissue and thus verify successful therapies. Traditionally, OA has been assessed using radiography which is able to detect alterations of the bones in the joint. However, traditional radiography does not show changes to the articular cartilage and menisci. Magnetic resonance imaging (MRI) is a powerful tool that can be used to provide images of soft tissues within the body. A more specific application of MRI is quantitative magnetic resonance imaging (qMRI), which allows for numerical values to be measured as well as images rendered. Quantitative magnetization transfer (qMT) is a qMRI approach that allows for the indirect observation of hydrogen atoms with resonance too short to be captured with conventional MRI. It is a powerful MRI contrast that allows for the determination of the restricted pool properties within cartilage and meniscus (specifically the macromolecules such as proteoglycan and collagen) that cannot be detected using conventional MRI. The objective of this project is to investigate qMT as a non-invasive imaging biomarker of cartilage and meniscus composition, structure, and function in OA patients.

**Methods:** Twenty pre-total knee arthroplasty (TKA) patients will be scanned at 3T using an established qMT protocol with 2 MT pulse flip angles and 5 offset frequencies. B0, B1, and T1 maps will also be acquired for processing. Articular cartilage and menisci will be obtained post-TKA surgery and scanned using the same protocol. Intact tissues will be used for the mechanical testing and core samples will be taken for biochemical analysis. For histology, radial sections of meniscus and cylindrical pieces of cartilage will be excised. An Iterative Closest Points (ICP) algorithm will be used to register MRI, mechanical testing, biochemical, and histological data. For the mechanical testing component, indentation testing will be carried out using a materials testing system (Mach-1, Biomomentum, Laval, PQ). The instantaneous modulus will be determined at discrete points over the entire surface of the samples and the 3D surface topologically mapped for registration. Proteoglycan and collagen content will be determined through standard sulfated glycosaminoglycan (sGAG) and hydroxyproline assays respectively. Specimens will be weighed, lyophilized, and re-weighed to determine wet to dry mass ratio. Samples will then be digested in proteinase-K and sGAG content determined using a dimethylmethylene blue assay and hydroxyproline using a kit (Cell Biolabs Inc., San Diego, CA) assuming a mass ratio of collagen to hydroxyproline of 8. For histology, samples will be processed and embedded in paraffin and then sectioned at a thickness of 5  $\mu\text{m}$ . Slides will be stained with Safranin O/Fast green for scoring using the Osteoarthritis Research Society International (OARSI) system for cartilage, and the modified Pauli method for meniscus. Multiple regression will be used to determine if qMT parameters are predictive of mechanical tissue properties using a packaged software (Stata, Statacorp, College Station, TX). Correlation between qMT parameters and biochemistry and histology results will be assessed using Pearson and Spearman coefficients respectively.

**Conclusion:** The objective of this project is to investigate qMT as a method for assessing cartilage and meniscus structure and function. This will be accomplished by determining if there is an association between qMT parameters and the mechanical, biochemical, and histological properties of the tissue.

This technique could prove to be a useful tool for diagnosis of early OA, assessment of the progression of OA over time, and for the evaluation of treatments in order to determine their effectiveness.

**Keywords:** Osteoarthritis, Magnetic Resonance Imaging, Biomedical Engineering, Cartilage, Meniscus  
**Self-assessment of research as interprofessional/interdisciplinary:** No

## 23. Biochemical characterization of the human cytidine deaminase APOBEC1

**Presenter:** Lai Wong

Collaborators: Frederick S. Vizeacoumar, and Franco J. Vizeacoumar

College of Medicine

Supervisor(s): Linda Chelico

**Background:** Humans produce many enzymes that can modify the sequences of single-stranded (ss) DNA and RNA to enrich the coding capacity of these biological molecules. APOBEC1 is one of the first modification enzymes identified. It was initially discovered to play an essential physiological role in lipid metabolism by enabling two proteins with distinct functions to be produced from the same RNA molecule through cytidine deamination to form uridine. Since this discovery, APOBEC1 has been found to modify many other RNA and ssDNA molecules, but the molecular basis by which this is achieved and how the enzyme selects and differentiates between ssDNA and RNA targets is not known. Importantly, APOBEC1 can exist in cells at the wrong time and place, and under these circumstances it may mutate the genomic DNA driving the cell to a cancerous form. We undertook biochemical characterization of human APOBEC1 to better understand the mechanisms that would enable APOBEC1 to access substrate DNA.

**Results:** Using synthetic oligonucleotides, we determined that APOBEC1 is a processive enzyme which would potentially enable it to search for transient ssDNA formed during replication or transcription. Although in vitro assays showed that the presence of replication protein A (RPA) on ssDNA decreased APOBEC1 activity, it did not abolish it, demonstrating that APOBEC1 can compete with RPA for ssDNA, likely due the ability of A1 to cycle on substrate ssDNA. Similar to other processive APOBEC family members, APOBEC1 existed in a dynamic oligomerization state made up of large oligomers, tetramers, dimers, and monomers, which was dependent on the presence or absence of RNA. Notably, in contrast to other APOBEC3 enzymes, bound RNA did not have an inhibitory effect on APOBEC1 enzymatic activity, but did effect the cooperative nature of APOBEC1 binding to ssDNA. These data provide insight into the mechanisms by which APOBEC1 may access ssDNA to induce genomic damage.

**Keywords:** APOBEC1, cytidine deaminases, DNA

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 24. Circulating neutrophil numbers and plasma G-CSF levels are associated with inhaled aztreonam lysine and Staphylococcus aureus in cystic fibrosis

**Presenter: Nathan Wright**

College of Medicine

Supervisor(s): John R. Gordon

**Background:** The neutrophil response contributes substantially to disease progression in cystic fibrosis (CF). Circulating neutrophils in CF have been shown to be stimulated and reduced in apoptosis when compared to controls. Therefore research was directed at understanding the circulating neutrophil in CF.

**Methods:** Medical chart data and blood samples were collected from volunteers with CF (homozygous  $\Delta F508$ ) while blood samples were collected from age-matched controls. Isolated plasma was then analysed for G-CSF and CXCL1 and statistically compared with neutrophil numbers and medical chart data, while signaling pathways in these neutrophils were investigated using kinome array approaches.

**Results:** Our results indicated that the CF group being treated with an antibiotic regimen that contained aztreonam lysine for inhalation (AZLI) had significantly increased isolated circulating neutrophil numbers ( $p < .01$ ) and increased G-CSF levels ( $p = 0.057$ ) when compared to the CF group without the antibiotic. Neutrophil numbers were also significantly increased in both the AZLI positive ( $p < .001$ ) and negative ( $p < .05$ ) CF groups when compared to the non-CF control group. Neutrophil numbers in CF displayed a significant ( $p < .05$ ) positive correlation with G-CSF levels. Decreased neutrophil numbers, G-CSF levels, and CXCL1 levels were related to detection of *S. aureus* in CF sputum. We also observed a significant ( $p < .05$ ) negative correlation between disease progression in CF (observed as FVC %) and neutrophil numbers. Kinome analysis was found to corroborate many of these results.

**Conclusion:** This study revealed a connection in CF between antibiotic treatment, sputum bacteria, inflammatory markers in the blood, altered neutrophil signaling, changes in circulating neutrophil numbers, and disease progression.

**Keywords:** Circulating Neutrophils, Cystic Fibrosis, Antibiotics, Sputum Bacteria

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 25. Chronic high dose neonicotinoid exposure decreases overwinter survival of honey bees (*Apis mellifera*)

**Presenter: Sarah C. Wood**

Collaborators: Roney de Carvalho Macedo Silva, Ihor Dvylyuk, Igor Medici de Mattos, Ivanna V. Kozii, Colby D. Klein, Igor Moshynskyy, and Tasha Epp

Western College of Veterinary Medicine

Supervisor(s): Elemir Simko

**Background:** Since 2006, North American beekeepers have experienced unsustainable increases in overwinter honey bee colony mortality. Overwinter, colonies rely on stored honey and pollen which is contaminated with the ubiquitous neonicotinoid insecticides clothianidin and thiamethoxam, at mean concentrations from 1.9-28.9 ng/g (1).

**Methods:** To determine whether dietary neonicotinoid exposure affects overwinter survival of *Apis mellifera* L., we chronically exposed winter bees to thiamethoxam or clothianidin in the field and in the laboratory and monitored survival.

**Results:** Field colonies chronically exposed to 100 ng/g thiamethoxam in fall sucrose syrup feeding experienced 65% overwinter mortality, which was significantly greater than the overwinter mortality of control colonies (10% overwinter loss,  $P < 0.001$ ) and colonies exposed to 20 ng/g thiamethoxam (25% overwinter loss,  $P = 0.011$ ). Under laboratory conditions, winter adult workers chronically exposed to 20 or 100 ng/g thiamethoxam or clothianidin in sucrose syrup had a significantly ( $P < 0.001$ ) increased risk of death compared to control.

**Conclusion:** Taken together, these field and laboratory results suggest that high environmental (20 ng/g) doses of neonicotinoids may decrease overwinter survival of honey bees and honey bee colonies. Further investigation of chronic exposure to mid-range environmental doses (5 and 10 ng/g) neonicotinoids on overwinter survival is in progress. References: 1 Sanchez-Bayo F, Goka K, Pesticide residues and bees—a risk assessment. *PLoS One* 9:e94482 (2014).

**Keywords:** honey bee, overwinter mortality, neonicotinoid, chronic

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 26. Development of a novel vaccine against low pathogenic avian influenza (LPAI) H7N9 viruses

**Presenter:** Shelby Landreth

Collaborators: Yao Lu, and Amit Gaba

School of Public Health

Supervisor(s): Yan Zhou

**Background:** Low pathogenic avian influenza (LPAI) H7N9 viruses are capable of inducing severe respiratory disease in humans, posing an adamant threat to society. H7N9 is of particular alarm due to its high infection rates and potential of acquiring adaptations that allow sustained human-to-human transmission. Since the primary strategy for protection and control of influenza is through vaccination, this study uses the first Canadian isolate LPAI (A/British Columbia/1/2015) [BC15 (H7N9)] to design a live attenuated influenza vaccine (LAIV).

**Methods:** The hemagglutinin (HA) cleavage site from A/British Columbia/1/2015 [BC15 (H7N9)] was engineered from a trypsin-sensitive motif to an elastase-sensitive motif for the live attenuated influenza vaccine (LAIV). The LAIV was generated by the use of an eight-plasmid reverse genetics system, composed of six segments from A/Puerto Rico/8 [PR8 (H1N1)], and the engineered hemagglutinin (HA) and neuraminidase (NA) from BC15 (H7N9). Simultaneously, a wild-type virus was generated composed of six segments from PR8 (H1N1), and the wild-type HA and NA from BC15 (H7N9). The LAIV was evaluated for its dependency on elastase, its growth properties, as well as its genetic stability. A mouse disease model was established with three different doses of BC15 (H7N9) as a prerequisite for pathogenicity and immunoprotection in vivo studies.

**Results:** The live attenuated influenza vaccine (LAIV) was successfully generated, is strictly elastase-dependent, possesses equivalent growth kinetics to the wild-type H7N9, and is genetically stable. The mouse disease model found mice to be highly susceptible to A/British Columbia/1/2015 [BC15 (H7N9)] for all three doses tested ( $10^3$  PFU,  $10^4$  PFU, and  $10^5$  PFU), evident by their rapid body weight loss

and severe mortality rates. BC15 (H7N9) induced severe pathology and potent expression of proinflammatory cytokines in the mouse lung. The  $10^3$  PFU dose was chosen to be the candidate challenge dose for future pathogenicity and immunoprotection in vivo studies.

**Conclusion:** In this study, we developed a live attenuated influenza vaccine (LAIV) which has demonstrated potential as a vaccine candidate against A/British Columbia/1/2015 [BC15 (H7N9)]. Since the mouse disease model found mice to be highly susceptible to BC15 (H7N9), we hypothesize that the LAIV will provide sufficient protection against BC15 (H7N9) infection. Therefore, the LAIV could serve as a novel vaccine against low pathogenic avian influenza (LPAI) H7N9 viruses to improve the preparation against a potential pandemic.

**Keywords:** Influenza, H7N9 vaccine, elastase, live attenuated

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 27. Characterization of homopolymeric region of a putative sialidase gene of *Gardnerella vaginalis*

**Presenter:** Shakya Kurukulasuriya

Western College of Veterinary Medicine

Supervisor(s): Janet E. Hill

**Background:** Phase variation is a form of gene regulation in bacteria where the expression of a phenotype is altered between “on” state and “off” state. One of the mechanisms involved in phase variation is slipped-strand mispairing (SSM) in which the template or the daughter strand loop-out causing a mismatch during DNA replication. SSM can occur in genomic regions that contain short, homogenous or heterogenous repeats and may change the length of the repeat region at each replication. Our lab group has discovered a gene (Gene 2) in *Gardnerella vaginalis* that predicted to encode a cell wall attached, extra cellular sialidase. Sialidase is recognised as a virulence factor in some strains of *G. vaginalis*. The open reading frame of Gene 2 contains a homopolymeric tract of about 12 cytosine residues. The objective of this study is to determine if the homopolymer region of Gene 2 varies in length in *G. vaginalis*.

**Methods:** . Primers were designed to amplify the homopolymer region of Gene 2. *G. vaginalis* (strain W11) was grown on agar and the homopolymer region was amplified from individual colonies by PCR. Amplicons generated from two isolated colonies were ligated into pGEM-T vector and plasmids were extracted and sequenced.

**Results:** The sequencing revealed that the cloned PCR products had identical sequences apart from the variation in the number of C residues in the homopolymeric tract. In the poly – C region, 12 C’s was the most commonly occurring length and the only length that makes the coding region in-frame. When there were 11, 13 or 14 C’s, a premature stop codon is generated when translated in-silico.

**Conclusion:** . We can conclude that the expression of Gene 2 may be regulated by SSM. Phase variation in a cell wall associated sialidase of *G. vaginalis* may play a role in adapting to the vaginal microbiome and evading the host immune system.

**Keywords:** *Gardnerella vaginalis*, homopolymer, slipped strand mispairing, vaginal microbiome, phase variation,

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 28. Determining the correlates of protection that prevent MERS-CoV infection in camelids

**Presenter: Swarali Kulkarni**

Collaborators: Jocelyne Lew, and William Deck

Western College of Veterinary Medicine

Supervisor(s): Darryl Falzarano

**Background:** Middle East respiratory syndrome coronavirus (MERS-CoV) can cause severe pneumonia in humans and was first identified in 2012 in Saudi Arabia. It is suspected that MERS-CoV transmission to humans occurs as a result of close contact with camels. Our lab is focused on developing a vaccine against MERS-CoV to be used in camels as a way of preventing transmission to humans. To achieve this, we have developed an alpaca model (a close relative of camels) that recapitulates MERS-CoV infection in dromedary camels. The aim of this study is to characterize the activity of neutralizing antibodies against MERS-CoV in alpacas following experimental infection and vaccination. All camelids are known to have three different isotypes of IgG: IgG1 is a conventional antibody, while IgG2 and IgG3 possess heavy chains only, a feature that is unique to camelids and sharks.

**Methods:** We have used affinity chromatography for purification of IgG1, IgG2 and IgG3. Then we have checked purity of each isotype with western blotting and isotype specific ELISA. Furthermore, we characterized neutralization activity of each isotype using microneutralization assay and surface plasmon resonance.

**Results:** Using an isotype-specific ELISA, we found that both IgG1 and IgG3 against the spike protein were induced following infection, while IgG2 was only observed following re-challenge. Furthermore, we analysed the neutralizing activity of each IgG isotype by using purified IgG isotypes from MERS-CoV-infected and -vaccinated alpacas. Our findings indicate that IgG3 and IgG1 possess high neutralizing activity. In contrast, IgG2 neutralizing activity was minimal. Additionally, we also characterised the antigen binding kinetics of each IgG isotype towards MERS-CoV spike protein using a urea ELISA and surface plasmon resonance (SPR).

**Conclusion:** This information advances our knowledge of what a protective IgG response may be composed of and provides targets to achieve in field trials in dromedary camels.

**Keywords:** Heavy chain antibody-IgG2 and IgG3

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 29. Formation of testicular tubular structures from neonatal porcine testicular cells in vitro

**Presenter: Tat-Chuan Cham**

Western College of Veterinary Medicine

Supervisor(s): Ali Honaramooz

**Background:** The establishment of in vitro spermatogenesis provides an option for preserving the fertility potential of prepubertal boys undergoing chemotherapy or radiation therapy. It can also be used to conserve the genetic potential of endangered species that die prematurely. This can be achieved by

culturing testis samples using 2D or 3D methods. Culturing cell pellets from neonatal mouse testicular cells on agarose gel, supplemented with 10% knockout serum replacement (KSR), has been reported to reconstruct the testicular tubular structure which supports the differentiation of germ cells. The present study was designed to evaluate the tubular reconstruction capacity of porcine testicular cells by culturing cell pellets on agarose gel soaked in media supplemented with KSR.

**Methods:** Primary testicular cells were collected from 1-wk-old piglets, centrifuged in conical tubes, and cultured for 2 days. The cell aggregates were further cultured either on 1.5 % agarose gel (1×1×0.5 cm) or without a gel (as control) in  $\alpha$ -MEM media supplemented with either 10% KSR or 10% fetal bovine serum (FBS). The media were changed every 3 days and samples were collected weekly for analysis.

**Results:** The reconstruction of testis cord-like structures was observed in cell pellets cultured on agarose gel supplemented with 10% KSR as early as 1 wk in culture. The testis cord-like structures were 50-60  $\mu$ m in diameter, which is comparable with testis cord diameters in the neonatal pig testes. No cord formation was observed in cell pellets cultured without agarose gels or those in media supplemented with FBS. The cell viability at the perimeter of cell pellets was also higher in media containing KSR than FBS.

**Conclusion:** These preliminary results show that neonatal porcine testicular cells have the potential to reconstruct testis cord-like structure in culture; an important step towards in vitro spermatogenesis using neonatal porcine testicular cells.

**Keywords:** Neonatal porcine testicular cells, In vitro spermatogenesis

### 30. The Combination of Gefitinib and Enterolactone Attenuates Hepatic Fibrotic Markers in vitro

**Presenter: Xiaolei Yang**

College of Pharmacy and Nutrition

Supervisor(s): Jane Alcorn

**Background:** Hepatic fibrosis threatens human health worldwide due to the risk of fatal complications such as cirrhosis and hepatocarcinoma. Currently, effective treatments remain elusive because of lack of both efficient and safe drugs for hepatic fibrosis. Literature evidence suggests that some tyrosine kinase inhibitors (TKIs), a group of multi-target drugs primarily marketed for cancer therapy, have ability to favorably modulate cell proliferation dysfunctional diseases such as renal fibrosis and pulmonary fibrosis, but dose-limiting toxicity prevents its use in fibrotic disease. The mammalian lignan, enterolactone, is an active polyphenolic metabolite of plant lignans that shows health benefits such as anti-proliferation, anti-inflammatory, and anti-oxidative effects along with evidence of benefit in fibrotic disease with long-term safety. Our study aims to determine whether enterolactone in combination with gefitinib attenuates fibrotic biomarkers in activated hepatic stellate cells to a greater extent than each compound alone.

**Methods:** Human hepatic stellate cell line (LX-2 cell line), considered as the major myofibroblast within hepatic fibrosis, was cultured in high glucose, FBS supplemented DMEM medium and seeded to multi-well plates. TGF $\beta$ 1 was used to activate LX-2 cells 6 hours before treatment with gefitinib and/or enterolactone for different assays. Quantitative PCR and ELISA assessed gene and protein expression, respectively, of fibrotic biomarkers Collagen I,  $\alpha$ -SMA, MMP2 and TIMP1 for qPCR and Collagen I and MMP9 for ELISA, in TGF $\beta$ 1-stimulated LX-2 cells. Subsequently, migration assay was conducted to assess the wound healing ability of enterolactone and/or gefitinib at different concentrations for 24 hours in

TGF $\beta$ 1-stimulated LX-2 cells. A caspase-3/7 apoptosis assay was conducted following treatment with enterolactone and/or gefitinib for different time points in TGF $\beta$ 1-stimulated LX-2 cells.

**Results:** The key fibrotic biomarkers were reduced by gefitinib at both gene and protein levels (this measurement for enterolactone and the combination are not finished yet). The migration of the TGF $\beta$ 1-stimulated LX-2 cells was attenuated by gefitinib at 24h after a scratch gap was made, and further attenuated by the combination with enterolactone. At 24 and 48 hours, gefitinib and enterolactone induced apoptosis of the stimulated LX-2 cells in a concentration-dependent manner.

**Conclusion:** Enterolactone in combination with gefitinib can attenuate fibrotic biomarkers in activated human hepatic stellate cells to a greater extent than using gefitinib alone, consequently this combination has a potential to be further investigated as anti-hepatic fibrotic approach in liver fibrosis.

**Keywords:** Hepatic fibrosis, LX-2 cell, gefitinib, enterolactone, flaxseed lignan, apoptosis, migration

**Self-assessment of research as interprofessional/interdisciplinary:** No

**Clinical 1****31. UNDERSTANDING LEUKOCYTE RECRUITMENT IN MURINE OZONE-INDUCED LUNG INFLAMMATION****Presenter: Claudia Marcela Guerrero Soler**

Collaborators: Jessica Andrea Brocos Duda, Elisabeth Snead, and Jaswant Singh

Western College of Veterinary Medicine

Supervisor(s): Gurpreet Aulakh

**Background:** Ozone (O<sub>3</sub>) is a major component of photochemical smog. Ambient O<sub>3</sub> is a criteria air pollutant that impacts both human morbidity and mortality. CCR2<sup>high</sup> CX3CR1<sup>low</sup> monocytes enter lungs under steady state conditions and develop into CX3CR1<sup>high</sup> CCR2<sup>low</sup> alveolar macrophages. This homeostatic mechanism appears to be dependent on the chemokine receptor CX3CR1. We hypothesized that CX3CR1 macrophages are protective in murine O<sub>3</sub>-induced lung inflammation and mediate lung neutrophil recruitment.

**Methods:** We exposed wild-type (WT) and CX3CR1knockout (KO) mice to 50 ppb filtered air or O<sub>3</sub> for 2 h, and collected peripheral blood, lung vascular perfusate and bronchoalveolar lavage (BAL) at 0, 6 and 22 h after exposure.

**Results:** O<sub>3</sub> causes an influx of mononuclear cells in the BAL and neutrophils in vascular perfusate. WT display a time-dependent reduction in expression of CX3CR1, immediately at 0 h (51.4%) and 22 h (81.1%) post-exposure. 6 h post O<sub>3</sub>, Ly6G (350%) and CCR2 (193.7%) cells were observed in WT, but not KO. O<sub>3</sub> induced a rapid upregulation of Ly6C (142.9%) in the KO, but not WT. We observed a rapid upregulation of iNOS (143.9%) in KO compared to 220.5% in WT at 24 h. At steady state, BAL from KO expressed higher Ly6G (25 fold), Ly6C (4.1 fold), CCR2 (15.3 fold) and iNOS (2.3 fold) than the WT, which reinforces the idea that the absence of CX3CR1 leads to an exaggerated inflammatory response.

**Conclusion:** Given the lack of systematic animal studies at ambient O<sub>3</sub> (50 ppb), further characterization of the metabolic and cytokine profile will allow us to better understand how and why leukocytes are recruited in O<sub>3</sub> induced lung inflammation and will guide development of protective health strategies and environmental standards.

**Keywords:** Ozone, Acute Lung Injury, CX3CR1**Self-assessment of research as interprofessional/interdisciplinary:** No

## 32. Quantifying error of high-resolution peripheral quantitative computed tomography and digital volume correlation measures of internal bone displacement

**Presenter: Dylan Zaluski**

College of Engineering

Supervisor(s): James (J.D.) Johnston and Saija Kontulainen

**Background:** Subject-specific finite element (FE) modeling is a computational engineering technique used to evaluate how a structure with varying material properties and complex geometry behaves when subjected to loading. This is a valuable tool for researchers and clinicians interested in better understanding musculoskeletal diseases such as osteoporosis or osteoarthritis as it offers unique information nearly impossible to measure experimentally (e.g., internal stress and strain distributions in bone), which can be linked to clinical symptoms and disease progression. The FE method typically uses quantitative computed tomography (QCT) to acquire tissue geometry and estimates of material properties (e.g., elastic modulus, strength), and is referred to as QCT-FE. Prior to usage, QCT-FE models must be experimentally validated. To date, QCT-FE estimates of cortical bone strain have been validated, but not internal bone deformation. Digital volume correlation (DVC) is an image-processing tool that allows the measurement of 3D, internal bone displacements by comparing and tracking consecutive CT scans of bone in unloaded and loaded (deformed) states. Importantly, DVC can be used for validating FE estimates of internal bone deformation. However, the measurement error of DVC is sensitive to scanning and image pre-processing procedures. A standard method for estimating DVC error is to perform a zero-strain study, by calculating the displacement field between two consecutive scans of an unloaded specimen with no repositioning. The standard deviation of the displacement field can be used to obtain a lower bound for the error due to image noise and scanner artifacts. The aim of this study was to quantify the zero-strain error and least significant change of bone displacement measures via HR-pQCT and DVC.

**Methods:** Using HR-pQCT, one cadaveric knee joint was scanned twice (300ms integration time, 41 $\mu$ m voxel size) with no loading or repositioning. Due to the large specimen size, scans were acquired as a series of consecutive, 220-slice blocks. To minimize misalignment between scan blocks, all blocks were acquired with a 20-slice overlap, and a custom script written in the scanner's programming language was used to rigidly register and stitch the blocks into a complete stack. After reconstruction, a custom MATLAB program was used for ring artifact correction and non-local-means denoising. DVC was performed using commercial software (DaVis 10.01, LaVision Inc.). To estimate measurement error, the standard deviation (SD) of the resulting displacement field was calculated. Least significant change (LSC) was calculated as 2.77xSD. The LSC represents the minimum displacement measure such that we are 95% confident that true physical displacement has occurred. A semi-automatic segmentation method was used in the scanner software to generate bone contours. Cortical bone was segmented from trabecular bone using a combination of thresholding and morphological operations to close holes in the segmentation. The resulting bone contours were used for masking the DVC displacement field to obtain separate error estimates for cortical and trabecular bone.

**Results:** From the zero-strain test, SD for displacement was 2 $\mu$ m in trabecular bone, and 4 $\mu$ m in cortical bone. This corresponded with LSCs of ~5.5 $\mu$ m and 11.1 $\mu$ m for trabecular and cortical bone, respectively.

**Conclusion:** Results of this study indicate that HR-pQCT and DVC displacement measures greater than 5.5 $\mu$ m for trabecular bone and 11.1 $\mu$ m for cortical bone can be considered reliable (i.e., represent true

physical displacement). This information will be used as displacement thresholds for future QCT-FE model validation.

**Keywords:** Digital volume correlation Finite element modeling Bone HR-pQCT

**Self-assessment of research as interprofessional/interdisciplinary:**

### 33. Microbial Causes of Circadian Clock Disruption in Autoimmune Diseases

**Presenter: Helyasadat Mortazavi**

Collaborators: Zohre Gheisary, and Liubov Lobanova

College of Dentistry

Supervisor(s): Petros Papagerakis, and Silvana Papagerakis

**Background:** Circadian clock has a hierarchical multi-oscillator structure that provides the 24-hour rhythms of light-dark cycles in behavior, physiology, and metabolic processes. Circadian oscillators are present in the central suprachiasmatic nucleus (SCN) of the hypothalamus in the form of neural and endocrine outputs, and peripheral cells of every tissue in the form of genetic codes. Microbiota is an endogenous circadian organizer (independent regulator) that consists of an ecological community of commensal, symbiotic and pathogenic microorganisms. Microbiota is essential in the development of host immunity, pathogen defense, metabolic health and in modulating host circadian rhythms; thus microorganisms can have a dramatic effect on circadian clock disruption. The composition and function of microbiota undertake diurnal fluctuations, and these fluctuations are influenced by eating patterns and timing of food ingestion, type, and composition of the diet, sex and age, and lifestyle stressors. It has been shown that peripheral tissues integrate signals of the microbiome to influence the temporal organization of genome-wide transcription. It has also been suggested that the microbiome can regulate host circadian activity via circadian oscillations of serum metabolites, programming circadian epigenetic and transcriptional sites, and transcriptome pattern. Interestingly, a pathogenic infection can trigger both microbiota and clock dysregulation. In pathologic conditions such as autoimmune disease adaptive autoimmune response, which involves both T and B lymphocytes, directs against a self-antigen; the immune system also displays circadian oscillations in immune cell count, synthesis and cytokine release, clock gene expression in cells and organs of the immune system as well as clock-controlled gene that regulates immune function. Circadian disruption leads to dysregulation of immune responses and inflammation which can further disrupt circadian rhythms. However, the links between microbiota dysregulation, circadian clock disruption, and autoimmunity remain unclear. Our goal is to elucidate microbial factors that can cause circadian clock disruption and microbiota changes that lead to immune system malfunctioning, autoimmune diseases pathogenesis, and progression. Microbiota is essential in the development of host immunity, pathogen defense, metabolic health and in modulating host circadian rhythms; thus microorganisms can have a dramatic effect on circadian clock disruption. The composition and function of microbiota undertake diurnal fluctuations, and these fluctuations are influenced by eating patterns and timing of food ingestion, type, and composition of the diet, sex and age, and lifestyle stressors. It has been shown that peripheral tissues integrate signals of the microbiome to influence the temporal organization of genome-wide transcription. It has also been suggested that the microbiome can regulate host circadian activity via circadian oscillations of serum metabolites, programming circadian epigenetic and transcriptional sites, and transcriptome pattern. Interestingly, a pathogenic infection can trigger both microbiota and clock dysregulation. In pathologic conditions such as autoimmune disease adaptive autoimmune response, which involves both T and B lymphocytes, directs against a self-antigen;

the immune system also displays circadian oscillations in immune cell count, synthesis and cytokine release, clock gene expression in cells and organs of the immune system as well as clock-controlled gene that regulates immune function. Circadian disruption leads to dysregulation of immune responses and inflammation which can further disrupt circadian rhythms. However, the links between microbiota dysregulation, circadian clock disruption, and autoimmunity remain unclear. Our goal is to elucidate microbial factors that can cause circadian clock disruption and microbiota changes that lead to immune system malfunctioning, autoimmune diseases pathogenesis, and progression.

**Methods:** In this study, mice models of circadian clock disruption and autoimmunity are being used. These include Per2 knock-out (KO), Bmal1 KO, Bmal1 conditional KO, and Cry1/2 KO. These mice are evaluated for circadian clock disruption and autoimmunity profiles after changes of microbiota. These mice will be challenged by specific infectious agents to characterize the effects of acute vs. chronic infections on the circadian clock disruption. In parallel, we will characterize oral and gut microbiome profiles of patients with various autoimmune diseases (Rheumatoid Arthritis, Multiple Sclerosis, Sjögren's Syndrome, and Crohn's) at different stages of diseases progression by direct next-generation sequencing, scanning electron microscopy (SEM) and multiplex PCR. The extent of circadian disruption is evaluated in biological specimens by measuring the fluctuations in the level of expression of melatonin and large panels of clock genes and their main molecular targets by using a circadian clock RNA microarray.

**Results:** We expect to find bidirectional pathways involving specific pathogens, opportunistic bacteria, viruses, and fungi, that can disrupt the immune system and microbiota. Identifying those microorganisms that influence the clock genes and trigger autoimmune diseases, can lead to novel approaches for targeting the causative agents with selective antimicrobial therapy, allowing for implementation of healthy regimen changes tailored on patient individual profile and type of autoimmune disease in order to restore a balanced microbiota and circadian profile.

**Conclusion:** The ultimate goal of our study is to improve clinical outcomes in patients with autoimmune diseases through a better understanding of the underlying molecular crosstalk between microbiota, clock genes, and circadian rhythms.

**Keywords:** Microbiota, Circadian Rhythm, Autoimmune Diseases, Bacteria, Viruses, Fungi

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 34. Sex differences in older adults during forward descents on outstretched arms

**Presenter:** Justin Pifko

Collaborators: Cathy Arnold, and Jon Farthing

College of Kinesiology

Supervisor(s): Joel Lanovaz

**Background:** Falls are a leading cause of injuries in older adult populations, with forward falls on outstretched hands being one of the most common fall arrest strategies. Previous research looking at fall arrest capacity has shown that older women are less able to absorb energy during a controlled forward descent on the arms when compared to younger women. Although women are at a higher risk of some types of fall-related injuries, serious trauma such as head injury are equally likely in men and women. In older adults, sex-related differences in fall arrest capacity are currently unknown as related studies are

frequently limited to female participants. Our purpose was to quantify possible fall arrest capacity differences among older men and women.

**Methods:** To date, twenty-two older adult participants (11 females, M(age female)=71.2yrs, M(age male)=72.8yrs, range: 60-86yrs) have been analysed. Using a custom testing apparatus, participants completed a forward descent motion similar to the downward portion of a push-up, starting with a body lean of 60° from horizontal. The initial pose consisted of extended arms, 90° shoulder flexion, hands shoulder width apart, keeping a neutral spine, fully extended knees, and feet together throughout the descent. Pace was set using an audible metronome with a target of 90° elbow flexion in 1.5 seconds. Three trials were recorded for each participant and average data were used. Force platforms (OR6-7, AMTI, Watertown, MA, fs=2000Hz) under each hand recorded reaction forces while bilateral 3D upper extremity kinematics were captured using an eight-camera motion capture system (VICON, Centennial, CO, fs=200Hz). Outcome variables included elbow range of motion (ROM), elbow moments, reaction forces, and energy absorption. Independent t-tests compared demographics between sexes while separate 2 x 2 (arm x sex) repeated measure ANOVAs examined the outcome variables.

**Results:** The males were significantly taller and heavier but body mass index was similar between sexes (M:29.6±3.9m<sup>2</sup>kg<sup>-1</sup>, F:28.4±5.2m<sup>2</sup>kg<sup>-1</sup>, p=0.54). There were no effects of arm or sex by arm interactions on any outcome variables. Elbow ROM (M:67.4±4.7°, F:78.1±4.5°, p=0.11) and peak normalized elbow extensor moment (M:0.018±0.001, F: 0.015±0.001, p=0.06) were not different between sexes. Males started the movement with a higher percentage of body weight on their hands (M:29.5±0.4%BW, F:27.4±0.3%BW, p=0.04). Males also completed the movement faster (M: 1.33±0.33s, F: 1.98±0.70s, p=0.01), consequently leading to greater peak force values (M:40.2±0.7%BW, F:36.0±0.6%BW, p=0.03). Normalized overall energy absorption was not different between sexes (M:2.10±0.12, F:2.14±0.11, p=0.82); however, males tended to absorb more energy during the early stages of the movement, which may be related to technique differences.

**Conclusion:** The current data shows that older males had some differences in forward descent technique (i.e. faster, different weight distribution) when compared to older females but were similar in elbow mechanics and overall energy absorption. This indicates that older men may stand to benefit as much as older women from fall injury prevention programs. Analysis of more participants in this study is ongoing.

**Keywords:** Biomechanics, fall-related injuries, upper limb, muscle strength

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 35. Children with Autism Spectrum Disorder Have Sustained Bone Deficits in the Radius and Tibia Shaft: 1-year Follow-Up

**Presenter:** Mahdi Rostami Haji Abadi

Collaborators: J.D. Johnston, and Saija Kontulainen

College of Kinesiology

Supervisor(s): Saija Kontulainen

**Background:** Poor bone development during childhood may explain an elevated risk of fracture in individuals with ASD. Previous studies reported 13-30% lower aBMD z-scores for total body, lumbar spine, hip and femoral neck measures in children with ASD when compared to TD children while aBMD changes were comparable. One study also indicated 10-20% deficit in bone microstructure and strength at the

distal radius and tibia in children with ASD. The literature has limited prospective evidence of bone mass, structure and estimated strength development in children with ASD. Our objective was to compare radius and tibia bone mass, structure and estimated strength between children with ASD and their TD controls at baseline and after 1-year follow-up.

**Methods:** We followed 13 children with ASD (12 boys) (mean age at baseline: 10.2, SD 2.8 yrs) and 32 TD children (15 boys) (mean age 10.7, 1.7 yrs). We used our standard protocols to obtain radius and tibia peripheral quantitative computed tomography (pQCT) scans at the distal and shaft sites of the radius and tibia at baseline and after one year. Outcomes included total area, and cortical content as well as density-weighted polar section modulus, a strength measure assessing resistance to torsional loading. As there were no between-group differences in age, body size or maturity (age from peak height velocity), we used MANOVA to compare bone outcomes between the groups at baseline. We normalized follow-up bone outcomes to 1-year change. We used repeated measures MANOVA to compare 1-year changes between the groups.

**Results:** There was a significant main effect of the group (Wilks' Lambda = 0.413,  $F(1, 35) = 2.233$ ,  $p=0.044$ ) but no interaction between group  $\times$  time (Wilks' Lambda = 0.643,  $F(1, 35) = 0.871$ ,  $p>0.05$ ). At baseline, radius shaft total area, cortical area, cortical content and estimated bone strength were 22-37% lower in children with ASD when compared to TD children. Tibia shaft cortical area and cortical content were 19-22% lower.

**Conclusion:** Observed 19-37% deficits in bone mass, structure and strength at radius and tibia shafts in children with ASD were sustained over 1-year follow-up.

**Keywords:** Autism spectrum disorder, Children, Bone density, Bone structure, Bone strength

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 36. Antacid Esomeprazole Inhibits Microtentacles Formation in Oral Squamous Cell Carcinomas

**Presenter:** Petros Kechagioglou

College of Dentistry

Supervisor(s): Silvana Papagerakis, and Petros Papagerakis

**Background:** Oral squamous cell carcinoma (OSCC) continues to be a disfiguring and deadly disease, which displays a wide range of biologic behavior. Advanced metastatic OSCC represents one of the most difficult challenges in head and neck oncology. We previously reported that the routine use of antacids Proton Pump Inhibitors (PPIs) in patients with oral, head and neck cancer significantly correlated with survival benefit and improved clinical outcomes. Tubulin-based membrane protrusions (microtentacles, McTNs) were reported as diagnostic and therapeutic targets in metastatic breast cancer. This study is the first to report the therapeutic potential of esomeprazole to alter the McTNs formation in OSCC.

**Methods:** McTNs and cytoskeleton alterations were investigated in OSCC lines, before and after esomeprazole treatment by immunofluorescence, confocal microscopy, Western Blot and mass spectrometry. Chemotactic movement of OSCC was measured using xCELLigence systems. GraphPad Prism software and Image J were used for data analysis.

**Results:** This is the first report of McTNs detection in OSCC cell lines. Our data shown that McTNs were enriched in detyrosinated and acetylated  $\alpha$ -tubulin, two post-translationally modified forms of  $\alpha$ -tubulin

which stabilize the McTNs. Significant decrease in the number of McTNS-containing cells and of cell migration was observed after 48-hour treatment with esomeprazole compared to untreated OSCC. Our proteomics data indicated that McTNs proteins and various epithelial-mesenchymal transition (EMT) markers were altered after esomeprazole treatment, suggesting that esomeprazole affects OSCC migratory and invasion abilities.

**Conclusion:** Our data suggests that McTNs detection can enhance the diagnosis and prognosis of metastatic oral cancer and that esomprazole alter the McTNs formation in OSCC. Elucidation of the biological effects of the antacids proton pump inhibitors on tumor progression and metastatic dissemination deserves further investigations for additional anticancer benefits in OSCC. The molecular mechanisms controlling OSCC progression and metastasis are keys to improving clinical outcomes.

**Keywords:** oral cancer, esomeprazole, microtentacles, metastasis, cytoskeleton

### 37. E. coli augments Enterococcus Associated Neonatal Chick Mortality

**Presenter: Ruwani Karunarathna**

Western College of Veterinary Medicine

Supervisor(s): Susantha Gomis

**Background:** Enterococci and E. coli are frequently isolated from non-viable chicken embryos and neonatal chicks with yolk sac infections worldwide. Our previous studies showed that a majority of enterococci infected dead embryos were co-infected with E. coli. The exact mode of transmission and pathogenies of enterococci associated embryonic deaths and neonatal chick mortalities are not yet clearly understood. Hence, we used the egg dipping technique to mimic the natural infection of embryonated eggs in order to determine its effect on bacterial colonization, embryonic survivability and subsequent neonatal deaths.

**Methods:** 12 days old viable SPF embryonated eggs (n=60) were dipped in respective bacterial broths of 109 CFU/ ml E. faecalis strains, E. coli 109 CFU/ ml, 106 CFU/ ml, 103 CFU/ ml, combined doses of E. faecalis 109 CFU/ ml and E.coli different doses as mentioned earlier. This E. faecalis strain was a multidrug resistant strain isolated from an early dead embryonic yolk material. The E. coli strain was obtained from a turkey septicemia case. The principle of the infection model was to facilitate bacterial penetration through the egg shell when a temperature gradient is developed between the eggs and the bacterial broth, where eggs were at incubation temperature (37 °C) and bacterial broth was maintained at 10 °C. Eggs from each group were immersed in the respective bacterial broth for 30 seconds and held outside for a few seconds to air dry. One group was dipped in sterile saline and another group in sterile Todd Hewitt media as controls. Hatchability and cumulative embryonic morality were determined after infection. After hatching, chicks were kept in pens for one week to check for survivability and any pathological changes. Swabs were collected for bacteriology from yolk samples from 5 viable embryos and any dead embryos at 48hrs, 6 days and 8 days post infection. The isolated bacterial colonies were identified using Matrix Assisted Laser Desorption Ionization-Time of Flight Mass Spectrometry. Yolk sac, liver, brain and lungs were collected for histopathology from any three live embryos from both experiments and any dead chicks at first week of age.

**Results:** None of the groups produced significant embryonic deaths or difference in hatchability. At 48 hrs post- infection, E. coli was re-isolated from all the corresponding groups except for the group infected with E. coli 103 CFU/ ml and co-infected with E. faecalis 109 CFU/ ml. The highest load of E. faecalis was

re-isolated from yolk when embryos were co-infected with 106 CFU/ ml of E .coli. None of the control groups were positive for bacterial isolation. All the tested embryos were positive for bacterial isolation at 6 days post-infection in the group co-infected with E. faecalis and E. coli 109 CFU/ ml. The bacterial load was higher at day 6 post-infection compared to 48 hrs post infection. Embryos infected with E. coli alone with 106 CFU/ml dose had the highest bacterial colonization with all the tested embryos being positive with high bacterial loads at 8 days post-infection. The highest cumulative neonatal chick mortality (13.33%) was observed in E. faecalis 10 9 CFU/ ml, E. coli 106 CFU/ ml co-infected group followed by E. faecalis 109 CFU/ ml and E. coli 103 CFU/ ml co-infected group (6.67%) and E. coli 109 CFU/ ml alone (6.67%) infected group. Chicks were apparently healthy and no mortality was observed from the rest of the groups. Gross pathological examination of dead chicks revealed yolk sac infections, pericarditis and perihepatitis. Histopathological findings were co-related with gross observations. Multiple areas of necrosis in the liver parenchyma and around most of the blood vessels were prominent. Gram-stained liver sections demonstrated gram-negative rods in hepatic sinusoids. Epicarditis, pericarditis, myocarditis, vascular congestion along with infiltration of heterophils and macrophages were significant findings in affected hearts. Gram-negative rods were also observed in affected heart muscles and blood vessels in lungs. Yolk sac membranes were thickened with proliferated fibroblasts and congested vessels. Infiltration of heterophils and macrophages around the necrotic debris were significant. Gram-positive cocci and negative rods both were present in yolk sac membrane associated with necrotic areas. E. faecalis and E. coli were re-isolated in high numbers from infected tissues.

**Conclusion:** These findings suggest that E. faecalis and E. coli can penetrate the eggshell, evade immune barriers in the egg and are able to colonize systemically. E. faecalis and E. coli polymicrobial infection may lead to synergistic effects on the virulence of these bacteria and lead to septicemic death of neonatal chicks.

**Keywords:** E. faecalis, E. coli, Co -infection, Neonatal chick mortality

**Self-assessment of research as interprofessional/interdisciplinary:** No

### 38. Impact of a novel antimicrobial stewardship mobile app on antimicrobial usage in Saskatoon, Saskatchewan

**Presenter:** Shaqil Peermohamed

Collaborators: Justin Kosar

College of Medicine

Supervisor(s): Shaqil Peermohamed

**Background:** Technology in health care is proliferating and given the ubiquitous use of smartphones amongst healthcare professionals, a novel platform for knowledge translation in antimicrobial stewardship has emerged. The purpose of this study was to assess the user engagement of the Spectrum mobile app and its impact on antimicrobial use.

**Methods:** The number of active users and sessions, use by healthcare profession and location and daily user engagement time was analyzed. Monthly antimicrobial utilization data on medical units of a tertiary-care academic hospital was measured prior to and after implementation of Spectrum. A Spectrum user satisfaction survey was distributed to healthcare workers in February 2019.

**Results:** Nine months following the launch of Spectrum, there were 733 active users who accessed the app an average of 1.4 times per day for an average of two minutes and thirty-four seconds. Active users

were composed of a wide range of healthcare professions such as pharmacists (35.1%), physicians (24.1%) and residents (17.9%). High usage was observed in Saskatoon but also extending to Regina, North Battleford, Prince Albert, Moose Jaw and Swift Current, reflecting significant reach provincially. The most commonly accessed guidelines were urinary tract infection (19.1%), community-acquired pneumonia (14.0%) and non-purulent cellulitis (11.1%). The most commonly accessed pathogens were MRSA (11.5%), *Enterococcus faecalis* (7.3%) and *Streptococcus pyogenes* (7.1%). The most commonly accessed antimicrobials were ceftriaxone (8.3%), amoxicillin-clavulanate (7.7%) and ciprofloxacin (6.7%). Amongst 182 survey respondents, 87.3% agreed Spectrum is easy to navigate, 89.0% agreed Spectrum is useful and 87.4% agreed Spectrum improves the appropriateness of their antimicrobial prescribing. Nine months following implementation of Spectrum on medical units in one tertiary-care hospital, total antimicrobial use significantly decreased by 24.7% ( $p=0.001$ ) and anti-pseudomonal antimicrobial use decreased by 33.4% ( $p=0.01$ ).

**Conclusion:** Spectrum has been widely used amongst healthcare professionals throughout Saskatchewan and its sustained usage supports this innovative app being an effective, localized antimicrobial stewardship tool in providing clinical decision support. Reductions in antimicrobial use likely reflect its dynamic value as a knowledge translation tool in improving guideline adherence and optimizing appropriateness of antimicrobial prescribing.

**Keywords:** Antimicrobial stewardship, technology, mobile app, knowledge translation

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 39. Is Arterial Stiffness Augmented in Pediatric Heart Transplant Recipients?

**Presenter: Shreya Singh**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** Adult heart transplant recipients (HTR) have greater arterial stiffness, despite resolution of the underlying pre-transplant diagnosis. The impaired vascular function may also contribute to the reported impaired exercise tolerance in these patients. Patient age and the duration and sequela of the pre-transplant cardiovascular disorder significantly contribute to the augmented arterial stiffness observed in adult HTR, while the direct role of immunosuppressive therapies is less understood. We tested the hypothesis that despite young age, pediatric HTR will display increased arterial stiffness owing to their significant pre-transplant cardiovascular disease and post-transplant physical inactivity. We also tested the hypothesis that arterial stiffness would be related to exercise tolerance (peak oxygen uptake, VO<sub>2</sub>).

**Methods:** Six pediatric HTR (3 females and 3 males;  $10 \pm 3$  years) and 12 age- and sex-matched healthy controls (6 females and 6 males;  $10 \pm 2$  years) were studied. Carotid-radial pulse-wave velocity by ECG-gated sequential applanation tonometry was used to determine arterial stiffness. HTR subjects also completed a peak VO<sub>2</sub> test by cycle ergometry. Data were analyzed through an independent samples t-test with significance differences being accepted at  $p < 0.05$ .

**Results:** Pulse wave velocity was not different between HTR ( $8.50 \pm 1.93$  m/s) and the healthy controls ( $8.55 \pm 1.52$  m/s,  $P = 0.951$ ). In addition, pulse wave velocity was not related to peak VO<sub>2</sub> in HTR ( $r = -.529$ ,  $P = 0.140$ ).

**Conclusion:** Unlike in adult HTR, pediatric HTR have normal arterial stiffness compared to healthy-matched controls, and arterial stiffness was not related to peak VO<sub>2</sub> in this pediatric population. These findings suggests that the pre-transplant diagnosis sequela do not unfavorably alter arterial stiffness in young pediatric HTR and that reduced peak VO<sub>2</sub> in pediatric HTR is not related to arterial stiffness.

**Keywords:** Arterial stiffness, Heart transplant, hypertension

**Self-assessment of research as interprofessional/interdisciplinary:** no response

## 40. Mechanisms Linking Circadian Clock Disruption, Lifestyle Traits and Microbial Flora in Autoimmune Diseases

**Presenter:** Zohre Gheisary

Collaborators: Helyasadat Mortazavi, and Liubov Lobanova

College of Dentistry

Supervisor(s): Silvana Papagerakis, and Petros Papagerakis

**Background:** The circadian rhythm is an endogenously generated 24-hour pattern leading to physiological, behavioral and cellular adaptation. Disruption of circadian rhythms has a crucial impact on health outcomes. Lifestyle traits such as shiftwork, social jet lag, diet (composition and meal schedule), physical activity and environmental toxins and heavy metal exposure are contributing to disrupted circadian homeostasis. Studies have shown direct relationships between disrupted biological rhythms and different morbidities including cancer, psychiatric disorders, cardiovascular and autoimmune diseases. It has been shown that components of circadian clock directly regulate inflammatory pathways and influence inflammatory responses in animal models of autoimmune diseases. On the other hand, experiments with germ free mice have determined functions of important components of humoral and cell mediated immunity regulated by stimuli from intestinal microbiota. In addition, acute circadian misalignment leads to disruption of physiological rhythms and acts like a physiological stressor that has potential to influence our body's bacterial profiles. Therefore, circadian clock-related microbiome dysbiosis may cause aberrant immune response and increased chronic inflammation contributing to autoimmune diseases pathogenesis, progression and response to therapy. The links between circadian disruption, microbial dysbiosis and autoimmune diseases remain unclear. Our long-term goals are (1) to measure the extend of circadian disruption and microbial flora dysbiosis in different patient cohorts prior, during, and after interventions aiming to reset the circadian clock and improve disease outcome and patient quality of life and (2) to evaluate the effects of circadian clock disruption in various mice models of autoimmune diseases such as Rheumatoid Arthritis (RA), Systemic Lupus Erythematosus (SLE), Sjögren's Syndrome (SS) and Multiple Sclerosis (MS).

**Methods:** Appropriate animal models of autoimmune diseases are being selected for RA and SS, and are divided into control and different experimental groups. Experimental groups are subject to modifications in diet content and timing (scheduled meal), sleep disruption, and exposure to selected environmental toxins. Autoimmunity and inflammatory biomarkers are evaluated by immunohistochemistry and RNA arrays. Circadian rhythms disruption will be evaluated by serum melatonin and using a clock gene reporter (Per2Luc) system. Gut and oral microbial flora of mice will be assessed to see how microbial flora is affected by environmental factors. The associations between microbial flora and circadian disruption will also be evaluated.

**Results:** Initial pilot data show that circadian clock disruption increases mouse autoimmunity biomarkers and chronic inflammation. In the near future, we expect to establish a comprehensive link between

circadian clock disruption, different lifestyles, environmental exposures, and microbiome in autoimmune diseases.

**Conclusion:** The goal of this study is to establish and utilize multiple objective measures of above-mentioned lifestyle factors in patients with autoimmune diseases and examine the relationship between circadian disruption, microbiome dysbiosis and disease progression. A clear understanding of these mechanistic links will provide foundation for designing and validating novel therapeutic interventions that may ultimately improve the quality of life of patients with autoimmune diseases.

**Keywords:** circadian rhythm, autoimmune diseases, lifestyle factors, microbiome, toxins, environmental exposure, health determinants

**Self-assessment of research as interprofessional/interdisciplinary:** No

## **Social Population Health 1**

### 41. Empowering Women Through the use of Technology

**Presenter: April Mackey**

College of Nursing

Supervisor(s): Sandra Bassendowski

**Background:** The achievement of gender equity and equality has been a long-time goal of many international entities. The main indicator for the goal of women's empowerment, as part of the Sustainable Development Goals (SDGs), has been to: "enhanc[e] the use of enabling technology by increasing the proportion of women and girls who have access" (United Nations [UN], p. 20). While information and communication technologies (ICTs) were initially thought to be neutral in terms of access and opportunity, emerging trends now indicate that the use of technology within society has significant social implications, specifically related to gender as a determinant of health.

**Methods:** Using the Arksey and O'Malley (2005) methodology for scoping reviews, the following question was answered: What is the impact of ICT on the level of women's empowerment worldwide? Using the stated research question, the primary objective of this scoping review was to identify the extent, range, and scope of evidence involving the impact and influence of ICTs on women's empowerment.

**Results:** The major themes that emerged from this review included: (a) the means in which ICTs have assisted in building the capacity and tools of women, (b) the manner in which ICTs have been used as an intervention in supporting empowerment; and (c) the approach in which ICTs can act as potential barriers and facilitators to women's attainment of agency.

**Conclusion:** The evidence from this scoping review supports the innovative use of current and emerging technologies within health care to connect with, engage, and empower women both within the acute and community settings. The extant evidence explores how ICT has played a role in the promotion and support of women's empowerment as well as supporting the development of health care policies and relevant programs.

**Keywords:** Technology; Women's health; Women's empowerment

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

### 42. Indigenous Health Program Success and the Input of Frontline Workers: A Literature Review to Scaffold an Interpretive Description Research Project

**Presenter: Charlene Thompson**

Collaborators: Michael Szafron

School of Public Health

Supervisor(s): Michael Szafron

**Background:** A significant health gap exists between Indigenous and non-Indigenous peoples. Successful Indigenous health programs (IHPs) can positively impact health outcomes and assist to address the burden

of health inequity. Frontline workers (FLWs) have been identified as an essential part of the Indigenous health program process, but have often been left out of the decision-making and their input has been neither prioritized, nor explored.

**Methods:** An interpretive description qualitative research approach will be used to explore the input of FLWs and gain the FLW perspective of factors that contribute to IHP success and program barriers.

**Results:** To “scaffold” the project, a literature review has been completed and found the attributes that contribute to IHP success to include community engagement, cultural considerations, community ownership, and a community-based/multi-sectoral approach. Barriers to IHPs can be categorized as contextual, resource, and community barriers, with some barriers unique to Indigenous communities. The attributes of success have been summarized into a framework that can, not only be used to help inform the IHP process, but will serve as the framework for the proposed research project.

**Conclusion:** With the literature supporting the inclusion of FLWs in the health program process within Indigenous communities, exploring the FLW perspective may yield some new insight into how to increase program success and modify some program barriers. There is potential for the input of FLWs in the IHP process to directly contribute to the attributes of program success, address some program barriers, and foster positive program outcomes and sustainability.

**Keywords:** Indigenous health, health programs, frontline workers, health equity, program planning and evaluation

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

#### 43. Scoping review of clinical practice guidelines for fall risk screening and assessment in older adults across the care continuum

**Presenter:** Hazel Williams-Roberts

Collaborators: Daphne Kemp, Alex Crizzle, and Shanthi Johnson

School of Rehabilitation Sciences

Supervisor(s): Cathy Arnold

**Background:** Falls are costly and common among older adults. As such, evidence-based identification of risk factors for fall prevention across the continuum of care is a significant priority for health care providers. The purpose of this scoping review was to synthesize published international clinical practice guidelines (CPGs) and recommendations for fall risk screening and assessment in older adults across community, acute and long-term care settings to identify gaps and opportunities to strengthen clinical practice.

**Methods:** Ten databases including MEDLINE, Embase, CINAHL, Physiotherapy Evidence Database (PEDro), Centre for International Rehabilitation Research Information and Exchange (CIRRIE), REHAB+, Epistemonikos, OT Seeker, Infobase of Clinical Practice Guidelines, and Turning Research Into Practice (TRIP) database were searched for relevant literature, in addition to websites of organizations and professional societies that develop practice guidelines. Studies were included if: 1) they were clinical practice guidelines or best practice recommendations about fall risk screening and assessment in older adults; 2) pertained to community, acute care or long-term care settings; and 3) published in English between 2008 and 2018. The search yielded 456 records; 22 were included in the review.

**Results:** Of the 22 CPGs, 6 pertained to multiple settings, 9 to community settings only, 2 to acute care and long-term care settings, respectively, and 3 did not specify any setting. Guidelines consistently screened for fall risk based on the history of falls and reported and/or demonstrated gait, balance and/or mobility abnormalities. CPGs shared many similar fall risk assessment components despite variation of recommended tools across settings. Gaps remain with regard to ideal timing and frequency of screening for fall risk across settings. There was little focus on transitional care and fall risk across settings.

**Conclusion:** The consistencies identified across CPGs may facilitate standardization of fall risk screening and assessment approaches across the care continuum but meaningful patient involvement and support for CPG implementation are also important considerations.

**Keywords:** Older adults Fall risk screening Clinical practice guidelines

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

#### 44. Training on Chronic Pain and Physical Activity Changes Physical Activity Providers' Pain Knowledge and Confidence to Provide Integrated Counselling

**Presenter:** Jocelyn E. Blouin

Collaborators: Nancy C. Gyurcsik, Susan M. Tupper, and Danielle R. Brittain

College of Kinesiology

Supervisor(s): Nancy C. Gyurcsik

**Background:** Twenty percent of Canadian adults experience chronic pain. Physical activity is an effective evidence-based non-pharmacological chronic pain management strategy. Yet, most adults with chronic pain are inactive or struggle to participate. Physical activity has been found to increase when health care providers are trained to deliver integrated counselling, including information and instruction on pain, physical activity, and adherence-promoting self-regulatory skills (e.g., overcome barriers; prevent relapses). For adults living with chronic pain, physical activity providers, including fitness instructors and personal trainers, are a preferred information source to provide integrated counselling. Yet, they receive no integrated counselling training during certification or continuing education opportunities. The purpose of this feasibility study was to test the effectiveness of a 3-hour in-person integrated counselling training on physical activity providers' pain knowledge and self-efficacy to deliver integrated counselling to adult clients with chronic pain.

**Methods:** Forty-eight physical activity providers (Mage = 44.38 ± 11.03 years) attended 1 of 4 training sessions offered in different Saskatchewan communities. The training provided education and integrated counselling strategies to help providers work with clients relative to learning about chronic pain, being active, and using self-regulatory skills to adhere to physical activity. Participants completed pre- and post-training paper surveys that assessed chronic pain knowledge, self-efficacy, and demographics. A repeated-measures multivariate analysis of variance (MANOVA) was conducted to compare pre- vs post-training scores.

**Results:** The overall MANOVA model was significant, Wilk's  $\Lambda = .33$ ,  $F(2, 46) = 46.23$ ,  $p < .001$ . Follow-up univariate comparisons illustrated that providers significantly improved in pain knowledge and self-efficacy from pre- to post training ( $p$ 's < .01).

**Conclusion:** Given the promising findings, designing and evaluating a full-scale training among a larger sample size of physical activity providers is warranted. Research should also compare the physical activity levels of clients with chronic pain instructed by physical activity providers who have and have not completed the training. A difference supporting the trained providers would suggest continued training should be offered via widespread adoption by provider certification organizations.

**Keywords:** Physical activity providers; Chronic Pain; Pain knowledge; Self-Efficacy; Physical activity  
**Self-assessment of research as interprofessional/interdisciplinary:** Yes

#### 45. What does Parents from Diverse Cultural Backgrounds want in a Family Engaged Intervention that Promotes Healthy Eating and Physical Activity? An Exploratory Study

**Presenter: Kavitha Ramachandran**

College of Medicine

Supervisor(s): Anne Leis

**Background:** The importance of parents'/ family engagement was minimally addressed in several population health interventions that focused on promoting healthful eating and active play in preschool children. Healthy Start/Départ Santé (HSDS) is such a population health intervention, which has been deployed in licensed childcare centres in Saskatchewan and New-Brunswick since 2013. HSDS was interested in better engaging parents as key partners to promote such healthy behaviours. Purpose: This study aimed to explore the insights of parents of preschool children about ways to engage the family in healthy eating and physical activity in the home environment.

**Methods:** Following a qualitative exploratory research design, a purposeful sampling strategy was applied to recruit parents from multicultural backgrounds who had a preschool child(ren) who had attended a HSDS childcare centre. Semi-structured individual interviews (n=27) and focus groups (n=4) were conducted with consenting parents from 8 childcare centres (6 urban and 2 rural) to discuss ways to better engage them in their child(ren)'s healthful eating and active living.

**Results:** Forty-eight parents (mean age = 33.5 years, 96% female, 73% with post-secondary education and 67% employed) participated in the study. Parents belonged to different ethnic origins (50% non-indigenous; 21% immigrants and refugees and 29% Indigenous). More simple and visual information about menu planning and physical activity were suggested. Parents also wanted access to relevant app(s), which would prompt them to engage in healthy eating and physical activity with their children in the home. The role of the broader environment such as access to fresh fruits and vegetables in grocery stores and peer support were mentioned as well. A few key recommendations for a feasible family-based intervention using fun, interactive, hands-on experiential learning will be shared.

**Conclusion:** Winning strategies were identified by parents and are currently being incorporated in a family-focused intervention called as FUN-15 in the home environment.

**Keywords:** Diverse parents' perspectives, parent's recommendations, parent engagement, family engagement, healthful eating, physical activity, Healthy Start, interviews, and focus groups.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 46. Adapting foods between Latino and Canadian culture: A photovoice comparing Saskatoon and Guatemala City.

**Presenter: Michele Monroy-Valle**

School of Public Health

Supervisor(s): Hassan Vatanparast

**Background:** Photovoice is a participatory research tool for advancing health equity; it promotes the participant's voice through taking and discussing photos and adding captions. International students experience food-related challenges in transitioning to Canadian study life. Latinos experiencing acculturation in Canada might use food to keep attached to their culture and self-care strategies meeting emotional and physical needs. Areas of food acculturation are related to maintaining cultural identity with traditional foods, their relation with health, their accessibility and affordability, support networks, food consumption for comfort, and the exploration of non-traditional foods crossing through the paradox of Canadian convenience. Barriers reported for university students to eat healthily are the nutrition knowledge, time, accessibility, affordability and availability of cultural foods. An additional challenge is understanding what is healthy when adapting to a new food environment. Food patterns in university students are already shaped, compared to children they are more resistant to the dietary acculturation process. In Latino food culture values, foods considered to be 'traditional' and 'healthful'; are related to food and spiritual wellbeing. When navigating the new food retail environment looking for these foods (of good quality and well-priced), Latinos try to follow pre-migration food customs and culture. Keeping healthy practices related to fruit and vegetable consumption can be difficult related to cost.

**Methods:** A qualitative study using photovoice methodology comparing Saskatoon to Guatemala City. The temporarily of the pictures was set on Sunday, the 18th of March 2018 (n 1-day), where it is summertime in Guatemala and wintertime in Saskatoon. We collected the photos two participants (spouses) from the same family and households who have a similar food pattern and use a weekly lunch menu planned by a nutritionist. Guidelines provided for taking the images can be resumed as follows: a place where the person purchases the majority of groceries, purchase areas where fruits, vegetables, spices, dairy products and food packaging products are available, and examples of traditional Guatemalan dishes prepared with Canadian ingredients. In total 21 photos were taken and 12 were selected for the Photovoice because they were the most significant for the acculturation content.

**Results:** In Saskatoon, choices of fruit and vegetables are limited in terms of availability and affordability. Some spices, nuts and ingredients are not offered in its raw and fresh form, this may affect the flavour and nutritional content. Other ingredients are not available at all. The staple foods and main ingredients are processed and costly. Dairy products in Saskatoon, are diverse, safe and processed compared to Guatemala. Ingredient availability and cost were the main barriers to keep a healthy culturally adapted diet. A traditional Guatemalan dinner can be prepared in Saskatoon with Q22 (CAD\$4.4) while in Guatemala the cost will be Q5 (CAD\$1).

**Conclusion:** As a Latino living in Saskatoon, following a culturally appropriate healthy diet is not accessible, available and affordable, so it poses the risk of food insecurity. Findings of the reflection after conducting this photovoice suggests a paradox of buying fresh food and ingredients in Canada is as expensive as purchasing canned and preserved food in Guatemala.

**Keywords:** Food acculturation, Latino, Food environment

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 47. Food insecurity status of Afghan refugees in Iran is linked to their socio-economic status and health outcomes

**Presenter: Mohammad Reza Pakravan Charvadeh**

Collaborators: Mahasti Khakpour

College of Pharmacy and Nutrition

Supervisor(s): Hassan Vatanparast

**Background:** Chronic food insecurity (FI) of the refugee population is a persistent challenge for the global community. Some studies expressed that food security is recognized as an important determinant of overweight-underweight status. However, others have questioned the validity of the claims of widespread food insecurity and hunger in the low income population because of the high prevalence of overweight/obesity. Most literature mainly focused on the association between food insecurity as determinant of overweight/obesity. An issue that has not been considered by many studies is that having an overweight/obese or underweight member within a family may create challenge in patterns of food intake in long term, and force them to move from high-quality and healthy food to unhealthy affordable foods. Parents cannot discriminate between their children regardless of overweight, underweight or normal weight status, therefore they allocate more resources to address their food needs. These changes may be associated with households' food security, especially among refugees who are already at risk. In fact, this association has been made between these two seemingly paradoxical states, and the association between food insecurity and overweight/obesity -underweight is not completely understood. The overarching objective of this study is to explore whether overweight/obesity and underweight among Afghan refugees in Iran are associated with the food insecurity status. The findings contribute to the literature considering the novelty of the hypothesis that the overweight/obesity may play a role in predicting food insecurity. We also propose a conceptual framework about the socioeconomic factors in the association between food insecurity and overweight/obesity.

**Methods:** About 515,567 Afghan refugees live in Tehran province, the most densely populated province in Iran, and for this reason, Tehran was selected as the target area of the present study. To collect data, interviews were conducted among 317 Afghan refugee households who had at least one adult during December 2017 and January 2018. The food insecurity status was assessed using the Household Food Insecurity Assess Scale (HFIAS). Also, Body Mass Index (BMI) was used to determine the status of underweight and overweight/obesity of Afghan households' adult. Independent factors were categorized into several groups including breadwinners' characteristics (age, gender, employment status, smoking status), economic status (income level), households' asset (personal saving, investment, house size), mothers' status (age, job, handicraft activities), households' status (number of boys, girls, students, employees, education level, house type, age of children, distance to downtown) and resettlement status (length of living time in Iran, frequency of travel to Afghanistan). Descriptive and logistic regression analyses were used to address the objective of the study.

**Results:** Of the total sample, 88.7% of refugee families were food insecure in Tehran province, among them 36% and 40% faced moderate and severe food insecurity respectively. About 44.8% of households who have at least one overweight/obese adult faced food insecurity. Around 67.3% of Afghan households who had at least one underweight adult faced food insecurity. The distribution of having an overweight/obese adult in the household was significantly different across two food secure and insecure groups, and in the food insecure group, it was higher than food secure group. Food insecurity was directly associated with the age of the breadwinners, length of staying in Tehran, the size of house, the frequency of traveling to Afghanistan, having a child greater than 18 years old, and the number of male and female

children (odd ratio=6.25,  $P<0.01$  for male, odd ratio=2.18,  $P<0.05$  for female) Income level (odd ratio=0.11;  $P<0.05$ ), households' investment (odd ratio=0.96;  $P<0.05$ ), the number of educated members, mother's age, and personal saving (odd ratio=0.22;  $P<0.01$ ) inverse association with food insecurity among Afghan refugees. Finally, overweight/obesity status was inversely associated with food insecurity among Afghan families (Odd ratio=0.79;  $P<0.05$ ).

**Conclusion:** Children's gender increases the risk of food insecurity in refugee families by 6.2 for boys and 2.18 times for girls. Therefore, the issue of food insecurity should not be addressed without considering gender disparities. Along with the factors reflecting economic status (income, investment, and personal savings, overweight/obesity was a predictor of food insecurity, in a way that having overweight/obese adult in a household decreased chance of food insecurity by 21%. The findings suggest that there may be a bidirectional association between food insecurity and overweight-obesity status among Afghan refugees, which warrants further research in longitudinal design.

**Keywords:** Food security, refugee, obesity, socioeconomic status

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 48. Getting to the Bottom of Shoulder Pain: An Ergonomic Assessment of Bovine Rectal Palpations

**Presenter:** Robyn Reist

Collaborators: Catherine Trask, Brenna Bath, and Murray Jelinski

College of Medicine

Supervisor(s): Catherine Trask

**Background:** Canadian veterinarians perform thousands of bovine rectal exams every year to check pregnancy status in cattle. This task has long been hypothesized as a contributor to high rates of musculoskeletal symptoms in the global veterinarian population. It potentially exposes veterinarians to repetitive awkward postures and high forces, which are known contributors to musculoskeletal pain and injury. We aimed to conduct a systematic ergonomic assessment of bovine rectal exams and identify the physical and environmental ergonomic risk factors associated with this task.

**Methods:** We observed practicing veterinarians performing rectal exams at routine appointments. The visits were recorded on video and playback was used to count the number of exams in each visit and calculate work and rest time. Inertial sensors were mounted on participants to measure neck and bilateral shoulder posture. Entry force was estimated using a handheld dynamometer immediately following the collection. Workplace design features and additional physically strenuous activities performed by the veterinarian were noted.

**Results:** Fourteen rectal exam appointments among seven unique veterinarians (two women, five men, aged 30-66) were assessed. Five appointments were for dairy cattle and nine involved beef cattle. The number of exams per collection ranged from 47 to 295, counted via video playback. The average exam time ranged from 8 to 91 seconds. The median rest time between exams ranged from 6 to 50 seconds. The average estimated entry force ranged from 121 N to 326 N. Arm and neck posture analyses are ongoing; preliminary findings indicate that shoulder flexion exceeded 60° in the majority of exams. Beef veterinarians in particular were observed participating in many other physical activities that could contribute to musculoskeletal symptoms, such as cattle handling and operating overhead gate mechanisms.

**Conclusion:** The results confirm published hypotheses that rectal exams expose veterinarians to many ergonomic risk factors. Not only is putting an arm or probe inside a cow a hazardous work task, but most veterinarians also participate in other repetitive, physically strenuous activities during the appointments that could contribute to the development of musculoskeletal symptoms. Strategies for reducing the exposures to awkward postures and secondary ergonomic hazards should be explored, with a focus on workplace organization and design.

**Keywords:** veterinarians, musculoskeletal disorders, ergonomics

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

#### 49. Does whole grain consumption beyond balanced intake of grains provides an optimal intake of nutrients and diet quality?

**Presenter:** Seyed H. Hosseini

Collaborators: Yanni Papanikoalu, and Hassan Vatanparast

College of Pharmacy and Nutrition

Supervisor(s): Hassan Vatanparast

**Background:** New Canada's Food Guide recommends whole grains should be consumed more in the daily diet of individuals. This study examines whether higher shares of whole grain consumption, beyond 60% of daily grain intake, are linked with optimal diet quality and intakes of some key nutrients contributed by grain-based foods for both children and adolescents and adults in Canada.

**Methods:** To meet the objective of this study we used, Canadian Community Health Survey-Nutrition 2015 and employed the Propensity Score Matching method.

**Results:** The results of our analyses imply an increase in the consumption of whole grains is associated with an increase in the levels of diet quality. However, after a certain level, no significant differences can be observed in diet quality scores of adults and children and adolescents. Moreover, it was observed that the proportion of obese and overweight individuals is significantly lower among adults that have balanced intakes of whole and non-whole grains. The results of logistic regression analyses also showed the probability of being obese and overweight is significantly lower in the case of adults with balanced intakes of grain. However, no significant differences were observed in the prevalence of obesity and overweight across whole grains consumption patterns in the case of children and adolescents.

**Conclusion:** The results of our analyses using PSM and comparison of mean intakes of diet quality and intakes of some nutrients in children and adolescents and adults in Canada showed higher intakes of whole grain, beyond the balanced intake, does not necessarily lead to optimal outcomes in terms of diet quality

**Keywords:** balanced intakes of grain, whole grain, propensity score matching

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 50. Canadian newcomer children's bone health and vitamin D status

**Presenter: Virginia (Ginny) Lane**

School of Public Health

Supervisor(s): Hassan Vatanparast

**Background:** Optimal bone development during childhood and adolescence is recommended to ensure long term bone health. An adequate calcium intake and supply of vitamin D during childhood play important roles in ensuring adequate bone mass gain to achieve optimal peak bone mass (PBM).

**Methods:** The Healthy Immigrant Children study employed a mixed-method cross-sectional study design to characterize the health and nutritional status of 300 immigrant and refugee children aged 3-13 years who had been in Canada for less than five years. A dual energy x-ray absorptiometry (DXA) machine was used to assess participants' body composition, bone mineral content of total body, hip, and lumbar spine. Participant blood samples were obtained through a single finger prick to assess serum vitamin D. Predictive variables were collected through the administration of questionnaires concerning demographics, food security, physical activity, and diet to the parents, and the completion of physical examinations on the children. A purposefully selected sample of 19 parents participated in in-depth interviews to better understand newcomer family lifestyle practices that may impact children's health status. Participants were purposefully selected to proportionally reflect the ethnic and socio-economic backgrounds observed among study participants and Saskatchewan newcomers in general.

**Results:** A significantly higher percentage of refugee children (72.3%) had insufficient (<50nmol/L) or deficient (<30nmol/L) serum vitamin D as compared to immigrants (53.2%). Vitamin D deficiency was most common among ethnic minority girls. Newcomer children with higher intakes of vitamin D, younger newcomer children, and those from western Europe/United States had higher serum vitamin D levels. Immigrants had significantly higher mean total body bone mineral content compared to refugees. However, 33% of older immigrant children had low bone mass, compared to 19% of refugees. Total body fat, serum vitamin D, calcium intake, height, height by calcium intake, total body fat by calcium intake and total body fat by height predicted total body bone mineral content levels. Vitamin D deficiency among newcomer children may be related to lack of knowledge regarding children's vitamin D requirements in the Canadian environment, dietary habits established in country of origin, low income that limits healthy dietary choices, and lifestyle habits that limit exposure to sunlight.

**Conclusion:** A substantial proportion of newcomer children are at risk of not achieving their optimal PBM due to high rates of insufficient serum vitamin D levels. Ethnic minority girls appear to be an especially vulnerable group due to the high proportion of them with deficient vitamin D status. Routine screening of newcomer children and pregnant women for dietary intake of foods rich in vitamin D may assist with identifying children at risk and implementing appropriate treatment to support optimal development, which incorporates culturally sensitive dietary advice regarding vitamin D intake.

**Keywords:** Vitamin D, bone health, children, newcomers, refugee, immigrant

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 51. Community-based participatory research: Developing a community of practice to support the wellbeing of mental health providers working in remote northern Saskatchewan First Nations Communities

**Presenter: Wanda Seidlikoski Yurach**

Collaborators: Shauna Eveleigh Harris

College of Medicine

Supervisor(s): Vivian Ramsden

**Background:** Mental health providers (MHPs) delivering trauma informed care/counselling in remote northern Saskatchewan First Nations communities (RNSFNCs) generally work in isolation, which has been identified as one of the most significant challenges of this work and has been linked to vulnerability to secondary trauma. Secondary trauma is the distress a person experiences when exposed indirectly to the trauma of others. MHPs working in RNSFNCs have expressed a desire to talk about the impact of this work on themselves as well as their families. With increasing demand for trauma-informed care/counselling in RNSFNCs and no studies to date on MHPs working in Saskatchewan it is of great interest to explore their experiences. MHPs are generally approved through First Nations Inuit Health Branch (FNIHB) of Health Canada to provide short-term crisis counselling or negotiate contracts directly with communities to provide longer-term supports. The aim of this study will be to understand the impact of this work on the well-being of MHPs including rates of secondary trauma while engaging in a transformative process to identify and develop supports including a sustainable community of practice.

**Methods:** An exploratory, embedded mixed methods research design will be employed in this study. A purposeful sample of female MHPs that have worked in RNSFNCs will be drawn from those approved with FNIHB and registered as a Social Worker with the Saskatchewan Association of Social Workers. This study will take place in three phases, incorporating a narrative approach as well as interpretative phenomenological analysis guided through a transformative framework using community-based participatory research to answer the research questions. In Phase 1 participants will be asked to take part in an in-person, interview utilizing a narrative approach. In Phase 2 participants will take part in a follow up in-person interview with quantitative data collection embedded within this interview using the self-administered Professional Quality of Life Scale to measure rates of secondary trauma. In Phase 3, all participants will be invited to take part in a group gathering to interpret the data as well as discuss sustainable supports including developing a community of practice.

**Results:** Expected study results will likely indicate MHPs are experiencing characteristics of secondary trauma with contributing factors likely being high trauma caseloads and being isolated from peer supports or clinical supervision. Protective factors will likely be identified as networking through a community of practice, competent supervision, self-care resources and being trauma-informed.

**Conclusion:** The proposed outcome of this study is to bring together MHPs to hear their stories to co-create sustainable supports including a community of practice to improve the quality of MHPs' northern healing work environments.

**Keywords:** Community-based Participatory research, Community of Practice, First Nations, Secondary trauma, Northern Saskatchewan mental health providers.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## **Undergraduate – Individual research**

### 52. Cardiovascular Responses to the Exercise Pressor Reflex in Pediatric Heart Transplant Recipients

**Presenter: Corey Blushke**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** Pediatric heart transplant recipients (HTR) have reduced exercise tolerance despite normal systolic ventricular function. A slower heart rate adaptation to exercise in HTR due to cardiac denervation is commonly observed in HTR patients, which explains, in part, the exercise intolerance. We tested the hypothesis that the cardiovascular response to exercise pressor reflex activation from handgrip exercise would be blunted in HTR.

**Methods:** Six pediatric HTR (3f/3m; mean±SD, 10±3 yrs) and five healthy-matched controls (CTL; 3f/2m; 10±2 yrs) were studied. After 3 min of resting baseline, subjects performed 2 min of isometric handgrip (HG) exercise at 40% maximal voluntary contraction, followed by 3 min post-exercise circulatory occlusion (PECO). Beat-by-beat mean arterial pressure, heart rate, and modelflow stroke volume and cardiac output were recorded. Data were analysed as the change ( $\Delta$ ) from rest using two-way repeated measures ANOVA (2 × 3; group × condition) and Holm-Sidak multiple comparisons analysis. Significance was accepted at  $P < 0.05$ .

**Results:** Mean arterial pressure increased in HTR ( $\Delta 17 \pm 15$  mmHg) and CTL ( $\Delta 13 \pm 16$  mmHg) during HG ( $P < 0.001$ ) and remained elevated above baseline during PECO (HTR:  $\Delta 10 \pm 10$  mmHg; CTL:  $\Delta 11 \pm 9$  mmHg;  $P < 0.05$ ), with no between group differences. Heart rate did not significantly increase during HG in HTR ( $\Delta 4 \pm 5$  bpm,  $P = 0.235$ ) but did in CTL ( $\Delta 14 \pm 11$  bpm,  $P < 0.001$ ), and was 9 bpm lower in HTR vs CTL ( $P = 0.005$ ). Heart rate was not different during PECO from rest in HTR and CTL. Stroke volume increased in HTR ( $\Delta 3 \pm 1$  mL) and CTL ( $\Delta 3 \pm 3$  mL) during HG ( $P < 0.001$ ) and remained elevated above baseline during PECO (HTR:  $\Delta 3 \pm 2$  mL; CTL:  $\Delta 4 \pm 3$  mL;  $P < 0.001$ ), with no between group differences. Cardiac output did not significantly increase during HG in HTR ( $\Delta 0.34 \pm 0.21$  L/min,  $P = 0.074$ ) but did in CTL ( $\Delta 0.71 \pm 0.54$  L/min  $P < 0.001$ ), and was 0.37 L/min lower in HTR vs CTL ( $P = 0.035$ ). Cardiac output was not different during PECO from rest in HTR and CTL.

**Conclusion:** Owing to the impaired heart rate response during handgrip exercise, cardiac output was lower in pediatric HTR compared to healthy-matched controls in response to exercise pressor reflex activation.

**Keywords:** Pediatric heart transplant recipients, Exercise pressor reflex

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

### 53. Assessing the pharmacology of select plant-derived cannabinoids on the type 2 cannabinoid receptor

**Presenter: Kawthar Mohamed**

Collaborators: Ayat Zagzoog, Mylyne Tham, Larry A Holbrook

College of Pharmacy and Nutrition

Supervisor(s): Robert B Laprairie

**Background:** Cannabinoids are compounds whose structure and or function is similar to  $\Delta^9$ -tetrahydrocannabinol (THC), the intoxicating component of Cannabis. In addition to THC, at least 120 other plant-derived cannabinoids, or phytocannabinoids, are present in Cannabis; many of these phytocannabinoids have poorly understood pharmacology. Two cannabinoid receptors have been identified: CB1R and CB2R. CB1R is well-known as a neuromodulatory receptor while CB2R is thought to inhibit inflammatory responses. The purpose of this experiment was to examine the molecular pharmacology of four phytocannabinoids: THC, cannabidiol (CBD), tetrahydrocannabivarin (THCV), and cannabivarin (CBDV) at CB2R.

**Methods:** Enzyme fragment complementation (EFC) assays were used to determine whether downstream signaling involves  $\beta$ arrestin2 recruitment and  $G\alpha(i/o)$ -coupled cAMP inhibition; and immunocytochemical techniques were used to measure ERK phosphorylation. Data from these assays was then used to calculate potential bias factors.

**Results:** As expected, THC was a CB2R agonist of  $G\alpha(i/o)$ -coupled signaling,  $\beta$ arrestin2 recruitment, and ERK phosphorylation. CBD partially activated CB2R and displayed weak affinity for the receptor. THCV and CBDV activated both  $\beta$ arrestin2 and ERK phosphorylation, but with greater potency for ERK.

**Conclusion:** Expanding our knowledge of cannabinoid function beyond THC will enhance our understanding of Cannabis and its activity on the body. Additionally, the isolation of specific cannabinoids from Cannabis may lead to the discovery of novel therapeutics whose pharmacology was previously uncharacterized.

**Keywords:** Cannabis, type 2 cannabinoid receptor, pharmacology

**Self-assessment of research as interprofessional/interdisciplinary:** No

### 54. Post-Exercise Oxygen Uptake and Muscle Oxygenation in Pediatric Heart Transplant Recipients and Healthy Matched Children

**Presenter: Kylee Kosokowsky**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** Pediatric heart transplant recipients (HTR) have reduced exercise tolerance and peak oxygen uptake ( $VO_2$ ) values are 57-73% of age-predicted norms. Slow post-exercise  $VO_2$  and muscle oxygenation recovery are related to exercise intolerance. However, despite clear exercise tolerance limitations and post-exercise fatigue,  $VO_2$  and muscle oxygenation during recovery responses are unknown in this population. We tested the hypothesis that both post-exercise  $VO_2$  recovery and muscle oxygenation recovery would be slower after peak exercise in pediatric HTR compared to controls.

**Methods:** Five pediatric HTR (age = 10.6 ± 3.0 years) and six healthy controls (age = 11.7 ± 2.7 years) performed cycle ergometry to peak exercise followed by 5 minutes of 20-W cycle recovery. Pulmonary VO<sub>2</sub> and muscle oxygenation (vastus lateralis tissue oxygenation index, TOI using near infrared spectroscopy) were sampled continuously during exercise and recovery. Data were linearly interpolated to 1-s intervals, and both VO<sub>2</sub> and TOI data were averaged into 5-s and 10-s time bins, respectively. VO<sub>2</sub> recovery data were mono-exponentially curve-fitted to yield a recovery time constant (tau). TOI recovery was normalized from 0% (end exercise) to 100% (5 min post-exercise) and data analyzed at set time points to characterize TOI time course changes (0s, 15s, 30s, 60s, 90s, 120s, 180s, 240s, and 300s). Statistical analyses included independent t-tests for VO<sub>2</sub> data and a between-within (2 × 9, group × time) factorial ANOVA for TOI time course changes. Significance was accepted at p < 0.05.

**Results:** Recovery VO<sub>2</sub> tau was significantly slower in pediatric HTR compared to healthy controls (mean ± SD; 68 ± 17 vs. 47 ± 12 s, respectively; p=0.044). There was a significant group × time interaction for TOI recovery (p=0.003) where TOI in HTR was significantly lower compared to controls at 15s (8 ± 8 vs. 46 ± 19%; p=0.003), 30s (22 ± 13 vs. 91 ± 31%; p=0.001), and 60s (47 ± 23 vs. 117 ± 36%; p=0.005). TOI was not statistically different between groups by 90s onwards (all p > 0.05).

**Conclusion:** Post-exercise VO<sub>2</sub> and TOI recovery are blunted in pediatric HTR compared to healthy controls. These findings suggest that non-cardiac factors may contribute to the excessive recovery time following peak exercise in pediatric HTR.

**Keywords:** Pediatric heart transplant, post-exercise recovery

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 55. Online-based or Mobile Application Support for Caregivers of Adolescence with Mental Health Disorders: A Systematic Review

**Presenter:** Lingxiu Susan Liu

Collaborators: Megan Kennedy

College of Arts and Science

Supervisor(s): Hua Li

**Background:** Research has shown that treatment of adolescents with mental health disorders is more effective when caregivers are involved. However, caregivers of adolescents with mental health disorders have reported experiencing high levels of psychological distress, burden and expressed emotion secondary to their role as caregivers. Various peer support groups (online and face-to-face) for the caregivers have helped them to reduce feelings of isolation, provide opportunities to share experience, and offer advice. However, there is a lack of a single integrated online-based or mobile application that provides caregivers with peer support, reliable online information, and evidence-based psychoeducation. The purpose of this study is to systematically review current existing literature on online-based programs or mobile applications that support caregivers of adolescents with mental health disorder.

**Methods:** A systematic search of the literature using PRISMA guidelines was conducted on seven academic health databases to identify any peer-reviewed articles published in English from 2009 to March 2019. Studies were screened, data were extracted, and the quality of the selected studies was assessed. In total, 9452 abstracts were returned from the search. After duplicate removal, 5330 remained for abstract screening, and 5 quantitative studies were selected for final analysis.

**Results:** An internet-based chat support group for caregivers of adolescents with mental health disorder showed that the chat support helped to implement family-based treatment (n = 1); caregivers reported that online-based social therapy was easily accessible and feasible, and was effective in reducing their stress (n = 2); the online-based and smartphone interventions were found to be effective in changing parenting behaviour and providing caregivers with the necessary skills and knowledge associated with their interactions with adolescents (n = 2).

**Conclusion:** The study reveals a significant gap in the literature of online-based or mobile application support for caregivers of adolescents with mental health disorder.

**Keywords:** Support, Adolescence, Mental Health Disorders, Caregivers, Online-Based/Mobile Application

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 56. Effect of a 12-week Fundamental Skill Intervention on the Physical Literacy levels of Children with Congenital Heart Disease

**Presenter:** Matthew Chapelski

Collaborators: Natalie Houser, Ashley Libke, and Corey Tomczak

College of Kinesiology

Supervisor(s): Marta C Erlandson

**Background:** Children with congenital heart disease can struggle to reach the recommended daily physical activity levels in part because they lack the confidence and competence to be physically active. Not reaching these guidelines can be detrimental to both their short- and long-term health. Physical literacy assesses how competent and confident an individual is in their physical function. Improving a child's physical literacy may give them the competence, confidence, and motivation to live an active lifestyle thus impacting their health and well-being. The purpose of this study was to assess if a 12-week intervention is effective in increasing the physical literacy of children with congenital heart disease.

**Methods:** Seven participants, 8-16 years of age, had their physical literacy assessed pre and post intervention. The battery of PLAY Tools were used to assess the participants' physical literacy. The PLAYself was used to assess the child's perception of their physical literacy. The PLAYparent was given to their parents to assess the parents' perception of their child's physical literacy levels. The PLAYfun was used to test 18 fundamental skills divided into five movement domains (running, locomotion, upper body object control, lower body object control and balance) which provides an overall physical literacy score. A higher physical literacy score relates to greater competence and confidence. The intervention involved six bi-weekly sessions that consisted of fundamental movement skill practice such as: object control, locomotion and balance activities. Percent change and paired t-tests were run to compare pre and post values.

**Results:** All PLAYfun domain scores increased. A significant increase ( $p < 0.05$ ) was seen in the PLAYfun locomotor, upper body object control, and their overall physical literacy score. There was also a significant increase in confidence and comprehension of the balance domain. All other domains' confidence and comprehension increased; however, none were significant. The PLAYself and PLAYparent results all increased; however, none were significant.

**Conclusion:** Our findings show that a 12-week intervention improved the physical literacy levels of the participants. These findings are similar to other physical literacy interventions in health individuals that

have founds increases in physical literacy levels after an intervention. As children with congenital heart disease are at an increased risk of physical inactivity, physical literacy development provides an exciting opportunity to increase physical activity and potential health benefits in this at-risk population.

**Keywords:** Physical Literacy, Congenital Heart Disease, Physical Activity

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 57. Best Practice Model for Medical Error Disclosure – A Call for a Paradigm Shift

**Presenter: Zoher Rafid-Hamed**

Collaborators: Jay Kalra

College of Arts and Sciences

Supervisor(s): Jay Kalra

**Background:** The quality of health care is an emerging concern worldwide. Disclosure of an adverse event is an important element in managing the consequences of a medical error. We have previously reported various error disclosure initiatives that are in practice in Canada and other parts of the world. The Canadian provincial initiatives, though similar in content, remain isolated because of their non-mandatory nature and absence of federal or provincial laws on disclosure. The objective of this study was to review and compare the disclosure policies implemented by individual health care regions/authorities in western Canada (Saskatchewan, Manitoba, Alberta, and British Columbia) to create the best practice guidelines for medical error disclosure.

**Methods:** The evaluation of various policies in western Canada was carried out based on six of our guidelines including an expression of regret or apology; some form of patient support; avoidance of blame; support to the staff; education/training to health care workers; and avoidance of speculation. A standard email was sent to the health care regions/authorities in western Canada requesting a copy of their disclosure policy currently in use.

**Results:** We observed that in the disclosure policies obtained from British Columbia, 100% included an apology, 50% mentioned avoidance of blame, 100% required avoidance of speculation, 67% included a clause for staff support, 100% called for some form of patient support, and none of the policies mentioned disclosure training (0%). Through Alberta's single health board, the province-wide policy calls inclusion of an apology, avoidance of speculation and blame, provision of support to both staff and patients, but lacks a clause describing disclosure training. In Saskatchewan, 69% mention inclusion of an apology, 92% mention avoidance of blame, 100% describe avoidance of speculation, 46% and 77% mentioned the support of staff and patients respectively, and 8% mentioned inclusion of disclosure training. In the disclosure policies acquired from Manitoba, 100% call for an apology, 73% suggested the avoidance of blame, 82% advise that speculation should be avoided, 73%, 82%, and 18% call for staff support, patient support, and mention disclosure training, respectively.

**Conclusion:** The complexities of medical error disclosure to patients present ideal opportunities for medical educators to probe how learners are balancing the ethical complexities involved in error disclosure with other related fields. We believe that the disclosure policies should provide strategies and framework, including these six guidelines for the best practice model for appropriate disclosure, which can lead to practices that are more transparent. We suggest that disclosure practices can be improved

by creating a uniform policy, centered on addressing errors in a non-punitive manner and respecting the patient's right to an honest disclosure and be implemented as part of the standard of care.

**Keywords:** Medical Error, Adverse Event, Disclosure, Quality, Patient Safety

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 58. The role of orthography, semantics, and phonology in the encoding of briefly presented words

**Presenter:** Shaylyn Kress

Collaborators: Josh Neudorf, and Chelsea Ekstrand

College of Arts and Science

Supervisor(s): Ron Borowsky

**Background:** This study seeks to investigate the role of the brain's language processing streams in word identification. The ventral stream is associated with lexical word processing. The dorsal stream plays a role in phonological and sub-lexical processing. We will test how these streams aid in word identification using a two alternative forced-choice task. British/American word pairs only differ on orthography, which should rely on the ventral stream, while word/non-word pairs also differ on phonology (a dorsal stream process) and semantics, which would recruit both streams. Therefore, word/non-word pairs should be easier for participants to identify than British/American spelling variants, because the differences activate more aspects of both the ventral and dorsal streams.

**Methods:** Participants completed the 2 alternative forced-choice-task with British/American word pairs and word/non-word pairs. After each trial, participants indicated whether they felt their answer was a guess. Participants also rated their familiarity with each British/American spelling variant.

**Results:** Analysis of within-subjects ANOVA and 95% confidence intervals found when participants were not guessing, accuracy was higher during the word/non-word trials than the British/American trials.

**Conclusion:** The current results support the hypothesis that word/non-word pairs would be easier for participants to identify than British/American spelling variants. Future studies could examine attentional difference in populations, such as video gamers to non-gamers, or use imaging techniques to localize the areas of activation.

**Keywords:** Cognition and Neuroscience, Reading, Visual Perception

**Self-assessment of research as interprofessional/interdisciplinary:** no response

## Afternoon session

### Basic Science 4

#### 59. Generating a stable binary complex of GSK3b and DISC1, a psychiatric risk protein to study their interaction

**Presenter: Anand Krishnan Nambisan**

Collaborators: Narsimha Pujari

College of Graduate and Postdoctoral Studies

Supervisor(s): Adelaine Leung

**Background:** Disrupted in Schizophrenia 1 (DISC1) is a psychiatric disease risk gene implicated in numerous mental disorders including schizophrenia. This 94KDa protein is involved in all major stages of neurodevelopment, from neural progenitor cell proliferation to neuronal migration and circuit integration. It is implicated in various cellular and physiological pathways by acting as a molecular scaffold and linking a large subset of partner proteins, which are themselves required for proper brain development and can be considered as risk factor for a wide spectrum of mental disorders. The 3D crystal structure of DISC1 has still not been solved. One of the reasons why the DISC1's 3D structure to be elusive is its inherent conformational flexibility, whereby it dynamically changes its structure to accommodate the binding with all these different protein partners and aid in their interactions required to carry out a physiological function. This structural plasticity acts as a deterrent to pursue conventional structural studies on the protein on its own. To overcome this challenge, our lab is focussing on DISC1's role in neuronal proliferation by modulating the Wnt/GSK3b signaling pathway. DISC1 is shown to inhibit GSK3b's activity of Wnt dependent substrates. This could be tapped to devise potential therapeutic intervention for these psychiatric illnesses.

**Methods:** Our aim is to generate a stable binary complex of DISC1 with GSK3b to pursue further structural and biochemical characterization. The codon optimized human DISC1 and GSK3b were cloned into a polycistronic vector, so as to express both the proteins simultaneously within the same bacterial cell. The proteins are then overexpressed in E. coli. The idea behind co-expression is to provide a more natural environment for the proteins to interact and form a complex in the cellular milieu, instead of trying to do by in vitro assays. The purification methodology comprises a series of multi column chromatography namely affinity purification and gel filtration to purify our proteins of interest in the form of a stable complex and get rid of the other endogenous E. coli contaminants. The purified complex is then subjected to different structural assays to characterize its structure.

**Results:** The genes of interest, DISC1 and GSK3b, were successfully cloned into the polycistronic vector and their sequence was confirmed by sequencing. The overexpression parameters were optimized to produce good expression levels for both DISC1 and GSK3b. The chromatography techniques worked in purifying the protein sample. The purification profile as well as the Dynamic Light Scattering (DLS) data shows the presence of a stable DISC1-GSK3b complex.

**Keywords:** DISC1, GSK3b, Psychiatric illnesses, Structural biology, Protein purification

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 60. Glycoprotein 41 targeted radioimmunotherapy as a novel treatment for neuroHIV/AIDS

**Presenter: Kienna Mills**

Collaborators: Ravendra Garg, and Kevin J. Allen

College of Pharmacy and Nutrition

Supervisor(s): Ekaterina Dadachova

**Background:** HIV/AIDS is a major global threat to public health. Currently, treatment with combined antiretroviral therapy (cART) has significantly improved the life expectancy of HIV-infected individuals. However, cART fails to eliminate the long-lived reservoir of latent HIV-infected cells; therefore, the virus continues to cause damage both systemically and to the central nervous system (CNS). Many cART regimens are ineffective in eradicating HIV infection in the brain due to the strict regulation for the entry of molecules by the blood-brain barrier (BBB). Radioimmunotherapy (RIT) includes antigen-specific monoclonal antibodies (mAbs) for targeted delivery of lethal doses of radiations to infected cells. Previously, we have demonstrated that HIV gp41 targeted 2556 human antibody conjugated with 213Bismuth (Bi) radioisotope selectively kills HIV-infected cells in vivo and in vitro. 225Actinium (Ac) and 177Lutetium (Lu) are two other clinically proven radioisotopes for cancer treatment. Hence, in this study, we have conjugated 2556 mAbs with three different radioisotopes (213Bi, 225Ac, and 177Lu) and compared their ability to kill HIV-infected human peripheral blood mononuclear cells (PBMCs).

**Methods:** Human PBMCs were isolated from normal healthy volunteers and infected with HIV-1. The chronically infected PBMCs were treated with different concentration of 213Bi-2556 (4-20  $\mu$ Ci), 225Ac-2556 (20-100 nCi) and 177Lu-2556 (4-50  $\mu$ Ci) radiolabelled mAbs. Viral load was quantified by p24 ELISA, and DNA damage from conjugated radioisotopes was assessed by H2A.X phosphorylation flow cytometry assays.

**Results:** After three days of treatment, 213Bi- and 177Lu- conjugated 2556 mAbs killed HIV-infected PBMCs and reduced virus production in a dose-dependent manner, whereas, 225Ac-2556 showed minimal effect. After seven days post-infection, all three conjugated radioisotopes showed significant killing of HIV-infected cells measured by p24 ELISA, and H2AX assays showed increased phosphorylation of H2A histone indicating an increase in DNA double-stranded breaks.

**Conclusion:** All three radioisotopes are able to kill or cause significant damage to HIV-infected cells in vitro when conjugated to mAb2556. In future, we will use a human in vitro BBB model to assess the ability of these conjugated mAbs to penetrate the BBB and to kill the HIV infected PBMCs in the brain compartment of the BBB model. This study will provide a novel treatment option for the eradication of HIV-1 infection and may also be useful for treatment of drug-resistant HIV strains.

**Keywords:** neuroAIDS, radioimmunotherapy, blood-brain barrier, HIV

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 61. Pro-inflammatory signaling is repressed in response to phenolic extracts from Saskatchewan-bred haskaps in primary dermal fibroblasts

**Presenter: Lily Zehfus**

College of Agriculture and Bioresources

Supervisor(s): Christopher H. Eskiw, and Nicholas Low

**Background:** Naturally-occurring phenolic compounds are potent antioxidants, with some having the ability to kill cancer cells in vitro. If acting strictly as antioxidants, this function would promote cancer cell health as well as that of normal cells. Previous data indicates that many phenolic compounds promote health through modulating cellular nutrient sensing pathways and driving changes in gene expression. Haskap berries (*Lonicera caerulea*) are known for high phenolic content and in vitro free radical scavenging activities.

**Methods:** To identify additional mechanisms by which these berries may promote cellular health, we have collected and characterized phenolic extracts (also phenolic isolates and fractions) from five varieties of Saskatchewan-bred haskaps. High performance liquid chromatography with photodiode array detection (HPLC-PDA) was used for quantitation of phenolic compounds by subclass; for more detailed structural analysis, HPLC tandem mass spectrometry (HPLC-MS/MS) was employed. To demonstrate the impact of haskap phenolics on cellular function, normal dermal fibroblasts (2DD) and immortalized (NB1 hTERT) cells were exposed to a range of either total phenolic extract or purified sub-fractions.

**Results:** HPLC-PDA identified anthocyanins as the major phenolic subclass, with cyanidin-3-O-glucoside, cyanidin-3,5-O-diglucoside, and cyanidin-3-O-rutinoside being the most abundant of this class. Other prevalent subclasses identified by HPLC included the flavanols, flavonols, and hydroxycinnamic acids. HPLC-MS/MS led to the identification of several previously uncharacterized phenolic compounds that may also have a significant impact on cellular health. Both total phenolic extracts and fractions slowed cellular growth without inducing cell death. Knockdown of Sirtuin 1 (SIRT1) in NB1 cells no longer exhibit these decreased growth rates. In addition, specific phenolic fractions showed anti-inflammatory activities demonstrated by decreased levels of the nuclear factor kappa B (NF- $\kappa$ B). Preliminary data indicates that knockdown of SIRT1 also ameliorates this response.

**Conclusion:** Results support the hypothesis that SIRT1 is key to mediating cellular responses to haskap phenolics. Future work will focus on phenolic-mediated changes in gene expression profiles, specifically pertaining to SIRT1 and its related biological pathways.

**Keywords:** phenolics, antioxidant, haskap, SIRT1, anthocyanin, anti-inflammatory, health

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 62. Targeted Mass Spectrometric Metabolomic Analysis of Urine for Asthma Diagnosis and Management

**Presenter:** Mays Al-Dulaymi

Collaborators: Mona M. Khamis, Chun Che, Joan Dietz

College of Pharmacy and Nutrition

Supervisor(s): Darryl Adamko, Anas El-Aneed

**Background:** Asthma is the most common chronic illnesses in children. The management of asthma in a typical primary care setting can be a challenge as we often lack objective tests for asthma diagnosis and severity. Metabolomics is the study of small molecules created by cellular metabolic activity. We have demonstrated that asthma has a different metabolomic profile compared to healthy children using proton nuclear magnetic resonance spectroscopy (1H-NMR). Fifty urinary metabolites were identified as potential diagnostic biomarkers for asthma. Recently, we developed targeted mass spectrometry (MS)-based methods to quantify these biomarkers in urine. We hypothesize that our novel MS-based methods will differentiate healthy children from those with asthma. We also expect that we will see changes in the urine of children with asthma depending on whether they have well controlled asthma versus uncontrolled asthma

**Methods:** To diagnose asthma in young children, we obtained urine samples from healthy children or those with asthma (n=100 each) diagnosed at 5 years of age from the CHILD birth cohort. To determine asthma severity, we recruited children with atopic asthma (n=18) and followed them monthly from July to November (Seasonal Study). An Asthma Control Questionnaire, Mini Pediatric Asthma Quality of Life Questionnaire and Asthma Control Test were filled at each visit. Pulmonary function tests were performed on all children 6 years of age or older. Urine samples were collected from all children during their appointments. The urine samples were analyzed using our targeted liquid chromatography tandem mass spectrometric platform and values were normalized to creatinine. Partial least squares discriminant analysis (PLS-DA, SIMCA) was used on these data to create models of separation.

**Results:** Urine samples from the CHILD study generated a model of separation between healthy and asthmatic children with an R<sup>2</sup> value of 0.74 and a Q<sup>2</sup> value of 0.68. The model included 21 significant metabolites attained from the variables of importance plot. The separation model correctly classified the validation test set with 78% accuracy. In the seasonal cohort, there were 21 instances where patients' asthma control worsened and 30 instances where their asthma control improved. PLS-DA modelling generated a separation model of controlled and uncontrolled asthma with an R<sup>2</sup> value of 0.72 and a Q<sup>2</sup> value of 0.592. A blinded analysis could not be done as we lacked a test set of children. We will do this in the near future with a separate cohort of children that we have acquired.

**Conclusion:** Urine metabolomic analysis attained positive results in the differentiation of asthma from healthy control children. It also suggests there is a metabolome of asthma severity. This work requires further validation using larger test sets, which is underway.

**Keywords:** Targeted metabolomics, Asthma, Mass Spectrometry,

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 63. Ablation of the Circadian Clock Results in Abnormal Enamel Formation

**Presenter: Raed Said**

Collaborators: Li Zheng, Silvana Papagerakis, and Petros Papagerakis

College of Dentistry

Supervisor(s): Petros Papagerakis, and Silvana Papagerakis

**Background:** Circadian rhythms are self-sustained endogenous oscillations occurring over a 24-hour period involved in many physiological processes. The circadian rhythm is maintained via the differential expression of ~20 transcription factors called clock genes. Period 2 (Per2) is one of the key clock genes. The incremental nature of enamel secretion and mineralization strongly suggests that ameloblasts are under circadian control. We reported that clock genes are differentially expressed by ameloblasts. The exact role of this “ameloblast” circadian clock remains unclear. Our aim was to examine the role of the circadian clock in regulating ameloblast differentiation and enamel formation using an in vivo circadian disruption model caused by Per2 deletion.

**Methods:** Enamel phenotype in Per2 knock-out (KO) and wild-type (WT) control mice was examined through gross morphology, SEM imaging, EDX, micro-hardness, and  $\mu$ CT analysis. Changes in gene expression levels of key ameloblast genes were evaluated by immunohistochemistry, qRT-PCR and RNAseq analyses to elucidate the links between the circadian molecular dysregulation and enamel phenotype in Per2KO mice.

**Results:** Our results demonstrate that Per2 plays an important role in regulating ameloblasts differentiation and gene expression. More precisely, Per2KO teeth show defects of enamel thickness and mineralization. In addition, Per2 KO ameloblasts showed altered expression of multiple key genes involved in enamel matrix deposition and transcellular calcium transport and calcium signaling during amelogenesis. This circadian disruption-caused gene dysregulation may contribute in the acquisition of the defective hypoplastic and hypomineralized enamel phenotype in Per2 KO mice.

**Conclusion:** Collectively, our data strongly suggest that the circadian clock tightly regulates ameloblasts differentiation by selectively targeting genes encoding several enamel matrix proteins and genes involved in enamel mineralization. More studies are needed to fully comprehend the complex circadian controls that regulate amelogenesis. Understanding the circadian controls of amelogenesis will provide the basis for a better understanding of enamel abnormalities and differences in enamel development and diseases.

**Keywords:** Enamel, Circadian Rhythm, Clock Genes, Per2, Ameloblast.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 64. Targeted therapy of osteosarcoma with radiolabelled monoclonal antibody to an insulin-like growth factor-2 receptor (IGF2R)

**Presenter: Sharayu Karkare**

College of Pharmacy and Nutrition

Supervisor(s): Ekaterina (Kate) Dadachova

**Background:** Osteosarcoma is the most common non-hematologic primary bone malignancy. It has been reported that it is the most common primary malignant bone tumour and the fifth most common primary malignancy among adolescents and young adults. There is a need for alternative novel treatment approaches to osteosarcoma treatment, as conventional chemotherapy strategies are not effective in many patients. We are investigating a novel approach to therapy of Osteosarcoma utilizing Radioimmunotherapy (RIT) targeted to insulin growth factor receptor type 2 (IGF2R), which has shown a constant over-expression in Osteosarcoma.

**Methods:** The binding efficiency of the IGF2R specific monoclonal antibody 2G11 to the panel of osteosarcoma cells lines was assessed by flow cytometry with the purpose of selecting the cell lines with the lowest and highest IGF2R expression for the biodistribution and therapy experiments. Biodistribution studies were performed in osteosarcoma xenografts in SCID B17 mice using Indium-111-labeled 2G11 specific antibody and the isotype matching control MOPC21. For therapy 1) the mice injected with the two different cell lines were randomized into 4 groups per cell line. Group 1 received 80 µCi of 177Lu-2G11, group 2 received 80 µCi of 177Lu- MOPC-21, group 3 received unlabeled (cold) 2G11, and group 4 was left untreated. In addition, a group of mice injected with 143B cell line received 80 mCi of alpha-emitter 213Bi-labeled 2G11 mAb.

**Results:** Based on the flow cytometry results, OS-17 and 143B cell lines were selected for initiation of tumors in SCID mice for biodistribution and RIT experiments. The 111In -2G11 demonstrated IGF2R-specific uptake in both OS-17 and 143B tumors which was significantly higher than that of isotype matching control MOPC21. 111In-2G11 cleared fast from all organs except for the spleen which expresses high levels of IGF2R. The therapy studies with 177Lu – and 213Bi -2G11 in tumour bearing mice showed that administration of this radiolabelled antibody significantly slowed down the growth of both the 143B and OS-17 tumours in comparison with the untreated tumours, cold 2G11 and radiolabeled isotype control antibody MOPC-21. 213Bi- 2G11mAb had a more significant effect on the tumours in comparison to 177Lu-2G11.

**Conclusion:** In conclusion, given the lack of new effective therapies for osteosarcoma, RIT targeting IGF2R warrants further investigation as alternative treatment for osteosarcoma.

**Keywords:** Osteosarcoma, Radioimmunotherapy, IGF2R, 2G11, MOPC-21, 177Lutetium, 213Bismuth,

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 65. In vivo Structure-Function Behavioral Analysis of GAT211 Analogs

**Presenter: Tallan Black**

Collaborators: Pushkar M Kulkarni, Sumanta Garai, and Peter Carlton Schaffer

College of Pharmacy and Nutrition

Supervisor(s): Robert B. Laprairie

**Background:** The type 1 cannabinoid receptor (CB1R) is the most common receptor in the central nervous system (CNS) and is found in areas of the brain linked with motor control, memory, reward, pain perception, and higher cognitive processing. Neurons and other cells within the body produce their own cannabinoids, known as endocannabinoids, which modulate pain, anxiety and depression, inflammation, and general neurotransmitter release by activating CB1R. Exogenous CB1R agonists, which activate CB1R through the same site as endocannabinoids (orthosteric site), have potential draw backs as therapeutics due to their intoxicating effects, addictive potential, and receptor down-regulation. Positive Allosteric Modulators (PAM) act on a site separate from the orthosteric site and increase endogenous ligand binding affinity, thereby possessing the potential to enhance therapeutic effects of CB1R activation without the associated negative effects seen in exogenous cannabinoids agonists. Our lab has been investigating PAMs related to GAT211 for their therapeutic use in treating pain and neurodegenerative diseases. Research suggests an important structure-activity function relating to the efficacy of the PAM. Performing a “fluorine-walk” on GAT211 improved binding and in vivo activity of CB1R PAMs. Specifically, the tri-fluorinated GAT591 and GAT593 appear to enhance ligand binding and displace CB1R antagonists better than other analogs.

**Methods:** Fluorinated GAT591 and GAT593 was administered via i.p into male mice at 0.1, 1, 3 and 10kg/kg  $\pm$  0.1 mg/kg THC, 0.1, 1, 3 and 10kg/kg THC alone or with vehicle (ethanol: cremaphor: saline 1:1:18). A modified behavioral tetrad was performed assessing catalepsy, body temperature and anti-nociceptive effects of the drugs. All experiments were performed with approval from the University Animal Care Committee (UACC).

**Results:** GAT591 and GAT 593 did not produce significant catalepsy or hypothermia. GAT 591 produced significant anti-nociceptive effects in the absence and presence of THC, whereas GAT593 did not produce anti-nociception alone, but did produce anti-nociception when co-administered with 0.1mg/kg THC.

**Conclusion:** GAT591 and GAT593 increased CB1R anti-nociceptive activity in an acute treatment paradigm, which is consistent with our hypothesis and understanding of CB1R PAM activity in-vivo. Unexpectedly, GAT591 also increase anti-nociceptive activity alone, consistent with partial agonist activity. This preliminary testing of GAT compounds will assist in the possible development of novel analgesic compounds.

**Keywords:** Cannabinoids, Positive Allosteric Modulators, CB1R, Animals, Behaviour, Tetrad,

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 66. Contrast-enhanced perfusion imaging in a teleost model organism, rainbow trout (*Oncorhynchus mykiss*)

**Presenter: Una Goncin**

Collaborators: Ngoc Ton, Ahmed El Kaffas, Markus Brinkmann

College of Medicine

Supervisor(s): Steven Machtaler

**Background:** Fish like zebrafish and rainbow trout have become attractive models for studying the impact of environmental toxins/pollution on development, tumour formation, reproduction, and overall fish health. This is not only important economically, but also to human health, as fish are rapidly gaining popularity as a model for the environmental impact of toxins/pollution on human health and disease. The aim of this study was to develop a tool using contrast-enhanced ultrasound (CEUS) imaging in fish to provide real-time, functional measures of organ perfusion. Microbubbles (MBs) are micron-sized, gas-filled contrast agents used for CEUS that have been well characterized for clinical applications in cardiology, liver, spleen, and kidney perfusion, and for molecular imaging of cancer. However, the use of MBs in non-mammalian species has not been well documented, and there are numerous challenges that must be investigated. Fish are ectotherms, therefore all physiological functions including body temperature and heart rate are affected by ambient temperatures, which may affect blood flow and metabolic rates. Most importantly, it is unknown how MBs behave in these conditions *in vivo*, what “normal” fish liver perfusion looks like, and if perfusion can be characterized using existing models. In this study, we investigated CEUS perfusion imaging in rainbow trout liver. Our ultimate goal is to characterize how MBs behave in fish in order to develop targeted MBs for molecular imaging that can be used to assess inflammation and tumour formation in response to environmental toxins/pollution.

**Methods:** Rainbow trout (n=4) were anesthetized by immersing fish in a solution containing Aquacalm (metomidate; 10 mg/L in water, 14C) and then placed onto an animal holding device. Anesthetic was continuously delivered through the mouth and over the gills for the duration of the imaging session. On a small region of their abdomen, scales were carefully removed. Fish were imaged using non-linear contrast mode on a small animal ultrasound system (Vevo3100; MV250 Transducer). A bolus of MBs (polydisperse, 1-5  $\mu\text{m}$ ; 5x10<sup>5</sup> MB/g of fish; total volume 1 mL) was administered through the caudal vein over 20 s. Each fish received a total of three MB boluses in the same imaging session and imaging plane in the following sequence: two boluses consecutively, allowing for MB clearance in between, followed by a dose of propranolol ( $\beta$ -blocker causing vasodilation; 1 mg/kg) and a final bolus 5 – 20 min post-propranolol administration. A ROI was drawn over the liver lobe and a time-intensity curve (TIC) was generated. This curve was used to determine peak enhancement (PE), repeatability, and estimated blood pool half-life. Following imaging, fish were euthanized and livers harvested for *ex vivo* histology.

**Results:** The average blood-pool half-life of MBs was 4.6 +/- 1.0 min. Average PE for each fish was: 69.8 a.u., 139.75 a.u., 258.5 a.u., 881.1 a.u., respectively. Repeatability between the first two sequential boluses was 95.6%. The response to propranolol varied between fish. Fish 2 received the final bolus 5 min post-propranolol (short incubation) and PE decreased 14% in PE (-19.3 a.u.). Remaining fish received final bolus 20 min post-propranolol (std incubation). Fish 1 and 3 saw increases in PE (148.5% [+125.3 a.u.], and 298.6% [+138.6 a.u.]), respectively, which is consistent with dilation of vasculature allowing more MBs into the field of view, increasing PE. Fish 4 showed a 17.6% decrease in PE (-154.7 a.u.), a non-standard response to propranolol.

**Conclusion:** CEUS perfusion imaging in fish liver was repeatable and able to visualize and quantify changes in the vasculature. Blood pool half-life and TIC of MBs show similarities to mammals, allowing us to construct a model based on existing perfusion models for fully characterizing fish perfusion. These data also suggest that molecular imaging with targeted MBs will be possible using existing approaches.

**Keywords:** animal models, rainbow trout, microbubble, perfusion imaging, contrast-enhanced ultrasound

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 67. Agricultural Respiratory Exposures: Glyphosate Combines with LPS to Induce Increased Lung Inflammation in Mice

**Presenter:** Upkardeep Singh Pandher

Collaborators: David Schneberger, Baljit Singh, and Gurpreet Aulakh  
College of Medicine

Supervisor(s): Shelley Kirychuk, R.S. Sethi

**Background:** Exposure to endotoxin and pesticides commonly occurs in the agricultural environment. Endotoxin (LPS) exposure is known to stimulate lung inflammation and is a relevant co-exposure with other contaminants. Glyphosate is used as an active ingredient in herbicides applied to control pests. Although glyphosate exposure associated with respiratory problems of workers, information is limited on lung inflammation. We hypothesized that co-exposure to glyphosate and LPS induces increased lung inflammation.

**Methods:** To explore this, C57BL/6 mice were intranasally treated with LPS (0.5 µg), glyphosate (1 µg), combined LPS and glyphosate (LPS: 0.5 µg + glyphosate: 1 µg; combined treatment), or HBSS (Hank's balanced salt solution) control for 1, 5 or 10 days respectively (N = 5 per group). HBSS was used to dissolve LPS and glyphosate. Concentrations are probably equivalent to the inhalation exposure occurs in the agricultural environment. Following mice treatments, bronchoalveolar lavage (BAL) was collected and analyzed for cellular changes. BAL cytokines were quantified through Mouse Multiplex Luminex Array. Lung tissues were assessed for mRNA changes through Real Time PCR. Tissues were fixed with 4% paraformaldehyde for hematoxylin and eosin staining or immunohistochemistry.

**Results:** Mice treated with combined LPS and glyphosate for 5 and 10 days showed significant increases in lavage total leukocyte count in comparison to treatments of either stimulus i.e. LPS, glyphosate individually. Neutrophils dominated in these 5 and 10 days combined treatment lavage, but macrophages and lymphocytes showed increases, especially after 10 days. Pro-inflammatory cytokines TNF-α, and KC were significantly released in the 5 days combined treatment group versus 10 days. Histology showed robust influx of inflammatory cells including neutrophils and immunohistochemistry showed higher expression of neutrophil marker Gr-1 into the lungs treated with combination for 5 and 10 days. Fold change of TLR4 and TLR2 mRNA also significantly upregulated in 5 days combined treatment group.

**Conclusion:** Co-exposure to glyphosate with LPS caused more lung inflammation as compared to the individual exposures. Co-exposures may be an important consideration in respiratory exposures and control strategies.

**Keywords:** lung inflammation, glyphosate, LPS, inhalation exposure, animal model

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 68. Nutrient restriction restores normal cellular phenotypes in Hutchinson-Gilford Progeria Syndrome

**Presenter: Zoe Elizabeth Gillespie**

College of Medicine

Supervisor(s): Christopher H. Eskiw

**Background:** Hutchinson-Gilford Progeria Syndrome (HGPS) is a rare and devastating premature aging disease affecting 1:4 million live births. Children with HGPS exhibit age-related phenotypes (osteoporosis, atherosclerosis, loss of subcutaneous fat and alopecia) and succumb to heart attack or stroke at ~14 years of age. Age-related features of HGPS are also evident at the cellular level, including defects in nuclear morphology, mis-localization of chromosomes and global loss of gene regulation resulting in the accumulation of senescent (“old”) cells. Cellular and organismal phenotypes of HGPS are attributed to accumulation of the mutant protein progerin, the result of a single point mutation in the laminA/C gene. Interestingly, progerin is hypothesized to accumulate in normal aging individuals as well indicating a parallel between HGPS and the normal aging process.

**Methods:** Previously rapamycin, an inhibitor of the mammalian target of rapamycin (mTOR) pathway, has been demonstrated to reduce levels of the mutant progerin, resulting in improved cellular phenotypes of HGPS; however, this drug has potentially severe side effects. It is logical that inhibition of mTOR by alternate means could be effective in reducing protein levels of progerin and improving HGPS cellular phenotypes. Nutrient restriction (NR) has also been shown to effectively inhibit the mTOR pathway, as has the antidiabetic drug metformin indicating that these treatments may be effective treatments to promote progerin degradation.

**Results:** We have demonstrated that 72 hours of NR via removal of amino acids arginine and leucine, or treatment with metformin, reduced progerin levels in HGPS patient fibroblasts. Concordant with this decrease, improvement in nuclear morphology, re-localization of chromosome territories, increased rates of DNA damage repair and increased methylation has been recorded across patient cell-lines. Importantly, no changes in nuclear morphology or decrease in cell viability were detected in normal control fibroblasts under the same conditions. Finally, NR via arginine and leucine extended survival in-culture beyond that of non-restricted control fibroblasts.

**Conclusion:** These findings indicate that NR or treatments with NR mimetics such as metformin, could supply potential therapeutic options for HGPS patients, with wider implications for extension of health span within the general population.

**Keywords:** Premature Aging, Nutrient Restriction, Hutchinson-Gilford Progeria Syndrome (HGPS), Metformin

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

**Basic Science 5**

## 69. Characterization and modulation of the type 1 cannabinoid receptor in a rat model of absence epilepsy

**Presenter: Anna Maria Smolyakova**

Collaborators: Mariam Alaverdashvili, Andrew J. Roebuck, and Quentin Greba

College of Pharmacy and Nutrition

Supervisor(s): Robert B. Laprairie, and John G. Howland

**Background:** Dysregulation of the endocannabinoid and GABAergic systems is involved in the pathophysiology of many forms of epilepsy including absence epilepsy. Absence epilepsy is characterized by generalized thalamo-cortical seizures with short lapses of impaired consciousness, co-morbid anxiety, and an EEG hallmark of >2.5 Hz spike-and-wave discharges (SWD). The type 1 cannabinoid receptor (CB1R) is a recognized target for anti-seizure drugs. In some models of absence epilepsy, CB1R agonists such as WIN55,212-2 are effective in reducing the frequency of SWD for a period of time, however the efficacy is short lived and followed by a late increase in SWD duration. The high doses required for efficacy of CB1R agonists carry negative adverse effects and lead to desensitization of CB1R. In contrast, CB1R positive allosteric modulators (PAM) may enhance the efficacy of endogenous cannabinoids without such adverse effects.

**Methods:** In this study, we chose to use the Genetic Absence Epilepsy Rats from Strasbourg (GAERS) model. Our goals were (1) to characterize aspects of the endocannabinoid and GABAergic system in this model using immunohistochemistry and radioligand binding and (2) determine whether the CB1R PAM GAT211 affected the epileptic phenotype of this model.

**Results:** CB1R protein levels and radioligand binding were lower in the motor cortex and hippocampus – but unaffected in the thalamus– of GAERS compared to non-epileptic controls ( $p < 0.001$ ,  $n = 17$  ;  $p < 0.05$ ,  $n = 19$  respectively). Similarly, levels of the GABA-synthesizing enzyme GAD67 were lower in the motor cortex of GAERS compared to non-epileptic controls ( $p < 0.05$ ,  $n = 17$ ). Preliminary data also suggests that seizure occurrence, seizure duration, and anxiety were reduced in GAERS following a single i.p. injection of the CB1R PAM GAT211 (1, 3, or 10mg/kg).

**Conclusion:** : CB1R and GAD67 deficits in the motor cortex may contribute to the propagation of seizures in absence epilepsy. CB1R PAMs may alleviate seizures through normalization of synaptic transmission.

**Keywords:** type 1 cannabinoid receptor, absence epilepsy, GAERS, CB1R, GAD67

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 70. NMR-based metabolomics: a novel tool to study stress in wild birds?

**Presenter: Asha Perera**

Collaborators: Catherine Soos, Karen Machin

Western College of Veterinary Medicine

Supervisor(s): Catherine Soos, and Karen Machin

**Background:** Metabolomics is a cutting-edge technique that examines fluctuations in small metabolite levels in biological systems. An important application of metabolomics is the study of effects of natural and anthropogenic environmental stressors on organisms. The vertebrate stress response functions to re-route energy typically utilized for maintaining homeostasis, towards metabolic processes that provide energy available for immediate survival functions, thus affecting the metabolome at the cellular level. While multiple studies have successfully applied metabolomics techniques in invertebrate and mammalian species, the use of this technique in wild birds is still in its infancy.

**Methods:** Our main objective was to validate the use of metabolomics in evaluating effects of stress on the metabolome of waterfowl. Captive Lesser Scaup (*Aythya affinis*) were implanted with either a biodegradable corticosterone pellet to mimic effects of chronic stress, or a placebo pellet. H1 Nuclear Magnetic Resonance (NMR) spectroscopy was performed on serum samples collected during the active implant period. We hypothesized that metabolomics can be used to differentiate ducks that received exogenous corticosterone from placebo (control).

**Results:** We found that serum metabolite profiles could be successfully used to differentiate ducks with higher corticosterone from control individuals. We further identified multiple key metabolites that varied between the two groups, all of which play important roles in energy metabolism.

**Conclusion:** To our knowledge, this is the first study to investigate the use of NMR-based metabolomics techniques to study stress responses in wild birds. Metabolomics technique show promise as a novel tool in identifying and characterizing physiological responses associated with large-scale environmental changes in wild birds.

**Keywords:** metabolomics, nuclear magnetic resonance, stress, corticosterone, birds

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 71. Ibrutinib as a potential therapeutic option for HER2+ breast cancer- role of STAT3 and p21

**Presenter: Chandra Bose Prabakaran**

College of Pharmacy and Nutrition

Supervisor(s): Meena Sakharkar

**Background:** Treatment response rates to current anticancer therapies for HER2+ breast cancer are limited and also have side-effects. Tyrosine kinases perform crucial roles in cellular processes by mediating cell signalling cascades. Ibrutinib is a recently approved Tyrosine Kinase Inhibitor (TKI) has been shown to be an effective therapeutic option for HER2+ breast cancer. The molecular mechanisms, pathways, or genes that are modulated by ibrutinib and the mechanism of action of ibrutinib in HER2+ breast cancer remains obscure.

**Methods:** In this study, we have performed a kinome array analysis of ibrutinib treatment in two HER2+ breast cancer cell lines.

**Results:** Our analysis shows that ibrutinib induces changes in nuclear morphology and causes apoptosis via caspase-dependent extrinsic apoptosis pathway showing the activation of caspases-8, caspase-3, and cleavage of PARP-1. We further show that phosphorylated STAT3-Y705 is upregulated and phosphorylated p21-T145 is downregulated upon ibrutinib treatment.

**Conclusion:** We propose that STAT3 upregulation is a passive response as a result of induction of DNA damage and downregulation of phosphorylated p21 is promoting cell cycle arrest and apoptosis in the two HER2+ cell lines under investigation. These results suggest that inhibitors of STAT3 phosphorylation may be potential options for combination therapy to help increase the efficacy of ibrutinib against HER2-overexpressing tumors.

**Keywords:** Ibrutinib, breast cancer, Kinome analysis, peptide array, tyrosine kinase inhibitors.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 72. “Enlightening Challenge”: Tracking Salmonella in Avian Hosts

**Presenter: Dinesh Wellawa**

Western College of Veterinary Medicine

Supervisor(s): Wolfgang Koester

**Background:** Chickens act as reservoir for Salmonella, allowing transmission to humans and potentially resulting in salmonellosis. Salmonella Enteritidis (SE) one of the serovars which accounts for the majority human salmonellosis cases in North America and globally. While mammals do show clinical signs, adult chickens are asymptomatic. This raises the question how Salmonella Enteritidis is able to thrive in its avian hosts modulating the immune response. Despite decades of research, the answer to this question remains a mystery. We believe that understanding the Salmonella-avian interactions not only answers that question but aids in translating that knowledge in therapeutics for humans and animals. Here we generated light emitting Salmonella strains to characterize some of the putative virulence genes in the context of colonization and infection of SE in chicken. Generated light was captured through a bioluminescent imager to track Salmonella once inside the bird. We believe that this technique is superior to other current modalities to characterize host-pathogen interactions. It allows visualization of

Salmonella colonization in overlooked niches, facilitates gene expression studies and importantly helps to differentiate Salmonella from rest of the microbiome. In parallel, we investigated the potential to develop a live imaging system using chicken as a model which the technique representing an ethically superior approach for innovative Salmonella research. The Bioluminescence resonance energy transfer technique (BRET) was used to increase the intensity of the light generated using a natural protein called lumazine. The role of genes related to iron homeostasis of SE in colonizing the chicken gastrointestinal tract and systemic dissemination to various sites in the avian host has been a scope of this study. Humans and other vertebrates rely on lowering the free labile iron pool for pathogens to be utilized as part of the nutritional immunity and thus limit pathogen grow inside host tissues. On the other hand pathogens like Salmonella succeed to overcome iron starvation using various strategies. Here we characterized the role of the Fe<sup>2+</sup> uptake system encoded by *feoABC* and Fe<sup>3+</sup> hijacking molecules called siderophores; enterobactin encoded by *entCEBH*, salmochelin encoded by *iroBCDE*, respectively, in colonization and infection. Mutant strains were generated and tagged with light emitting cassettes (*luxCDABE*) thus facilitating co-infection studies.

**Methods:** The *luxCDABE* operon from *Photobacterium luminescens* was integrated into chromosomes of SE wild-type and mutant strains and generated a continuous light signal. Chromosomal integration was achieved through a MiniTn7 vector-based transposon method. Single gene mutations of genes of interest were accomplished via the Lambda red recombinase system. The ability of Salmonella strains to infect and colonize was tested in a chicken model. The digestive tract of chicken was subjected to ex-vivo imaging post challenge, using whole animal imager (Caliber,Life) at different time points to track Salmonella and each mutant strain. Bioluminescence resonance energy transfer technique (BRET) was implemented to shift or boost the signal of the reporter. Lumazine protein encoded by *lumP* from another Gram-negative bacterium, *Photobacterium leiognathi*, was expressed in tandem with *luxCDABE*. We hypothesized that lumazine protein will closely interact with the luciferase protein (which is the main catalytic enzyme for emitting green-blue light at a peak wavelength of 490nm) and increase the intensity of the signal (peak wavelength at 475nm).

**Results:** Bioluminescent signals were detected through ileum, cecum, colon and yolk when the wild-type strain was used to infect one-day-old chickens. BRET-based technology increased the signal strength of *luxCDABE* in-vitro by two-fold in different Salmonella strains due to the expression of lumazine protein. Strains lacking siderophore production showed a reduced level of colonization in cecum compared to the wildtype at days 4 and 5 post-challenge (2-week old birds). Interestingly  $\Delta$ entB (enterobactin synthesis deletion strain) showed a significant reduction in systemic infection. Similar results were obtained for  $\Delta$ feoABC in cecal colonization.

**Conclusion:** The bioluminescent reporter system facilitated ex-vivo imaging in chickens, yet needs further enhancement to improve detection. Salmonella Enteritidis strains have a predilection to cecum yet yolk sac is another overlooked niche where they might persist in chicks. It was possible to enhance the signal of the current reporter system to give brighter light which eventually benefits improving the detection limits. Genes related to iron homeostasis in Salmonella play an important role in colonization in an avian environment. Especially siderophore synthesis and uptake systems can be future targets for generating novel antibiotics and vaccines to mediate neutralizing antibodies.

**Keywords:** Salmonella, Bioluminescence, Chicken, Iron, BRET

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

### 73. Long-term comparison of therapeutic efficacy of Fumagillin, prebiotics, and probiotics on Nosema infection, health, and productivity of honeybee colonies

**Presenter:** Igor Medici de Mattos

Collaborators: Juliana Sartori Lunardi, Sarah Wood, and Ivanna Kozii

Western College of Veterinary Medicine

Supervisor(s): Elemir Simko

**Background:** The Canadian agriculture is in part dependent on robust apiculture that provides healthy honeybee (*Apis mellifera*) colonies for crop pollination. Thus, recent high colony losses have been raising concerns throughout Canada. Increasing evidence indicates that the microsporidian pathogen *Nosema* spp plays a significant role in mortality. Despite the negative impact of nosemosis, the only homologated treatment in Canada (i.e. Fumagillin-B) recently became unavailable due to discontinued production. Moreover, the efficiency of available alternatives has been often reported as contradictory.

**Methods:** Accordingly, we combined field studies with laboratory trials to compare the therapeutic efficacy of probiotics (i.e., Super DFM and ProBee) and prebiotics (i.e., Nozevit and Honey-B-Healthy) to Fumagillin-B. A total of 75 colonies (5 groups: 15 colonies each) were infected with *Nosema* spp. spores (~15,000 spores per bee) and subsequently treated with one of the tested formulations. In addition, one group (n=15) was challenged with *Nosema* but not treated (positive control) and another group (n=15) was neither challenged nor treated (negative control). The variation between the spore loads found after inoculation (AI) and after treatment (AT) ( $\Delta$ AI-AT) was used to assess the efficiency of the tested supplements.

**Results:** The ANOVA test showed a significant difference across all tested groups ( $F= 3.420$ ,  $df= 5$ ,  $P= 0.009$ ) and the post hoc comparison showed a significant increase in the spore counts of ProBee treated colonies ( $\bar{X} = 68.71$ ,  $SD= 91.91$ ) when compared to the untreated control colonies (9.48, 12.49) (Tuckey test:  $P= 0.027$ ).

**Conclusion:** 5 weeks after treatment there was no significant effect of probiotic and prebiotic supplementation on the *Nosema* spore counts in experimental colonies. Both laboratory trials and field experiments are in progress and the evaluation of *Nosema* spore load, overwinter survival and productivity of colonies will be continue over the next two years.

**Keywords:** *Nosema*, probiotics, prebiotics, antibiotic, honey bee

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 74. In vivo precision of magnetic resonance imaging based finite element outcomes of the proximal femur

**Presenter:** Kadin Majcher

Collaborators: Saija Kontulainen, David Leswick, and JD Johnston

College of Engineering

Supervisor(s): James (J.D.) Johnston, Saija Kontulainen

**Background:** Hip fractures are a life threatening injury, with an estimated 30,000 occurring annually in Canada. Dual-energy x-ray absorptiometry (DXA) measurement of areal bone mineral density at the proximal femur provides the clinical standard for osteoporosis diagnosis and fracture risk assessment. The inherent limitations of DXA (planar measures, size dependence) inhibits its ability to estimate bone strength. Subject-specific FE modeling from MR images can be used to non-invasively estimate bone strength at the proximal femur. However, the precision (repeatability) of FE-derived mechanical outcomes (stress/strain) are unknown. Knowledge of measurement error is important to establish the reliability of a technique. The objective of this research was to determine the in vivo measurement precision of MR-based FE outcomes for loading configurations simulating a fall and stance.

**Methods:** MR images (T1-weighted, turbo spin echo sequence, 0.45x0.45 mm in-plane pixel size, 4 mm slice thickness) of the left proximal femur from 13 participants (5M:8F; age: 30.4 ± 12 years), each scanned 3 times were obtained from a previous study. Images were corrected for inhomogeneity shading variation and linearly interpolated to create an isotopic cubic array (0.45 mm). The proximal femur was then semi-automatically segmented (Analyze). Using custom algorithms (Matlab), images were aligned into sideways fall and stance configurations and then the FE models generated. Each voxel was converted into a hexahedral element. Bone material properties were assumed to be linearly elastic and isotropic, with elastic moduli (E) and compressive yield strength (Syc) derived from bone volume fraction and ash density relations, where  $E = 12.9 * [1.08(1 - \text{Intensity}_{\text{pixel}} / \text{Intensity}_{\text{max}})]^2$  and  $S_{yc} = 125.2 * (1 - \text{Intensity}_{\text{pixel}} / \text{Intensity}_{\text{max}})^{2.2}$ . Tensile yield strength (Syt) was found using the relation of  $0.7 * S_{yc} = S_{yt}$ . A Poisson's ratio of 0.3 was assumed for all elements. For the FE models, a distributed load was applied over the femoral head (fall: 2\*bodyweight; stance: 1\*bodyweight), with boundary conditions applied as in previous studies. Outcomes were analysed at 4.5mm thick regions of interest at the neck, intertrochanteric, and shaft. FE outcomes included the mean von Mises stress, mean von Mises strain, and percentage of failed tissue (von Mises yield, Brittle Coulomb-Mohr, minimum principal strain, Hoffman stress, and Hoffman strain). The short-term precision of each outcome was evaluated using CV%RMS.

**Results:** CV%RMS ranged from 3-9% for stress outcomes, while CV%RMS was higher for strain measures (>28%). von Mises strain and minimum principal strain appeared least precise. To our knowledge, this is the first study to report the repeatability of MR-based FE outcomes of the proximal femur. Previous studies have used MR and FE modeling to evaluate hip strength; however, they have not reported measurement precision. Excluding strain, our results support applying MR-based FE modeling for non-invasively assessing mechanical behavior of the hip.

**Conclusion:** FE stress outcomes have a greater measurement precision than strain measures. Results indicate that femoral strength can be reliably estimated using MR based FE modeling.

**Keywords:** Bone; MRI; Precision; Finite Element Modeling; Proximal Femur

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 75. Psychiatric risk protein DISC1 inhibits kinase GSK3 $\beta$ : Structural insights to the protein complex using crystallography

**Presenter: Narsimha Pujari**

Collaborators: Stephanie Saundh, Anand Nambisan, and Steve Gagne

Western College of Veterinary Medicine

Supervisor(s): Adelaine Leung

**Background:** Disrupted in Schizophrenia 1 (DISC1) is a candidate risk gene in major psychiatric illnesses such as depression, bipolar disorder and schizophrenia. DISC1 is a scaffold protein that interacts with a myriad of proteins, forming a large protein-protein interaction network that coordinates various stages of brain development. Our lab is interested to understand how the structure of DISC1 facilitates its function in brain development. One of DISC1's interactors is the enzyme glycogen synthase kinase 3 $\beta$  (GSK-3 $\beta$ ). The complex of DISC1 and GSK3 $\beta$  has been found to have an important role in neuronal cell development. A 44-amino acid region of DISC1 (referred to as DISC1-44mer) has been mapped to have the strongest binding and inhibitory effect on GSK3 $\beta$ , compared to other regions on the protein. Disruption in the complex formation due to mutations in the human DISC1 gene increases susceptibility towards the mentioned illnesses.

**Methods:** We plan to use X-ray crystallography to gain structural insights into the molecular framework of the protein complex. Crystallisation process requires the protein sample to have at least 90% purity and a concentration of at least 5 mg/ml. We used a T7 promoter-based bacterial system to express a large amount of DISC1-44mer and GSK3 $\beta$ . Ion exchange, affinity and size exclusion chromatography were used in sequence to remove most of the contaminants. The two proteins were concentrated together (8 mg/ml) to allow complex formation. Crystallisation trials with commercial screens were performed with purified GSK3 $\beta$ /DISC1-44mer.

**Results:** The sequential use of multiple chromatography stages helped achieve protein purity of more than 90%. Crystals were observed in 4 conditions; we were able to reproduce the conditions in the fine screen. Despite the small size, the crystals diffracted to 3.5 Å. The streaky spots however made indexing difficult. Further optimisation is underway.

**Conclusion:** Crystallizing conditions can be further optimized to yield a better quality crystal. The structure of the complex once solved, can be used in designing targeted therapeutics.

**Keywords:** Psychiatric illnesses, Protein biochemistry, X-Ray crystallography, Structural biology

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 76. Characterization of tight junction proteins in the maternal-fetal interface of porcine placenta

**Presenter: Pauline B. Guidoni**

Collaborators: Alex Pasternak, and Daniel J. MacPhee

Western College of Veterinary Medicine

Supervisor(s): John Harding

**Background:** Paracellular transport occurs through tight junctions which are complexes of proteins that create intercellular boundaries between the plasma membrane domains of epithelial and endothelial cells. Tight junction proteins can be defective in some diseases of epithelial organs, resulting in reduced or increased paracellular transport of solutes and increased permeability to large molecules. Therefore, our objective is to determine and understand the normal expression of specific tight junction proteins in the porcine maternal-fetal interface (MFI) and establish a baseline for use in future experiments comparing groups of porcine reproductive and respiratory syndrome virus 2 (PRRSV-2) infected intrauterine growth restricted (IUGR) and non-IUGR fetuses.

**Methods:** Six paraffin embedded blocks of porcine MFI samples, each representing a randomly selected fetus, were sectioned and placed on glass slides. Tissue sections were immunostained with anti-claudin7 (CLDN7) and images recorded with an Olympus IX83 microscope equipped for epi-fluorescent imaging. Staining intensity was scored using a semi-subjective scoring system (0 - absent, 1- mild, 2- moderate, 3- abundant), based on localization, and Image J software with a series of custom macro functions.

**Results:** Staining intensity was most consistent and abundant (mainly score 3) in the glandular epithelium and fetus villus tip, followed by areola. The least consistent staining was in the fetus villus crypt followed by maternal villus crypt. Absent (0) or mild intracellular staining (1) was found in endothelial cells. Staining was consistently observed basolaterally in glandular epithelium, maternal villus tip, and villus crypt, paracellularly in fetal villus tip, villus crypt and amnion, and intracellularly only in endothelial cells. Localization in the maternal and fetal areola regions varied between paracellular and basolateral.

**Conclusion:** These results indicate that there are variable amounts of staining in all regions, but was most intense in fetus villus tip, glandular epithelium and maternal areola which is interesting considering that both have nutrient transfer properties. The least intense staining was in endothelial cells. CLDN7 does not make a good biomarker to differentiate cell types in placenta because it does not distinguish any one region, or maternal from fetal tissues.

**Keywords:** Porcine placenta and tight junction protein

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 77. Engineering <sup>89</sup>Zr-labeled amino acid functionalized diamond nanoparticles for gene delivery: method development, optimization, stability study and biodistribution studies

**Presenter: Raj Rai**

College of Pharmacy and Nutrition

Supervisor(s): Ildiko Badea

**Background:** As nanodiamond are relatively new to drug therapy, little is known about their specific interaction with living systems. It is known that the targets of many therapeutic agents are localized inside the cells in subcellular compartments; therefore, it is vital to engineer nanoparticles that can carry the drug to the affected tissues and inside of the diseased cells in the body. Elucidation of the biodistribution of nanodiamonds brings the opportunity to better understand the risk that these systems may pose in living system and provides an important basis for designing a ND- based drug delivery systems. With rapid advances of nanoscience in drug delivery system, the application of functionalized nanodiamonds to make target specific drug delivery in cancer could revolutionize the way current cancer treatments work. It can help the province to tackle around 5800 new cancer cases per year effectively and efficiently.

**Methods:** lysine and lysine histidine fNDs were synthesized via covalent conjugation using a 3-carbon chain linker. <sup>1</sup>HNMR was used to confirm synthesis of amino acid conjugates at all steps. Extensive method development was carried out to deduce the best synthetic approach for designing radio labeled fNDs. Briefly, after synthesizing fNDs, a chelating agent 'deferoxamine' was conjugated to allow labeling with a radio nuclei Zirconium 89 (89Zr). Thermograms of fNDs from previous analyses were used to quantify the percentage of DFO conjugation on the surface. DFO was conjugated at 8%, 6%, 3% and 1% and characterized to maintain size and positive surface without compromising optimum radiolabeling efficiency. Pharmacokinetic and biodistribution studies of 89Zr labeled fNDs were performed in CD-1 mice using ex vivo gamma counter and microPET/CT imaging.

**Results:** lysine and lysine histidine fNDs were synthesized via covalent conjugation using a 3-carbon chain linker. <sup>1</sup>HNMR was used to confirm synthesis of amino acid conjugates at all steps. Extensive method development was carried out to deduce the best synthetic approach for designing radio labeled fNDs. Briefly, after synthesizing fNDs, a chelating agent 'deferoxamine' was conjugated to allow labeling with a radio nuclei Zirconium 89 (89Zr). Thermograms of fNDs from previous analyses were used to quantify the percentage of DFO conjugation on the surface. DFO was conjugated at 8%, 6%, 3% and 1% and characterized to maintain size and positive surface without compromising optimum radiolabeling efficiency. Pharmacokinetic and biodistribution studies of 89Zr labeled fNDs were performed in CD-1 mice using ex vivo gamma counter and microPET/CT imaging. Results: Among all conjugation ratios of 1-8%, 3% DFO conjugation to fNDs maintained the optimal size of under 200nm and positive surface charge of +19.4±4.1 mV. The conjugates formed diamplexes (DFO conjugated fNDs/siRNA complexes) at biocompatible mass ratios. Radiolabeling method was developed and optimized with respect time and temperature achieving more than 90% efficiency. The radiolabeling efficiency remained stable in phosphate buffer saline and mouse blood serum for over 96 hours (97±2%). Biodistribution assays revealed high accumulation of fNDs in liver after 6 hours (6.11±4.06) and 72 hours (2.32±2.09) followed by spleen (0.17±2.71 at 6 hours and 1.66±1.31 at 72 hours). PET images further confirmed the finding of biodistribution assays.

**Conclusion:** This study establishes an understanding of in vivo behavior of fNDs for future design, optimization and application of these novel carriers for targeted gene therapy.

**Keywords:** Gene therapy, nanodiamonds, Biodistribution, radio labeling, 89Zr

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## **Basic Science 6**

### 78. Development of a Dried Blood Spot Assay for Detecting Prenatal Cannabis Exposure in Newborns

**Presenter: Stephanie Vuong**

Collaborators: Deborah Michel, Richard Huntsman

College of Pharmacy and Nutrition

Supervisor(s): Jane Alcorn, and Andrew W. Lyon

**Background:** Legalization of recreational Cannabis in October 2018 resulted in increased concerns about the potential increase of Cannabis use in pregnant women. Many women mistakenly believe that Cannabis may help to ease their nausea and morning sickness. Due to their high lipophilicity, cannabinoids have the tendency to cross the blood-placental barrier, exposing the fetus to the cannabinoids. Cannabinoids, such as tetrahydrocannabinol (THC), act upon type 1 cannabinoid receptors, which are located in the central nervous system. In the fetal stage, the brain is still undergoing development, therefore, exposure to Cannabis can lead to long-term neurological impairments. All newborns in Saskatchewan are required to have a heel prick test/dried blood spot test to detect for any congenital metabolic disorders. The requirement of a dried blood spot test from newborns makes it easily accessible to detect for prenatal exposure to Cannabis. Liquid chromatography-tandem mass spectrometry will be used for the quantitative analysis of cannabinoids in the dried blood spots for its sensitivity and selectivity.

**Methods:** Mass spectrometry can be affected by major endogenous components found in blood matrices, such as plasma proteins, phospholipids, and red blood cells. These endogenous components can potentially interfere with the quantitative analysis of cannabinoids, leading to inaccurate measurements. It is crucial to remove these endogenous components from the sample. Typical blood sample cleanup includes liquid-liquid extraction or solid phase extraction, however, these techniques are expensive, time-consuming, and require method development. A recent technique has been developed that is efficient yet as effective as solid phase extraction for the removal of plasma proteins, phospholipids, and red blood cells. The Agilent Captiva EMR-Lipid device is a 96-well plate containing a filter and lipid sorbent that has the ability to capture high molecular weight components (plasma proteins and red blood cells) and selectively bind to phospholipids, allowing the filtrate to be free of these endogenous components. Avoidance of these potential interferences will lead to better sensitivity and selectivity of the analytes.

**Conclusion:** An LC-MS/MS method has been established and will be used to detect for cannabinoids in the newborn dried blood spots and to compare the prevalence of prenatal Cannabis exposure in Saskatchewan pre-legalization and post-legalization of recreational Cannabis. We are at the final stages of developing the LC-MS/MS method and will subsequently follow with method validation.

**Keywords:** Dried Blood Spot, Cannabis, Cannabinoids, Prenatal, Neonates, LC-MS/MS

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 79. Predicting off-axis bone strength of the distal radius using high-resolution peripheral quantitative computed tomography based finite element modeling

**Presenter: Amy Bunyamin**

College of Engineering

Supervisor(s): James (J.D.) Johnston, and Saija Kontulainen

**Background:** Distal radius fractures are one of the most common types of fractures to occur in older adults. Bone strength (e.g., failure load) of the distal radius can be estimated using finite element (FE) models generated from high-resolution peripheral quantitative computed tomography (HR-pQCT) images; however, these models are limited because they determine failure load under pure compressive loading conditions and neglect off-axis loads that occur during a fall on an outstretched hand. The objective of this research was to develop a HR-pQCT distal radius FE model that accounts for off-axis loading and identify moment arms that best predicted experimental failure load with highest explained variance.

**Methods:** We scanned the distal radius (9.5 mm site) of 21 fresh-frozen cadaveric forearms from female donors (82, SD 9 years) using HR-pQCT. We tested the specimens until fracture in a testing configuration set to simulate a fall on an outstretched hand to obtain experimental failure load. We created FE models by assigning an elastic modulus of 6.829 GPa to all bone voxels and included a stiff plate on the proximal face of the distal radius segment to allow for off-axis loading. We applied a point load at different medial-dorsal and lateral-dorsal moment arm combinations to determine predicted off-axis failure loads for different failure volumes and different failure criterion. We report the moment arm combination with the highest explained variance (R<sup>2</sup>) in experimental failure loads.

**Results:** When incorporating off-axis loading, applying a 1 mm dorsal moment arm explained up to 80% of variance in experimental failure load.

**Conclusion:** Off-axis loading explains 80% of variance in experimental failure load, improving explained variance from pure compressive loading by 5%. These findings suggest that accounting for off-axis loading in current HR-pQCT FE models may improve predictions of distal radius failure load, which may potentially help to improve future HR-pQCT fracture prevention and intervention studies.

**Keywords:** Bone, Distal radius, Falls, Finite element, Mechanical testing

## 80. Novel Approaches for Enamel Regeneration using Dental Epithelial Stem Cells, Specialized Gene Delivery Systems and 3D-printed Scaffolds

**Presenter: Fatemeh Mohabatpour**

Collaborators: Silvana Papagerakis, Ildiko Badea, and Mays Al-Dulaymi

College of Dentistry

Supervisor(s): Petros Papagerakis, and Daniel Chen

**Background:** Enamel is the highest mineralized tissue in the human body and it is produced by ameloblasts, which are originated from enamel organ epithelium. Enamel is incapable of self-repair due to the ameloblasts apoptosis prior tooth eruption which makes endogenous enamel regeneration and repair impossible. The aim of this study is to fine-tune the optimal conditions needed to regenerate dental enamel and promote enamel–dentin integration.

**Methods:** Previous studies have shown that TBX1 protein is a key inducer of ameloblast differentiation. To optimize Tbx-1 gene delivery system as means of inducing rat dental epithelial stem cells (HAT-7) to ameloblasts, we tested 2 different lipid formulations. Lipoplexes were prepared by mixing TBX-1 plasmid DNA (pDNA) with gemini surfactant (GS), we fabricated, or DOTAP, a commercial available lipoplex. Then, we compared three various nitrogen to phosphate (N/P) ratios of 2.5, 5 and 10 to achieve optimal condensed DNA. The size and zeta potential of lipoplexes were also measured using dynamic light scattering (DLS). Next, HAT-7 cells were transfected using the 2 lipid formulations and cell viability, transfection efficacy and gene expression profiles were comparatively analyzed after 48 hours using MTT and CCK-8 assays, qRT-PCR, immunofluorescence and western-blot. In addition, HAT-7 cells were co-cultured with dental pulp stem cells (DPSCs) for 1, 4, 7, 14, 28 days and the expression levels of ameloblast biomarkers and mineralization potential were evaluated. Pilot studies were also undertaken to characterize ameloblast differentiation in vivo by co-seeding HAT-7 and DPSCs in immune-compromised mice.

**Results:** The decrease in particle size and increase in zeta potential of lipoplexes are observed as N/P ratios rises. By increasing the N/P ratio, TBX-1 expression is greatly increased but cell viability is diminished. Cells treated with GS having a N/P ration of 5 show the most optimal survival rates and biologically significant TBX1 over-expression levels. Induced TBX-1 expression resulted in enhanced ameloblast differentiation. The data also indicated that HAT-7 cells when co-cultured with DPSCs, using co-culture systems or within alginate-chitosan hydrogels fabricated using the 3D printing, follow a more robust and well-organized differentiation program compared with HAT-7 cultured alone. Consistently, our pilot in vivo studies show that enamel- and dentin-like tissues are formed in vivo only upon concomitant HAT-7 and DPSC co-seeding. HAT-7 or DPSCs seeded alone failed to form dental-like tissues.

**Conclusion:** The optimized lipid-based system for TBX-1 delivery together with epithelial-mesenchymal co-culture 3D hydrogel systems may provide optimal conditions for enamel regeneration.

**Keywords:** Enamel regeneration, gene delivery, tissue engineering, 3D printing

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 81. Polyphenols in lentil seed coats: antioxidants and iron chelators

**Presenter: Fatma M. Elessawy**

Collaborators: Albert Vandenberg

College of Pharmacy and Nutrition

Supervisor(s): Randy Purves, and Anas El-Aneed

**Background:** Lentil gained importance in Canada for their rich content of proteins, fibers, minerals and polyphenols. Polyphenols are a diverse family of plant secondary metabolites. They can be used in various applications in industry and medicine, especially as antioxidants. Moreover, it was found that polyphenols bind to iron to prevent nuclear DNA damage in human cancer cells. However, some polyphenols specifically chelate iron and prevent its absorption in the duodenum. Accordingly, polyphenols are double-faced compounds and their structure and concentration should be taken into consideration to know what effect they would exert. Although colored lentil seed coats are a valuable source for polyphenols, these seed coats tend to have a relatively low market value and diverted into animal feed products. Although lentil seed coats could represent a potential source to obtain beneficial polyphenols in high quantities, there is limited information about polyphenol types and concentrations in seed coats and its correlation to antioxidant and iron chelation capabilities. This study aims at analyzing polyphenols of seed coat extracts from four different lentil seed coats and estimating their antioxidant and iron chelation capacities.

**Methods:** Polyphenol extraction procedure is simple and fast which involves mixing 70% acetone with the pulverized seed coats for one hour, followed by centrifugation, taking the supernatant and drying it down. Dried-down extracts were reconstituted in 10% methanol to be ready for further analysis. Liquid chromatography (LC) coupled to mass spectrometry (MS) was applied for semi-quantitative analysis of polyphenols. DPPH (2,2-diphenyl-1-picrylhydrazyl radical) and ferrozine assays are used for measuring antioxidant and iron chelation capabilities, respectively

**Results:** LC–MS semi-quantitative analysis of 98 polyphenols showed that the major polyphenol subclasses among different seed coat colors were anthocyanins, dihydroflavonols, flavones, flavonols, hydroxybenzoic and hydroxycinnamic acids, stilbenes, procyanidins and flavan-3ols. Delphindin-3- $\beta$ -D-glucoside, robinin, kaempferol dirutinoside, luteolin, luteolin-4'-O-glucoside, vanillic acid-4- $\beta$ -D-glucoside, vanillic acid, 4-hydroxybenzoic acid, (+)-catechin, catechin-3-O-glucoside, (-)-gallocatechin, procyanidin B1, B3 and C1 are the major polyphenols found in lentil seed coat extracts. Black, brown and green lentil seed coats showed similar content of procyanidins, but anthocyanins were only found in the black seed coats. Although black, brown and green lentil seed coats showed different contents of flavan-3-ols, flavonols, they showed similar antioxidant and iron chelation capabilities.

**Conclusion:** Different seed coat colors of lentil showed similar profiles for the major polyphenol classes investigated. As expected, the polyphenol profile of the white (low-tannin) seed coat extract showed the lowest levels of polyphenols. Black, green and brown seed coats showed similar antioxidant and iron chelation capabilities. Moreover, improved knowledge on the polyphenol concentrations in lentil seed coat varieties might help in guiding breeders to improve the quality of the lentil seed coats by increasing the content of favorable polyphenols.

**Keywords:** polyphenols, lentil, DPPH, ferrozine, antioxidant capacity, iron chelation capability

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 82. Neonatal Pig Testis Stem Cells Produce Bone Matrix Under In Vitro Osteogenic Conditions

**Presenter: Gustavo dos Santos Rosa**

Western College of Veterinary Medicine

Supervisor(s): Ali Honaramooz

**Background:** Given the teratogenic potential of embryonic stem (ES) cells and induced pluripotent stem (iPS) cells for cell therapy applications, alternative sources of pluripotent cells are desirable, especially in non-rodent animal models. Gonocytes are progenitors of spermatogonial stem cells in the neonatal testes. We have shown that once cultured, gonocytes can spontaneously develop large colonies that express both germ- and pluripotent cell markers, and thereby may provide a safer alternative source for stem cell research. The aim of the present study was to evaluate the osteogenic potential of gonocyte colonies.

**Methods:** Testis cells containing ~40% gonocytes from 1-wk-old piglets were cultured in DMEM+10%FBS for 2-4 wk before being subjected to either the same media as control group (CG) or differentiation media group (DG) for an additional 2 wk. The control and StemPro Osteogenic Differentiation media were changed every 3 days. On the day of analysis, the number and diameter of gonocyte colonies were calculated before staining with 2% Alizarin Red solution to identify calcium deposits.

**Results:** Gonocyte colonies in CG had a typical light-colored appearance, while those in DG had a more compact appearance with a dark center. The number of colonies did not differ between the groups ( $P=0.56$ ), but the diameters of DG colonies were 24% greater ( $P=0.003$ ). All DG colonies showed hydroxyapatite deposits as confirmed by the positive Alizarin Red staining while none of the CG colonies showed this staining. No differences in the extent of differentiation were observed between the cultures induced after the initial 2 or 4 wk of culture, indicating that the osteogenic potential of gonocytes is maintained even after a month of in vitro culture.

**Conclusion:** These results provide important proof-of-principle that gonocytes have multipotential to substantiate subsequent studies using them in bone regeneration research.

**Keywords:** cell differentiation, hydroxyapatite, osteoblast.

## 83. ARE ALL HONEY BEE CASTES AFFECTED EQUALLY BY EXPOSURE TO THIAMETHOXAM DURING LATE LARVAL DEVELOPMENT?

**Presenter: Ivanna Kozii**

Collaborators: S.C. Wood, C.D. Klein, R. de C.M. Silva, C. I.O. Fabela, C. Folkes, I. Dvilyuk, I. M. de Mattos, L. Guillemin, and M. Ferrari

Western College of Veterinary Medicine

Supervisor(s): Elemir Simko

**Background:** Honey bees provide essential pollination services and a number of products used in many industries (food, pharmaceuticals, dentistry, cosmetics, etc.). Out of the three honey bee castes (workers, drones, queen) workers are the most numerous and are extensively used in toxicity assays. As workers are non-reproductively active, their evaluation alone may overlook potential toxic effects on bee reproduction. However, a number of environmental contaminants were already shown to decrease

reproductive potential of the honey bee drones and queens. The objective of this study was to evaluate if the honey bee casts were affected equally by exposure to a neonicotinoid insecticide thiamethoxam (THI) during late larval exposure.

**Methods:** Five honey bee colonies were manipulated to produce synchronized age of worker, drone and queen brood. Larvae of each caste were exposed to one of 4 experimental treatments 1 day prior to capping (worker – day 8, drone – day 10, queen – day 7 of development from oviposition). The treatments consisted of 4  $\mu$ l of double distilled water containing 0, 5, 50, or 100ng of THI. Post treatment capping, eclosion, and emergence weights were recorded for all casts. Drone and worker post emergence survival was monitored in the laboratory conditions.

**Results:** Emergence rate in THI100 group was 26.7% and 84.26% for queens and workers, respectively, but was not affected in drones. The emergence weights were significantly decreased in drones and workers exposed to THI100 and workers exposed to THI50 but not in queens. No treatment effects were observed on drone and worker survival in laboratory conditions.

**Conclusion:** The results of our study may suggest that honey bee castes are not equally susceptible/resistant to THI during late larval stages.

**Keywords:** Honey bee cast, survival, neonicotinoid, queen, drone

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 84. Utilization of Ultrasound Biomicroscopy (UBM) as a Non-invasive Tool to Monitor the Development of Xenogeneic Testis Tissue Grafts and Cell Implants

**Presenter: Mohammad Amin Fayaz**

Collaborators: Awang Hazmi Awang-Junaidi, Jaswant Singh, Ali Honaramooz

Western College of Veterinary Medicine

Supervisor(s): Ali Honaramooz

**Background:** Xenogeneic grafting of neonatal testis tissue fragments and implantation of testis cell aggregates under the back skin of recipient mice can be used as unique in-vivo models to study testis development, spermatogenesis, and steroidogenesis. The present study was designed to use ultrasound biomicroscopy (UBM) for non-invasive monitoring of testis tissue grafts and cell implants over a 6-month period.

**Methods:** Testis tissue fragments (~5 cubic millimeter, each) and cell aggregates (100 million cells, each) from 1-wk-old donor piglets (n=30) were grafted/implanted under the back skin of immunodeficient mice (n=6) in 8 analogous sites per mouse; 4 grafts on one side of the midline and 4 cell implants on the other. Three-dimensional transcutaneous Doppler UBM was performed and a randomly-selected graft (n=3) and its corresponding implant (n=3) were retrieved at 2, 4, 6, 8, 16, and 24 wk, and examined physically and histologically.

**Results:** The UBM-measured volume of both tissue grafts and cell implants increased over time but the growth patterns differed (time\*sample type, P=0.04). Likewise, the physical volume and the weight of samples increased over time (P<0.001 for both). Both UBM measurements of testis cord development (cordal) and non-cordal areas, corresponding with differing echogenic layers, increased over time (P<0.001 for both). Similarly, in the largest histological cross-sections, the relative size of cordal and non-

cordal areas increased over time ( $P=0.03$  and  $P<0.001$ , respectively). Additionally, gradual encapsulation, neovascularization, and testicular tissue formation in grafts and implants were observed through UBM examinations.

**Conclusion:** In conclusion, UBM can be used for non-invasive, high-resolution, and reliable quantification of long-term developmental changes in testis tissue grafts and cell implants. This can lead to a potential reduction in the number of recipient mice in time-course experiments by using the same group of animals over time with increased precision of measurements and less biological variation.

**Keywords:** Ultrasonography, Testicular tissue xenografting, Testis cell implantation, Testicular development, Male reproduction

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 85. Determining mechanism of glycogen utilization and comparison among Gardnerella species

**Presenter: Pashupati Bhandari**

Western College of Veterinary Medicine

Supervisor(s): Janet E. Hill

**Background:** Gardnerella vaginalis is one of the common bacteria associated with bacterial vaginosis, a dysbiosis of human vaginal microbiome. Glycogen is a major carbon source available to vaginal microbiota, and it is breakdown into smaller products (maltose, maltotriose and maltodextrins), by the action of amylase enzyme. Earlier, we found that G. vaginalis has an extracellular  $\alpha$ -amylase enzyme that can breakdown glycogen and some strains are able to utilize maltose, a major breakdown product. We do not know if Gardnerella can utilize maltotriose. Phylogenetic analysis of amylase protein sequences from 26 Gardnerella isolates shows a cluster containing sequences from all 26 isolates suggesting this protein might have a role in amylase activity. We aim to clone a gene encoding this enzyme to see if this enzyme actually shows an amylase activity. Competition for glycogen and its breakdown products may be a key factor in determining microbial community structure in vaginal microbiome.

**Methods:** Growth curve experiments were performed on 13 G. vaginalis strains to test their ability to utilize maltotriose in NYC III broth with and without 2% maltotriose. A gene predicted to encode an extracellular amylase from G. vaginalis was cloned and expressed in E. coli and protein was purified.

**Results:** Most tested isolates (11/13) were able to utilize maltotriose, a glycogen breakdown product. Cloned, expressed and purified amylase enzyme is able to break down the starch.

**Conclusion:** Maltotriose utilization was not subgroup specific in G. vaginalis and purified enzyme showed amylase activity on starch substrate.

**Keywords:** Amylase, Bacterial vaginosis, Glycogen, Maltotriose

## 86. Identification of Biomarkers for Vaccine Responsiveness through Kinomic Analysis

**Presenter: Sean Lipsit**

College of Medicine

Supervisor(s): Scott Napper

**Background:** Vaccination is one of the most effective means of managing infectious diseases to protect human and animal health. However, individuals who fail to mount a protective immune response become susceptible to infection, allowing the disease to proliferate. We hypothesize that characterization of the immediate kinase-mediated signaling events that occur prior to vaccination will help understand the polygenic, multicellular phenotype of vaccine-induced immune responses. Understanding differences in kinase events between individuals that generate an immune response and those that do not may offer insight into a novel method of detecting vaccine non-responders in a population.

**Methods:** We conducted kinome analysis on PBMCs of pigs (n=120) before and after vaccination against *Mycoplasma hyopneumoniae*. We then employed principal component analysis (PCA) to visualize variation within data-sets and identify variables (peptide phosphorylation) capable of discerning animals considered 'high' and 'low' immune responders, based on specific-antibody titer. Finally, we used a fluorescent microsphere immunoassay to analyze cytokine concentrations in pre-vaccinate samples to detect differences in cytokine signaling prior to vaccination.

**Results:** PCA plots sufficiently separated pre-vaccination samples of high titer (2201-20821) and low titer (82-437) animals suggesting differences before vaccination in high responders (HR) and low responders (LR) are detectable through phosphorylation events. Comparisons of kinome profiles of HR (n=10) and LR (n=13) based on pre-vaccination (Day 0) and post-vaccination (Day 2/Day 6), showed differential phosphorylation of 75, 83, and 47 peptides respectively (p<0.05). Pathway analysis of consistently differentially phosphorylated peptides indicated differences in 'Interleukin signaling' and 'JAK-STAT signaling'. Cytokine analysis of high and low responders suggested increased plasma IFN $\gamma$  in LR compared to HR (p=0.069) before vaccination.

**Conclusion:** Here, we classified pigs as high and low responders based on vaccine-induced antibody responses. Using blood samples of animals prior to vaccination, we detected significant changes in phosphorylation of peptides at three time-points that suggested differences in cytokine signaling. Increased IFN $\gamma$  in low responders approached statistical significance and will be further verified in an independent population.

**Keywords:** Vaccine Response, Biomarker, Kinome

## 87. The Effects of Fatigue on the Cross-Education of Skill

**Presenter: Annika Streilein**

Collaborators: J. W. Andrushko, D. W. Renshaw, L.A. Glead

College of Kinesiology

Supervisor(s): Jonathan P. Farthing

**Background:** Cross education (CE) is a phenomenon whereby performance improvements occur in the untrained limb after unilateral skill or strength training. Unilateral fatiguing exercise has been shown to

decrease inhibition in both sides of the brain, which may be relevant for CE paradigms. The purpose of this study was to examine if fatiguing exercise prior to unilateral skill training would enhance CE of skill to the untrained limb.

**Methods:** Eight participants were randomized into a non-fatigue (n=4) and fatigue group (n=4) before skill training of the right hand (force target matching task). The fatigue group performed a 1-minute fatiguing contraction on their left hand prior to training the right hand, whereas the non-fatigue group performed a light non-fatiguing contraction. After baseline testing, participants completed four consecutive days of training before post-testing (day 7) and retention testing (day 14). Measurements of task performance, maximal grip force and electromyography recordings of evoked volitional waves (an indirect measure of descending neural drive) were collected for both the right and left hand at each testing occasion (baseline, day 7, day 14).

**Results:** Both groups significantly improved task performance (reduced cumulative error) at day 7 for the trained right (19%) and untrained left limb (26%;  $p=0.047$ ,  $Np2=.400$ ), with no significant difference between groups. Maximal grip force improved significantly in both hands for the fatigue group only ( $p=.036$   $Np2 = 0.494$ ). Preliminary analysis of volitional waves showed no significant change for either arm or either group at day 7 and day 14.

**Conclusion:** Cross education was evident in both the fatigue and non-fatigue groups; however, contrary to the hypothesis, fatigue did not alter the magnitude of skill transfer.

**Keywords:** Cross-education, skill transfer, fatigue, inhibition.

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 88. Respiratory viruses identified in western Canadian beef cattle by metagenomic sequencing and their association with bovine respiratory disease

**Presenter: Maodong Zhang**

Collaborators: Trevor W. Alexander, Edouard Timsit, Frank van der Meer  
Western College of Veterinary Medicine  
Supervisor(s): Yanyun Huang, Janet E. Hill

**Background:** High throughput sequencing (HTS) promises to become a potential technology to detect infectious agents widely in an agent-independent manner. HTS has many advantages not only in identification of non-culturable or difficult-to-culture organisms, or completely a novel and a variant of a known pathogen, but also strengthens our understanding of infectious diseases via pathogen candidate discovery, vaccine development, drug resistance and pathogen variability and genotyping. Focusing on viral exploration will lead us to understand the role of newly discovered viruses and virus variability in infectious diseases. One of the application area of HTS is bovine respiratory disease (BRD). BRD causes significant economic losses in western Canada despite viral vaccination and massive antimicrobial treatment. The pathogenesis involves interactions between bacteria, viruses, environment and management factors. Primary viral infection can greatly increase susceptibility of beef cattle to bacterial infection, and is thus a vital part of BRD pathogenesis. The objective of this study was to establish the method of detecting various viruses simultaneously and use metagenomic sequencing to characterize the respiratory viromes of paired nasal swabs and tracheal washes from western Canadian feedlot cattle, with or without BRD.

**Methods:** A total of 116 cattle (116 nasal swabs and 116 tracheal washes) from 4 feedlots categorized into 2 groups were enrolled in this study. After DNA and RNA extraction and library preparation, the samples were sequenced on MiSeq and subsequent bioinformatic analysis was performed in-house.

**Results:** Influenza D virus (IDV), bovine rhinitis B virus (BRBV), bovine respiratory syncytial virus (BRSV) and bovine coronavirus (BCV) showed significant association with BRD. There was a statistical trend between the presence of BRAV and BRD. Furthermore, the presence of at least one of the following viruses - IDV, BRAV, BRBV, BRSV and BCV – was used as a dichotomous variable for analysis and showed significant association with BRD. The agreements of the identification of viruses between nasal swabs and tracheal washes were generally slight to moderate. IDV, BRBV and BRAV were mainly identified in nasal swabs. In contrast, the majority of BRSV was identified in tracheal washes, while BCV was identified in both nasal and tracheal regions. BRBV and BRSV were present in all four feedlots and each feedlot had at least two of the five viruses described above that were associated with BRD.

**Conclusion:** 1. Successfully established the method to detect various viruses simultaneously using MiSeq. 2. There are several viruses associated with BRD in the current data set (IDV, BRAV, BRBV, BRSV, BCV). 3. Further studies needed to understand the roles of these viruses (especially IDV) in BRD -- Diagnostic assays will be developed for these viruses.

**Keywords:** virome, bovine respiratory disease, metagenomic sequencing

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## **Clinical 2**

### 89. Cannabis and Multiple Sclerosis: A Systematic Review Examining Utilization and Effectiveness

**Presenter: Natasha Breward**

Collaborators: Nafisa Absher, Katherine Knox

College of Pharmacy and Nutrition

Supervisor(s): Charity Evans, and Jane Alcorn

**Background:** Several pharmaceutical options exist for the management of multiple sclerosis (MS) and its associated symptoms. Some individuals with MS utilize Cannabis to help manage their symptoms. Cannabinoid use in MS animal models have shown promise, and currently one formulation of Cannabis (Sativex®) has Health Canada approval as an adjunct treatment option for MS-related pain. Health Canada also allows access to dried Cannabis for medical reasons, including MS, when supported by a prescribing physician. Evidence supporting the indication(s) for Cannabis in MS is rapidly evolving and highly relevant to clinical practice.

**Methods:** Medline, Embase, and International Pharmaceutical Abstracts were searched for articles related to MS and CBM in February 2018. All human studies, with outcomes specific to MS, and published in English were eligible for inclusion. There was no publication year limit and no restrictions based on study design. Articles were screened independently by two reviewers, first by title and then by abstract. Two reviewers then independently performed data extraction on all included articles, and a quality assessment using a modified Downs and Black assessment tool. Included articles were categorized by their primary outcome into the following categories: spasticity, tremor, pain, cognition, balance/walking, bladder dysfunction, general symptoms, adverse events/safety, or disease progression. Reporting follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

**Results:** After removal of duplicates, 2058 articles were identified, with 60 studies meeting the inclusion criteria. Twenty-six articles were randomized controlled studies, and 34 utilized a non-randomized study design. Cannabidiol and delta-9-tetrahydrocannabinol oromucosal spray (Sativex) was the most commonly studied CBM for MS. The dose size and frequency of administration between studies was inconsistent. Spasticity was the most common symptom to be treated with CBM (n=29), followed by pain (n=9) and cognition (n=7). Twenty-two studies were considered to be poor quality, 14 were fair quality, and 24 were good/excellent quality. CBM treatment showed a trend of reducing spasticity, pain, and balance/walking difficulties in individuals with MS. Side effects were minimal and CBM was well tolerated; however dried Cannabis appeared to be associated with decreased cognitive function.

**Conclusion:** Our initial examinations suggest modest evidence of benefit of CBM for the management of MS, with few serious adverse effects. However, the variable quality of the evidence requires consideration when examining results of individual studies.

**Keywords:** multiple sclerosis, cannabis, cannabis-based medicine, symptom management, spasticity, pain

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 90. R&D of novel MRI-safe physical activity simulator for gait alterations experimental assessment

**Presenter: Alvaro Espinosa**

Collaborators: James (J.D.) Johnston, Allan T. Dolovich

College of Engineering

Supervisor(s): Emily J. McWalter

**Background:** Osteoarthritis (OA) is a debilitating joint disease most commonly affecting the knee. The disease is characterized by articular cartilage breakdown, high pain and limited mobility. There is no known cure and OA is not detected after significant cartilage damage. Quantitative magnetic resonance imaging (qMRI) is a non-invasive technique that can assess articular cartilage biochemical content and mechanical integrity at an early disease stage, which is key for more successful treatment. Preliminary studies of T2 and T1 $\rho$  relaxation times (qMRI metrics) have shown correlations with cartilage and meniscus health condition. However, most studies are carried out in unloaded in-vivo knees or in ex-vivo knees under simplified (axial) loading. Since mechanical loading contributes to OA progression, it is important to study knee soft tissue structure under true physiological loading. Hence, the objective of this research is to assess the effects of loading inter-subject variability on tissue deformation and structure throughout the entire walking cycle (stance and swing).

**Methods:** Regarding system development, key design criteria included: MRI-compatible materials (minimum non-ferromagnetic metals), space constraints due to MR scanner bore (0.45m max diameter), keeping the knee capsule intact to emulate the in-vivo knee, and applying constant loads (not constant displacements) due to soft tissue viscoelasticity. Physically realistic loading (used for design purposes and mechanical testing) was determined using data from musculoskeletal modelling (OpenSim, <https://opensim.stanford.edu/>), instrumented implants (OrthoLoad, <http://orthoload.com>) and a custom software (MATLAB, the Mathworks, Natick, MA) to simulate internal knee joint loads for walking. For mechanical testing and imaging, cadaveric knee joints will be obtained from an anatomical tissue bank. Knees will be placed in the custom, MRI-safe, materials testing system, which loads the joint at different angles (e.g., extended, flexed) corresponding to different gait time-points according to its companion software. Knee joints will be imaged unloaded at 0° and loaded at 0°, 15°, 30° and 60° of flexion; loads will correspond to normal gait average profiles and perturbations within the healthy variability bounds. Commercial segmentation software (Analyze, <https://analyzedirect.com/>) will be used to define bone, cartilage, menisci, and ligaments geometry, which will serve as geometrical inputs for another custom code (MATLAB), which will measure deformation and contact characteristics. This mechanical response will be then related to qMRI parameters.

**Results:** Both loading rig and companion software have been developed, which allowed determining the system settings to deliver the mean loading regime for a 100kg subject. In terms of operation, a statically-equivalent multiaxial loading scenario is achieved by tensile/compressive actuators and cables oriented in different directions, the rig actuators are powered by a pneumatic compressor, and torques are applied via force offsets. Next steps include determining the gait variability range in joint loads, calibrating and testing the device, and conducting the mechanical testing, imaging, and image processing.

**Conclusion:** The final design, unlike other loading rigs or in-vivo setups, can provide more realistic loading conditions without complex controls systems, while still allowing qMRI. This study will further characterize the sensitivity of gait alterations in joint loading, which will improve our understanding of loading, function and structure in healthy soft tissues, which has important implications for

understanding and later predicting OA. Ultimately, this research will help us better treat degenerative joint diseases!

**Keywords:** Osteoarthritis (OA), magnetic resonance imaging (MRI), knee soft tissue, gait, design

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 91. Improvement of Radiofrequency Ablation in Liver Cancer: Cellular Uptake of Gold Nanoparticles in Cellular Model

**Presenter: Amelie Guiho**

Collaborators: Deborah Michel, Ildiko Badea, Geoff Sweatman, and Katlin Mallette

College of Pharmacy and Nutrition

Supervisor(s): Ildiko Badea

**Background:** The overall goal is to use biocompatible gold nanoparticles (NPs) to improve radiofrequency ablation (RFA) by controlled and uniform heating of large tumour masses. NPs preferentially target and accumulate in solid tumours, therefore should increase the selectivity of RFA, sparing the nearby healthy tissue. Our objective was to investigate the correlation between properties of the nanogold (size and surface characteristics) and its cellular internalization. In addition, the intrinsic toxicity was also evaluated.

**Methods:** Gold nanoparticles of various diameters (20, 50 and 100nm) with or without poly-l-lysine coating were tested in monolayer of hepatocellular carcinoma model (Hep2G cell line). Cellular toxicity of NPs was evaluated by MTT, a colorimetric assay for assessing cell metabolic activity. Cellular uptake was determined by flow cytometry measuring the change internal cellular complexity, while transmission electron microscopy (TEM) was used to confirm cellular internalization and to map the intercellular distribution of the manifold.

**Results:** Low level of toxicity was detected in the highest concentrations (20 nm at  $3.27E11$  nanoparticle/mL, 50 nm at  $1.75E10$  nanoparticle/mL and 100 nm at  $3.8E9$  nanoparticles/mL) of the nanoparticles. Cells treated with non-coated NPs had a small shift in internal complexity after treatment with various nanoparticle size and concentrations with an average of 60 to 70 absorbance units. On the other hand, the shift in light scattering was greater than 200 absorbance units when cells were treated lysine-coated NPs with the highest concentrations (20 nm at  $3.27E11$  nanoparticle/mL, 50 nm at  $1.75E10$  nanoparticle/mL and 100 nm at  $3.8E9$  nanoparticles/mL) provided the best cellular uptake.

**Conclusion:** Our results demonstrated that poly-l-lysine coating improved cellular uptake in HepG2 cells indicating the potential to be employed for enhancement of RFA.

**Keywords:** Gold nanoparticles Radiofrequency ablation TEM MTT Flow cytometry

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 92. Effects of Home-Based Exercise Training on Post-Exercise Peripheral Muscle Oxygenation in Children with Congenital Heart Disease

**Presenter: Dana Lahti**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** A hallmark feature of children with congenital heart disease (CHD) is exercise intolerance, along with slow post-exercise muscle oxygenation recovery. Exercise rehabilitation programs have been shown to improve peak  $\dot{V}O_2$  in children with CHD; however, exercise tolerance is still limited compared to healthy matched controls. Whether exercise training improves post-exercise recovery of muscle oxygenation (as measured by tissue oxygenation index, TOI) in children with CHD compared to healthy children is unknown. **PURPOSE:** To determine whether a 12-week home-based exercise intervention can improve post-exercise TOI response after peak exercise in children with CHD compared to controls.

**Methods:** Eight children with CHD (f/m = 4/4; mean  $\pm$  SD age: 12  $\pm$  2 yrs) with simple and complex lesions and seven healthy controls (f/m = 3/4; age: 12  $\pm$  3 yrs) were studied. Children with CHD completed a home-based exercise program 3 times/week for 12 weeks, in addition to 6 biweekly in-person sessions. Exercise tolerance was assessed with peak  $\dot{V}O_2$  testing to volitional fatigue on a cycle ergometer, followed by 4 minutes of 20-W recovery. Vastus lateralis TOI was continuously sampled during exercise and recovery via near-infrared spectroscopy. Post-exercise TOI recovery data was normalized from 0% (end-exercise) to 100% (4 min post-exercise) and data analyzed at set time points to characterize TOI time course changes (0s, 15s, 30s, 60s, 90s, 120s, 180s and 240s). Pre vs. post training changes in TOI were analyzed using paired t-tests. Significance was accepted when  $P < 0.05$ .

**Results:** Post-exercise TOI was significantly lower in CHD pre-training compared to controls at 15s (9  $\pm$  9 vs. 27  $\pm$  16%;  $P = 0.018$ ) and 30s (32  $\pm$  17 vs. 72  $\pm$  35%;  $P = 0.012$ ). Similarly, post-exercise TOI in CHD after exercise training was significantly lower than controls at 15s (9  $\pm$  7 vs. 27  $\pm$  16%;  $P = 0.014$ ) and 30s (36  $\pm$  22 vs. 72  $\pm$  35%;  $P = 0.030$ ).

**Conclusion:** Excessive post-exercise impairment in TOI recovery persists after home-based exercise in children with CHD compared to controls.

**Keywords:** Congenital Heart Disease Muscle Oxygenation Exercise Intolerance

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 93. Precision Oral Oncology and Chronotherapy

**Presenter: Farinaz Ketabat**

Collaborators: Daniel Chen, Mohammad Ayman, and Liubov Lobanova

College of Dentistry

Supervisor(s): Silvana Papagerakis, and Petros Papagerakis

**Background:** Head and neck squamous cell carcinomas (HNSCC) is the sixth most common cancer worldwide, and approximately 650,000 patients are diagnosed every year. Recently, human papilloma virus (HPV) is recognized as an ethio-pathogenic factor for HNSCC development. First line of treatment for advanced HNSCC is surgery and/or radiotherapy followed by chemotherapy as an adjunct therapy. Despite considerable efforts to improve treatment modalities of HNSCC, conventional methods still suffer from

serious drawbacks. Novel therapeutic approaches to preserve the organ function and enhance patient survival are needed. We aim to design and validate innovative chrono-modulated drug delivery strategies that will ensure timely drug release tailored to patient' individual circadian (24 hours) rhythms to optimize targeted therapeutic efficacy at cellular and molecular levels while improving drug metabolism and minimizing cytotoxicity.

**Methods:** First, the circadian clock system characteristics are being evaluated in primary HPV-positive and HPV-negative HNSCC cell lines using qRT-PCR, flow cytometry and western-blot in addition to transfection with a circadian clock luciferase reporter and measurements of circadian activity. Second, different delivery systems and combination of drugs will be tested in vitro, to ensure that the degradation time of delivery system is optimally adjusted according to different parameters. After optimizing the delivery system and the release rate, the drug loaded nanoparticles are being injected into tumors developed in our HNSCC experimental mice models to further optimize our therapeutic approaches.

**Results:** Circadian clock disruption plays a key role in HNSCC pathogenesis and disease outcome. Design of a rhythmic drug release according to the circadian profile of each patient are critical to improve therapeutic efficiency and patient survival. This approach may lead to personalized therapeutic approaches that take in consideration the level and extend of circadian clock disruption to a given patient. Novel therapeutic approaches tailored on the individual unique profile are much needed for precision health care.

**Keywords:** Head and neck cancer, Precision oral oncology, Clock genes, Circadian disruption, Chronotherapy, Controlled drug delivery

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 94. Development of a non-invasive biosensor for diagnosis and monitoring of circadian rhythm disruption in sleep disorders and beyond

**Presenter: Meenakshi Pundir**

Collaborators: Eric Harderic, Nishant Jalgaonkar, and Nikolaos Chronis

College of Dentistry

Supervisor(s): Petros Papagerakis, Daniel Chen, Silvana Papagerakis, and Liubov Lobanova

**Background:** Irregular sleep and sleep deprivation are the outcomes of circadian rhythm disruptions and circadian rhythm sleep disorders (CRSD). According to the USA National Institute of Neurological Disorders and Stroke, each year at least 40 million Americans suffer from chronic, long-term sleep disorders, and an additional 20 million people experience occasional sleeping problems. CRSDs dramatically interfere with work and social life and also are major determinants of almost any other disease such as psychiatric disorders (mood, anxiety, and panic disorders), metabolic disorders, cardiovascular diseases (CVD), and autoimmune diseases (diabetes) adding to the worsening of the overall patient well-being status. Treatment of only the CRSDs costs an estimated \$16 billion in medical bills each year, while the indirect costs due to lost productivity and other factors add another \$50 to \$100 billion per year. In addition to these costs, indirect health issues related to associated diseases further increase health spending. Diagnosis of CRSDs currently involves saliva sample collection every 30-60 minutes over 24 hours in a hospital setting and detection of Dim Light Melatonin Onset (DLMO) in a specialized laboratory which is

expensive and cumbersome. Our aim is to develop and validate novel approaches for DLMO detection in saliva.

**Methods:** An intra-oral device that collects saliva at different time points is designed and fabricated by 3D printing. A traditional antibody-based ELISA is being used for measuring salivary melatonin. For the future, ELISA-PCR will be established in our lab for faster and improved sensitivity which could enhance diagnostic time and quality. Future developments of our intra-oral device also include real-time colorimetric detection of salivary melatonin and other biomarkers using bilayer nanoparticles controlled release strategies comprising of antibodies and/or aptamers.

**Results:** Our device is being fabricated and tested in vitro for biocompatibility and cytotoxicity, saliva leakage, and preservation of melatonin over time at physiological conditions. Salivary melatonin levels are also being evaluated at different concentrations of artificial saliva using different detection methods.

**Conclusion:** The intra-oral device fabricated will provide easy collection of saliva in hourly intervals for a period of 24 hrs and will allow accurate measurement of melatonin. This will avoid 24-hour hospitalization of patients and will help to standardize diagnostic measurement of salivary melatonin. Additionally, early and specific detection of biomarkers for melatonin can lead to an effective administration of therapeutics such as light therapy and drugs in patients with sleep disorders as well as with sleep-related disorders/diseases.

**Keywords:** Circadian rhythm, Sleep disorder, melatonin, intra-oral device, ELISA, ELISA-PCR

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 95. Peak Exercise and Post-Exercise Recovery Oxygen Uptake and Muscle Oxygenation in Patients with Heart Failure and Preserved Ejection Fraction and Healthy Matched Adults

**Presenter: Natasha Boyes**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** Exercise intolerance and muscle dysfunction characterize heart failure with preserved ejection fraction (HFpEF). Exercise intolerance, as measured by low peak oxygen uptake (VO<sub>2</sub>), and slow post-exercise VO<sub>2</sub> recovery are predictors of mortality. The relationship between peak exercise and recovery VO<sub>2</sub> and muscle oxygenation is unknown in this population. Purpose: We tested the hypothesis that post-exercise VO<sub>2</sub> recovery would be slower in patients with HFpEF compared to controls, and that slower post-exercise VO<sub>2</sub> recovery would be related to slower muscle oxygenation recovery in patients with HFpEF.

**Methods:** Eight patients with HFpEF and 8 healthy age- and sex-matched controls completed a stationary cycling peak exercise test to volitional fatigue followed by 5-min of passive recovery. Pulmonary VO<sub>2</sub> (gas exchange via metabolic cart) and muscle oxygenation (tissue muscle oxygenation index, TOI) and deoxygenated hemoglobin (HHb via near infrared spectroscopy) were sampled continuously during the exercise test and recovery. Breath-by-breath VO<sub>2</sub> data were linearly interpolated to 1-s intervals, and both VO<sub>2</sub> and NIRS data were averaged into 5-s time bins. VO<sub>2</sub> recovery data were mono-exponentially curve-fitted (OriginPro, 2017) to yield a recovery time constant (tau) and amplitude change. TOI and HHb at end-exercise, end-recovery, and the amplitude change were calculated as 10-s averages. Statistical

analyses included independent t-tests and stepwise multiple regression. Significance was accepted at  $P < 0.05$ .

**Results:** Peak  $\text{VO}_2$  ( $15.8 \pm 5.9$  vs.  $24.6 \pm 6.6$  mL/kg/min,  $P=0.011$ ) and  $\text{VO}_2$  recovery amplitude ( $-10.0 \pm 4.9$  vs.  $-15.1 \pm 4.2$  mL/kg/min,  $P=0.041$ ) were significantly lower in patients with HFpEF compared to matched controls. However, there were no differences between groups in  $\text{VO}_2$  recovery tau ( $98 \pm 43$  vs.  $71 \pm 16$  s,  $P=0.122$ ) nor in any TOI or HHb parameter (all  $P > 0.05$ ). Stepwise regression by group to predict peak  $\text{VO}_2$  yielded a positive regression using both peak-exercise HHb and  $\text{VO}_2$  recovery amplitude in HFpEF ( $R^2=0.957$ ,  $P < 0.001$ ) but only  $\text{VO}_2$  recovery amplitude in controls ( $R^2=0.947$ ,  $P < 0.001$ ). The same parameters predicted  $\text{VO}_2$  recovery tau in HFpEF ( $R^2=0.940$ ,  $P=0.001$ ) with no significant finding in controls ( $P > 0.05$ ).

**Conclusion:** Slower post-exercise  $\text{VO}_2$  recovery in patients with HFpEF compared to their healthy counterparts was not confirmed with these data, although this may be largely influenced by the elevated variance in the HFpEF group, or the mild-moderate HFpEF severity. Regression analyses suggest that the level of muscle deoxygenation, i.e., the level of  $\text{O}_2$  extraction, during peak exercise may be a more important contributor to peak  $\text{VO}_2$  in patients with HFpEF compared to their healthy counterparts. The latter may suggest a muscle-based limitation in HFpEF not observed in healthy controls.

**Keywords:** heart failure with preserved ejection fraction; integrative exercise physiology; post-exercise recovery; oxygen uptake; muscle oxygenation

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 96. Lower baroreflex sensitivity during muscle metaboreflex activation in children and adolescents with the Fontan circulation and single ventricle physiology

**Presenter: Ramlah Iqbal**

College of Kinesiology

Supervisor(s): Corey Tomczak

**Background:** Individuals with the Fontan circulation and single ventricle physiology have elevated sympathetic nerve activity at rest and during muscle metaboreflex activation that is consistent with autonomic dysfunction. Adults with the Fontan circulation also show reduced baroreflex sensitivity (BRS); however, there is limited understanding of BRS in children or adolescents with the Fontan circulation. In healthy adults, BRS decreases with increased sympathetic nerve activity during isometric handgrip exercise, but not during isolated muscle metaboreflex activation. The effect of handgrip exercise and muscle metaboreflex activation on BRS in children and adolescents with the Fontan circulation is currently unknown. **PURPOSE:** We tested the hypothesis that BRS is lower at rest and less responsive during handgrip exercise and post-exercise circulatory occlusion (PECO) in children/adolescents with the Fontan circulation compared to healthy controls.

**Methods:** **METHODS:** Eight children/adolescents with the Fontan circulation ( $12 \pm 2$  yrs; 3 males) and 8 healthy controls ( $13 \pm 4$  yrs; 5 males) were studied. Continuous heart rate (ECG) and non-invasive blood pressure (Finometer<sup>®</sup> MIDI) were recorded during 3-min of resting baseline, 2-min of isometric handgrip exercise at 30% of maximal voluntary contraction, and 3-min of PECO. Continuous heart rate, systolic blood pressure, and diastolic blood pressure signals were analyzed using the BRS Analysis software

(Nevrokard, Slovenia, 2018) to yield average BRS values during rest, handgrip, and PECO for each group. Differences between groups and across conditions were assessed using two-way repeated measures (2 × 3, group × condition) ANOVA. P<0.05 was considered significant.

**Results:** RESULTS: There was a significant group × condition interaction for BRS (P<0.001). BRS was lower in children/adolescents with the Fontan circulation vs. healthy controls at rest (13 ± 8 vs. 38 ± 10 ms/mmHg; P<0.001) and during PECO (18 ± 17 vs. 37 ± 18 ms/mmHg; P=0.044), but not during handgrip (13 ± 10 vs. 14 ± 6 ms/mmHg; P=0.843). BRS in children/adolescents with the Fontan circulation did not change across conditions (P=0.188).

**Conclusion:** CONCLUSION: Our findings suggest that BRS is lower at rest and has a blunted response during sympatho-excitation in children/adolescents with the Fontan circulation compared to healthy controls. Collectively, our findings indicate potential autonomic dysfunction in children/adolescents with the Fontan circulation.

**Keywords:** Lower baroreflex sensitivity, muscle metaboreflex, children and adolescents with the Fontan circulation

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 97. Indirect 3D bioprinting: the matter of poor printability of low concentration alginate scaffolds for nerve tissue engineering

**Presenter:** Saman Naghieh

Collaborators: MD Sarker, Emily Abelseth, and Xiongbiao Chen

College of Engineering

Supervisor(s): Daniel Chen

**Background:** Extrusion-based three-dimensional (3D) bioprinting techniques are widely used for tissue engineering applications. One of the challenges in 3D bioprinting, still to be further elucidated, is finding biomaterials that are printable and have appropriate biological and mechanical properties. Although low-concentration hydrogels have favorable properties, specifically for nerve tissue engineering, they have poor 3D printability. Poor printability means the materials cannot maintain the structure during the printing process. The key question is how to create low concentration hydrogel scaffolds knowing that these scaffolds have poor printability.

**Methods:** We hypothesized that an indirect-bioprinting process can address the poor printability of low-concentration hydrogel scaffolds. This indirect approach includes the fabrication of a temporary structure made of gelatin, the impregnation of the framework with low-concentration alginate (a natural hydrogel), and the removal of the gelatin framework. Fabricated scaffolds were characterized in terms of mechanical properties (compression test) and biological (cell viability) characteristics. For biological assessments, Schwann cells were either incorporated or seeded. In this study, 0.5% to 3% alginate scaffolds were fabricated and evaluated.

**Results:** Results showed low-concentration alginate scaffolds can be fabricated indirectly. In agreement with the hypothesis of this study, our results showed better cell functionality of scaffolds with a lower concentration of alginate than a higher concentration.

**Conclusion:** In conclusion, we proposed an indirect fabrication method to create low-concentration hydrogel scaffolds.

**Keywords:** 3D bioprinting, scaffold, tissue, nerve

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 98. Testing of a rehabilitation harness and breastplate to aid in rehabilitation of horses with ambulatory difficulties

**Presenter: Samantha Steinke**

College of Engineering

Supervisor(s): Julia Montgomery

**Background:** Limb injuries rarely result in death for humans, but for horses euthanasia is often necessary, which is a major welfare concern. Limb injuries in horses can be difficult to manage due to their large size and inappropriate loading of healthy limbs.

**Methods:** The first objective was to design a harness through evaluation of anatomical, physiological and behavioural parameters. The second objective is to test an instrumented breastplate measuring pressure, temperature and humidity.

**Results:** The harness prototype has been weight tested to 600kg and allowed for a 40% reduction of the horse's weight. Addition of an H-frame allowed for a 46% (140 of 301kg) reduction of weight on the forelimbs. An instrumented breastplate is currently under development to control the amount and duration of pressure on underlying tissues. The breastplate has been weight tested to 620kg, assessing the safety of its use. This fibreglass prototype is lined with silicone air pockets to alter pressure distribution through an inflation and deflation cycle, allowing blood flow to return to the skin. The breastplate is equipped with pressure, temperature and humidity sensors to monitor skin surface temperature, humidity and the amount of pressure on underlying tissue structures. Material testing and design modifications are underway. Once these are complete, testing will continue in live horses. Next steps include incorporation into the harness and ongoing prototype modifications.

**Conclusion:** The goal is development of a rehabilitation harness for use with a computer-controlled dynamic lift, supporting the weight of horses with ambulatory difficulties around their load bearing structures.

**Keywords:** biomechanics, equine, rehabilitation, musculoskeletal injuries, harness

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 99. Boys with Grip Force below the 50th Percentile Have 19% Lower Distal Radius Bone Strength

**Presenter: Yuwen Zheng**

College of Kinesiology

Supervisor(s): Saija Kontulainen, and James Johnston

**Background:** Grip strength has been associated with bone size and strength at the radius shaft in children. However, the role of grip strength in predicting variance in distal radius bone strength, specifically bone failure load and stiffness obtained from high-resolution imaging and finite element (FE) analysis, has not yet been reported. Our objectives were to test following hypotheses: (1) grip strength would independently predict distal radius bone failure load and stiffness at the distal radius in children; and (2) children with grip strength below the 50th percentile would have lower failure load and stiffness at the distal radius when compared to those with grip strength equal or above the 50th percentile.

**Methods:** We recruited 160 typically developing children (ages 7-14yrs) from local schools. We included 137 (75 girls) participants (mean age 10.5yrs, SD 1.8) with valid maximal grip strength (kg) measurement and high-resolution peripheral quantitative computed tomography (HR-pQCT) scans at the distal radius of dominant limb. We analyzed scans with manufacturer-provided FE software to obtain bone failure load (N) and stiffness (kN/mm). We tested Hypothesis #1 using hierarchical regression analyses to predict variance in failure load or stiffness by entering grip strength in the (base) model with forearm muscle area. We report change in model fit ( $\Delta R^2$ ) and standardized beta coefficient (std. $\beta$ ) for predictors. To address Hypothesis #2, participants were first categorized as having a grip strength <50th or  $\geq$ 50th percentile groups, based on Canadian grip strength reference values. We compared bone failure load and stiffness between groups using MANCOVA, adjusting for maturity in boys and body mass and forearm muscle area in girls.

**Results:** Grip strength improved model fit when included with muscle area to predict variance in failure load and stiffness in both boys and girls ( $\Delta R^2$ :0.03-0.15, std. $\beta$ : 0.29-0.48,  $p < 0.05$ ). Boys with a grip strength <50th percentile had 18% and 19% lower distal radius failure load and stiffness, respectively, than boys with the grip strength  $\geq$ 50th percentile group ( $p < 0.01$ ). In girls, there were no differences in failure load and stiffness between the groups.

**Conclusion:** Grip strength independently predicted distal radius failure load and stiffness in both boys and girls. Boys with grip strengths below the 50th percentile had, on average, 18-19% lower failure load and stiffness than their peers with grip strengths equal or above the 50th percentile of Canadian grip strength reference data.

**Keywords:** Children, Muscle strength, Bone strength

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 100. Effect of Environmental Enrichment on Disease Resilience and Measures of Welfare in Swine

**Presenter: Madelena Pedersen-Macnab**

Western College of Veterinary Medicine

Supervisor(s): Yolande Seddon

**Background:** Stress and disease are major causes of economic loss and welfare concern in hog production. Environmental enrichment may improve disease resilience and mitigate stress. This study explored the effect of point-source environmental enrichment objects on the behaviour, immune response and welfare of pigs.

**Methods:** nursery, remaining for 19 days, before transfer to a Natural Challenge Barn (NCB) with random assignment to enrichment and control treatments. The pigs were infected with a Porcine Reproductive and Respiratory Syndrome (PRRS) virus, with blood drawn pre- and post- pathogen exposure. This experiment aims to identify whether pigs raised with point-source enrichments differ in immune response, disease incidence and behaviour when compared to those raised in barren environments. Behavioural data will be analyzed from periodic video recordings, and Complete Blood Count data will be available to examine cellular immune responses in response to the disease challenge. Data for treatment and control groups can then be compared to determine if differences exist between groups.

**Results:** To examine these relationships, the study seeks to answer key questions: 1) Does the immune response to infection differ between pigs raised with enrichment and those raised in barren pens? 2) How does social behaviour differ between pigs raised with and without enrichment? 3) Do pigs raised in enriched environments differ in disease incidence and severity as measured by treatment use, growth and mortality when compared to those raised in barren pens? Data collection is ongoing, and as such final results are not yet available.

**Conclusion:** These results will provide information on how point-source enrichments impact the behavioural and immune response to disease in pigs. Along with measurements of disease incidence, vet treatments, mortality, growth and feed intake, this study will test if a relationship exists between provision of enrichment and disease resilience.

**Keywords:** Disease resilience, environmental enrichment, animal health, swine

**Self-assessment of research as interprofessional/interdisciplinary:** No

## **Social Population Health 2**

### 101. Cultural Determinants of Indigenous Peoples among Canada's Physical Activity

**Presenter: Avery Ironside**

Collaborators: Caitlyn Kirkpatrick

College of Kinesiology

Supervisor(s): Heather J.A. Foulds

**Background:** Cultural connectedness, a cultural factor unique to Indigenous history, is defined as a measure of attachment, sense of belonging, and group identification, and is a fundamental concept of human life. Many Indigenous peoples take a wholistic approach to health and well-being which includes cultural, social, mental, and physical aspects of health. Improved physical activity (PA) has been shown to attenuate the risk of many chronic diseases. As Indigenous populations experience elevated risks for chronic diseases, PA may be an ideal target for Indigenous health-related interventions. To date, the effect of cultural connectedness on PA among Indigenous populations remains unclear. The objective of this study is to examine the associations between cultural connectedness and PA among Indigenous populations.

**Methods:** This research study followed the methodologies outlined in Chapter 9 of the Tri-Council Policy Statement 2, while also using a decolonizing lens, taking a strength-based approach, and overseen by an Indigenous community advisory group. Participants were self-identified, Indigenous students, staff, and faculty on campus and were given the option of taking an online survey or interviewer administered survey. Two measures were used to identify cultural connectedness: the culturally generic Multigroup Ethnic Identity Measure which examines degrees of ethnic commitment, identity exploration, ethnic identity, identity search, affirmation, and belonging, and the Cultural Connectedness Scale which measures degrees of identity, traditions, and spirituality and was designed specifically for First Nations groups. Associations were evaluated among Métis, First Nations and Cree participants. Participants in each group were divided at the group mean into high and low physical activity groups. Independent t-tests were used to compare the cultural connectedness score means between the high and low physical activity participants of each Indigenous group.

**Results:** Data was collected from 121 participants. Among Métis participants, more physically active participants reported lower identity exploration ( $2.5 \pm 0.8$  vs.  $3.0 \pm 0.6$ ,  $p=0.04$ ), ethnic identity ( $2.4 \pm 0.8$  vs.  $2.9 \pm 0.6$ ,  $p=0.049$ ), cultural traditions ( $8.7 \pm 6.4$  vs.  $15.9 \pm 7.2$ ,  $p=0.01$ ), spirituality ( $12.1 \pm 6.6$  vs.  $18.1 \pm 5.7$ ,  $p=0.01$ ), and overall cultural connectedness ( $58.7 \pm 23.8$  vs.  $78.8 \pm 17.4$ ,  $p=0.01$ ). Physically active First Nations participants reported higher commitment to ethnicity ( $3.5 \pm 0.6$  vs.  $3.1 \pm 0.8$ ,  $p=0.02$ ), identity exploration ( $3.4 \pm 0.5$  vs.  $2.9 \pm 0.7$ ,  $p=0.001$ ), ethnic identity ( $3.3 \pm 0.5$  vs.  $2.9 \pm 0.6$ ,  $p=0.02$ ), identity search, affirmation and belonging ( $3.6 \pm 0.5$  vs.  $3.3 \pm 0.7$ ,  $p=0.03$ ), overall identity scores ( $3.5 \pm 0.4$  vs.  $3.1 \pm 0.6$ ,  $p=0.02$ ), cultural identity ( $51.1 \pm 6.1$  vs.  $46.6 \pm 8.0$ ,  $p=0.02$ ), and overall cultural connectedness ( $95.0 \pm 16.9$  vs.  $85.1 \pm 20.8$ ,  $p=0.04$ ). Among physically active Cree participants higher scores for identity exploration ( $3.4 \pm 0.6$  vs.  $2.7 \pm 0.7$ ,  $p=0.001$ ), ethnic identity ( $3.3 \pm 0.5$  vs.  $2.7 \pm 0.6$ ,  $p=0.01$ ), cultural identity ( $50.7 \pm 6.1$  vs.  $45.3 \pm 7.6$ ,  $p=0.02$ ), and overall cultural connectedness ( $94.4 \pm 15.0$  vs.  $82.8 \pm 20.8$ ,  $p=0.046$ ) were reported.

**Conclusion:** Cultural connectedness was lower among more physically active Metis participants yet higher among more physically active First Nations and Cree participants. Cultural connectedness may be a determinant of PA among Indigenous populations.

**Keywords:** Physical Activity Cultural Connectedness Indigenous Health

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 102. Differences in Fall Risk Factors Between Men and Women Aged 60 years and older

**Presenter: Danelle Banman**

Collaborators: Cathy Arnold, and Joel Lanovaz

College of Kinesiology

Supervisor(s): Cathy Arnold

**Background:** A decrease in muscle strength, impaired balance, problems with gait and slow walking speed are risk factors for falls in ageing adults. Demographic factors such as age and body mass index (BMI) may increase the likelihood of a fall. There is sparse evidence comparing gender differences in sociodemographic fall risk factors and no cross-sectional studies comparing physical fall risk factors between men and women. The purpose of this study was to compare differences in demographic and physical fall risk factors between men and women over 60 years.

**Methods:** Data was collected from n=73 participants (45% males) that participated in an ongoing study on fall risk prevention. Age, height and weight were recorded at each session. Medical demographic questionnaires were used to identify medications used and number of falls within the past 12 months. Physical fall risk factors assessed were total strength, functional mobility, walking speed, balance, and response time. Total strength was assessed via combined mean of three trials of the right- and left-hand grip and push off test scores. Timed up and go test was used to assess functional mobility. Walking speed was calculated using a 10-meter walk test. Balance assessment included: 30 second tandem stance, one legged stance test, and the modified clinical test of sensory interaction and balance (MCTSIB). Response time was recorded in response to a random tone that was manually activated with pre-determined pause lengths. An independent samples t-test was used to compare fall risk factors, where as a chi square analysis was used to compare the history of reported falls.

**Results:** Males (M= 125.10, SD=36.73) scored significantly higher than females (M=74.33, SD=19.33) in total strength, as well were significantly faster in the auditory response time task when compared to females. Females MCTSIB scores on the foam pad (M= 19.73, SD=11.41) was significantly higher than the male participants (M= 14.30, SD=9.63).

**Conclusion:** Possible explanation for a significant difference between participants strength, response time and balance may be due to age. Further testing should consider a larger sample size and similar age when testing for differences in fall risk factors between genders in older adults.

**Keywords:** Older adult health, fall risk factors

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 103. Tayan na ćopi: To Learn This Well or Come Together to Share Good Things

**Presenter: Deanna Bickford**

College of Nursing

Supervisor(s): Pammla Petrucka

**Background:** In Canada, and around the world, research ‘about’ or ‘on’ Indigenous peoples has traditionally been carried out at the expense of the peoples it was supposed to benefit. Many researchers have proposed methods to increase the cultural appropriateness and respectfulness of the research. This research used a traditional Dakota way of preserving and sharing knowledge (winter count) to explore what First Nations youth believed contributed to their well-being. It incorporated select aspects, principles, and concepts from Community Based Participatory Research, Two-Eyed Seeing, postcolonial theory, and cultural safety to build a novel, responsive and inclusive method.

**Methods:** The objectives for this research were a) to review and renew the winter count legacy in the community of SBDFM through the youth, b) to build capacity within the participating youth to create and perpetuate winter counts that are tools for knowledge translation and transfer, c) to explore the utility, cultural appropriateness, and potential of winter counts as a visual research methodology, and d) to discover what these First Nation youth believe are important events in their lives that have contributed to their well-being and who they are today.

**Results:** Fifteen First Nations youth participated in learning about winter counts, creating an individual winter count, and sharing their winter counts with their peers, teacher, and Elders, as well as with the researcher through individual interviews. The youth identified events that contributed to their well-being and five themes emerged from their stories. These included Culture and Spirituality as Wellness, Physical Activity as Wellness, Success as Wellness, Relationships as Wellness, and Relationships as ‘Dys’ Wellness. Each of these themes offers some opportunities for wellness, as well as some further areas for research.

**Keywords:** two eyed seeing, winter count, Indigenous youth, CBPR

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 104. Chronic Obstructive Pulmonary Disease and Cognitive Impairment in the Canadian Elderly Population: Multilevel Analysis of a Cross-sectional Nationwide Survey

**Presenter: Edris Hagher**

School of Public Health

Supervisor(s): Cindy Feng

**Background:** With the aging of the Canadian population, certain chronic conditions such as cognitive impairment and Chronic Obstructive Pulmonary Disease (COPD) have become increasingly important public health concerns. Previous studies have reported a potential link between COPD and the development of cognitive decline, as the hypoxemia, systemic inflammation and cytokines may contribute to neuronal injury and result in neurodegenerative disorders. However, few studies considered accounting for contextual effect at the regional level. Using multilevel modeling, this study aimed to

examine the association between COPD and cognitive impairment among community-dwelling seniors in Canada.

**Methods:** This cross-sectional study uses data derived from the nationally representative Canadian Community Health Survey (CCHS) 2013-2014 Annual Component. The sample for the present analysis was restricted to participants aged 65 years and older, with the complete response to the questions related to the Cognition Health Status measures ( $n = 37242$ ). Hierarchical multilevel logistic regressions, with a four-step modeling strategy, were employed with individuals (Level 1) nested within a health region (Level 2) to estimate odds ratios (ORs) and 95% confidence intervals (95% CIs).

**Results:** Overall, COPD was reported by 8.06% of our study participants, and 30.98% were classified as being cognitively impaired. We found that regional variations accounted for 2.3% of the variance in cognitive function among the respondents after controlling for individual characteristics. Furthermore, our results indicate that within a health region, the odds of developing cognitive impairment increases with aging, smoking, COPD (OR=1.34; 95% CI, 1.24 to 1.46), heart disease (OR=1.22; 95% CI, 1.15 to 1.30), stroke (OR=1.95; 95% CI, 1.74 to 2.19), and mood disorder (OR=2.59; 95% CI, 2.37 to 2.82). Conversely, females (OR=0.93; 95% CI, 0.88 to 0.98) and those with higher educational attainment have a lower risk of acquiring cognitive impairment.

**Conclusion:** Findings of this study suggest that COPD and cognitive impairment remain significantly related after adjustment for individual-level factors and regional variations among Canadian seniors.

**Keywords:** Cognitive impairment, COPD, Seniors, Multilevel analysis, CCHS

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 105. THE HEALTH EXTENSION WORKERS IN ETHIOPIA: POTENTIAL FOR IMPROVING COMPLEMENTARY FEEDING PRACTICES AND HEALTH OF RURAL CHILDREN

**Presenter:** Getenesh Berhanu Teshome

Collaborators: Susan J Whiting, and Carol J Henry

College of Pharmacy and Nutrition

Supervisor(s): Susan J Whiting, and Carol J Henry

**Background:** In Ethiopia, Health Extension Workers (HEWs) deliver health messages to rural households, including information and skill development related to nutrition. The current study aimed at assessing the knowledge and performance of HEWs to deliver a nutrition education package on using pulses in complementary feeding. A pulse-cereal mix improves nutrition of young children yet is not widely practiced.

**Methods:** In-depth interviews with purposefully selected HEWs before and after we provided training in pulse use. Half of the HEWs were trained to deliver the nutrition content and half were in control sites.

**Results:** Based on thematic analysis techniques, we found training improved their knowledge and skills, which then improved their ability to deliver these messages to mothers. They were supportive of the need to provide more information about nutrition, specifically benefits and processing related to using pulses.

**Conclusion:** Engaging the HEWs through nutrition education training can help to improve HEWs nutrition knowledge. This may facilitate positive changes in their attitudes toward nutrition care, and

thus in their behavior, therefore resulting in improved skills in management of nutrition-related problems such as child undernutrition.

**Keywords:** Health Extension Workers, Nutrition Education, SNNPR, Pulses.

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 106. Survey for Indigenous Cancer Supports in Saskatchewan

**Presenter: Lorena Stringer**

College of Medicine

Supervisor(s): Gary Groot

### **Background:**

- Rates of cancer in Indigenous people are higher now than they have ever been in Canadian History (1).
- Cancer survival rates are also lower amongst Indigenous Canadians than non-Indigenous Canadians (1).
- Health professionals speculate that late cancer diagnosis, less participation in cancer treatment, and lower understanding of cancer are some of the main factors contributing to lower survival rate among Indigenous cancer patients
- Fortunately, social supports and positive social relations have been found to improve cancer survival rates (6,7).
- Yet, there is little known about the cancer care supports available to Indigenous cancer patients in Saskatchewan

### **Methods:**

- The study falls into a postpositivist framework that aligns with an empirical survey while, still recognizing other worldviews
- Qualitative interviews have informed the survey creation
- Key Informant interviews will be used to create a survey to explore Indigenous cancer care supports needs.
- The survey will be refined in conjunction with community leaders
- This project will pilot the survey in an Indigenous Saskatchewan community
- Feedback from survey respondents will be utilize to determine question appropriateness and survey accurateness

**Results:** Currently making the survey

**Conclusion:** The results of this study will benefit Indigenous cancer patients, their families, and their communities. This study could help to inform health professionals and policy makers on the needs of Indigenous cancer supports; identify gaps in cancer care supports available to Indigenous cancer patients; and assess cancer care priorities in Saskatchewan Indigenous communities. This knowledge could help to optimize cancer care support utilization in Indigenous populations, and ultimately reduce cancer related deaths in Indigenous cancer patients in Saskatchewan.

**Keywords:** Indigenous Cancer Support Survey

## 107. Food security of Protracted Refugees: A Chronic Global Crisis

**Presenter: Mahasti Khakpour**

College of Pharmacy and Nutrition

Supervisor(s): Hassan Vatanparast

**Background:** While, the zero-hunger goal set by the sustainable development goals of the United Nations by 2030, there are many at-risk populations for food insecurity including refugees. Despite the efforts of international institutions and host countries, refugees and asylum seekers struggle to meet their basic needs throughout their displacement. Among all needs, food is one of the basics of livelihood and social determinant of health. The objectives of this multi-national and multi-disciplinary study are twofold. First to evaluate the prevalence of household food insecurity of protracted Afghan refugees and asylum-seekers under different refugee resolution models: reintegration, resettlement, and asylum-seekers camp setting. Second, to identify the region-specific barriers and facilitators toward their food security.

**Methods:** 730 refugee families from five regions of the world, including Canada, Australia, Switzerland, Pakistan, and Iran participated in the study. Under the framework of the socioecological model, we used explanatory mixed methods design. Within the quantitative section of the study, a standard socio-demographic tool from the Canadian Community Health Survey and the United States Department of Agriculture (USDA) food security questionnaire was used. To address the second objective, we conducted a series of in-depth interviews with semi-structured questions.

**Results:** We found a high prevalence of food insecurity among families due to economic, social, and cultural barriers: In Canada and Australia as resettlement countries, more than 85% of the refugee families suffered from food insecurity in Canada and 83% were food insecure in Australia. In Iran and Pakistan (reintegration and point of entry during the refugee influx), 99% and 82% of the families were food insecure respectively. In Switzerland (n=24): Secondary destination and campsite for asylum seekers. 73.6 % of asylum seekers were food insecure with the majority moderately food insecure (36.8%). The barriers toward food security under reintegration and resettlement setting were different. While the culturally accepted food was one of the main concerns in resettlement regions (Canada, Australia, Switzerland), the cultural proximity in reintegration regions (Iran and Pakistan) did not offset the financial barriers toward food security. Refugees in reintegration regions, Iran and Pakistan, were mostly fallen under severe food insecurity level and hunger (65% in Iran and 44% in Pakistan), in resettlement regions (Canada and Australia), the majority were under moderate food insecurity (59% in Canada and 37% in Australia). Cultural differences, unemployment or underemployment, lack of social interaction, and language barriers, were indicated as the main post migration challenges. Financial struggle, lack of access to culturally accepted food, and lack of knowledge in food utilization came up as the main themes in food security related interview questions. Emerging common themes from the family in-depth interviews showed a lack of financial and residency stability, information and resources associated with health services and food literacy, cross-cultural training, and food utilization skills.

**Conclusion:** While a considerable number of refugee households and children were suffering from severe food insecurity and hunger in both reintegration regions, the resettled refugees in the three countries in this study were mostly moderately food insecurity. Social, financial, and cultural capacities varied in different settings. These differences warrant identifying local problem-solving policies based on the available capacities in each region. The collaborative approach between the world aid organizations, governments, and community-based organizations involved in refugee influx is essential. Finally, policies that address the food insecurity crisis beyond the initial influx time and consideration for protracted refugee situation need to be adopted. Our findings warrant further investigation in a larger sample of

key informants, aid organizations, and policymakers to determine possible solutions toward the food insecurity of protracted refugees and asylum seekers. This includes clarification of the role of stakeholders at the local, national, and international level who are involved in providing services, as well as the level of coordination and collaboration among them.

**Keywords:** Food security, Refugees' health, Global health policy, Mixed methods

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 108. Perceived clinic access and health status of Refugees after one year of care at the Refugee Engagement and Community Health (REACH) clinic

**Presenter: Monique Reboe-Benjamin**

Collaborators: Global Gathering Place, Saskatoon Open Doors Society, Saskatoon Community Clinic  
College of Medicine

Supervisor(s): Anne Leis

**Background:** The ability of refugees to fulfil their human capital potential depends heavily on their health. Refugees who come to Canada face a high risk of poor health outcomes, and inadequate health-care resulting in part from a lack of a user-friendly, regular place of care or family doctor and insufficient knowledge of health services. Demographics, language, culture and care perceptions are known challenges for providing appropriate, timely care. In Saskatoon, the Refugee Engagement and Community Health (REACH) clinic was established to optimize access to equitable health care for refugees. The clinic provides primary and specialized care, urgent care and other multidisciplinary services for one year, before clients are transition to a family physician within the community. Therefore, the objectives of this study are to describe demographic characteristics, perceived clinic access and self-reported health status of refugees who accessed REACH within their first year of arrival in Saskatoon

**Methods:** Using a cross-sectional survey design, adult refugees completed a questionnaire at the time of transition. Data included demographics, accessibility, use of clinic services and perceived health status and collection will be completed by the end of April 2019. Descriptive and inferential analyses are being conducted.

**Results:** Out of the 57 respondents so far, 53% are male, 67% originate from the African continent and 50% are aged 25-44. 75% of the sample reported being satisfied with clinic services; with reception (96%), doctor (94%), pharmacy (87%), laboratory (87%) being the most used services; 75% had access to appointments when needed; Three quarter of them reported good to excellent health status after accessing the clinic for one year which correlates significantly with frequency of clinic visits ( $X^2 < 0.05$ ).

**Conclusion:** This study will help to refine clinic services and address existing gaps to improve care.

**Keywords:** Refugees, health, Saskatoon

## 109. The association between enriched non-whole grain consumption and health outcomes

**Presenter:** Pardis Keshavarz

Collaborators: Seyed Hamzeh Hosseini

College of Pharmacy and Nutrition

Supervisor(s): Hassan Vatanparast

**Background:** Enrichment of grain is a way to improve the nutrient composition of staple foods in most of the countries. The restoration of nutritional value through enrichment of refined grains in which nutrients lost during processing (thiamin, niacin, riboflavin, and iron) are added back, can address the problem. On the other hand, dietary guidelines recommend decreasing the amount of refined grain intake and increase the whole grain consumption instead. While the association between whole grain consumption and health is well studied and it has been proved that consumption of whole grain would decrease the probability of health outcomes. With respect to Canada's Food Guide (CFG) 2019, which the focus is on WG intake, less is known about the relationship between enriched non-whole grain (ENWG) consumption and health outcomes. Therefore, we conducted a scoping review to identify what are the fortification practices are on grain products globally and to evaluate the evidence, which contribute to the association between ENWG consumption and health outcomes.

**Methods:** Following Prisma guidelines, several datasets were searched for the original studies and reviews including Scopus (which include Medline and Science direct), PubMed, Cochrane library, Embase and google scholar in the period of 1999- 2019. The inclusion criteria were limited to human studies, studies that mainly focused on "refined grain" and "enriched non-whole grain", "whole grain vs. enriched refined grain" and the health outcomes except white rice studies. The exclusion criteria were studies which focused on whole grain (WG) vs. refined grain (RG) (if the refined grain foods were not enriched) and white rice and narrative review articles; case reports, also studies reporting partial results of a previous study, editorial papers. To evaluate the fortification policies and identifying the added nutrients along with their values, based on the availability of the data, we explored the food fortification initiatives across continents and countries such as United States, Canada, Africa, Australia, Asia, Europe and UK as well as the health ministries of some countries.

**Results:** The results were inconsistent among different studies however; most studies reported that there is no clear association between refined grain intake and adverse health outcomes. Only a few studies found that the highest level of refined grain intake would contribute to increase in health risk such as cardiovascular disease and diabetes, while there was no information whether the refined grain was enriched or not. The evidence from refined grain enrichment demonstrated that 85 countries have mandatory fortification policy for wheat, 16 countries for maize and six countries for rice flour. The most common nutrients, which are being used for enrichment of refined grains, are vitamin B1, B2, B3, folic acid and Iron. United States in the first place and Canada in the second place having the lowest prevalence of zinc inadequacy, anemia and Neural tube defects (NTD) among infants, since the mandatory fortification legislation for wheat.

**Conclusion:** Overall, in the absence of fortified whole grain products, while the benefits of enriched refined grain products in terms of reducing the nutrient inadequacy is well known, less is known about their potential health risks. Therefore, more studies are needed to evaluate the impact of enriched core refined grains (without significant added fat, sugar, or sodium) on health outcomes.

**Keywords:** enriched non-whole grain, refined grain, health outcomes, grain enrichment

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 110. Educational Intervention for Community Pharmacists Concerning Substance Use Disorder Delphi Study: Substance Use Management Protocol for Community Pharmacists

**Presenter:** Sarah Fatani

Collaborators: Daniel Bakke

College of Pharmacy and Nutrition

Supervisor(s): Anas El-Aneed, and Marcel D'Eon

**Background:** Community pharmacists have a vital role in proper health care management specially in chronic disease, such as diabetes and hypertension. However, pharmacist's role in caring for a patient suffering from substance use disorder is limited. Numbers of barriers were identified for the limited role of pharmacists regarding substance use disorder; however, education is identified as the main barrier. This project aims at developing educational interventions to increase community pharmacists' involvement in caring for people with substance use disorder. The project has several elements including educational workshop, pharmacist-patient encounter protocol and training sessions. The encounter protocol in particular will guide pharmacists in their interactions with patients, leading possible to better care.

**Methods:** Screening, brief intervention, and referral is one of the most useful approaches in substance use management. This approach is novel to the community pharmacy setting. Therefore, the substance use management protocol designed to direct community pharmacists through an algorithm in a step-wise approach. Community pharmacists will be able to screen for risky drinking and substance use, provide brief intervention and refer clients to proper service(s), based on identified need(s). The protocol is validated through a Delphi study. Two rounds of questions were sent to experts in the field of substance use disorder. In the first round, experts commented on the appropriateness and clarity of each item of the protocol as well as provided some feedback. Based on the feedback from the first round the protocol was modified. The modified protocol was sent for the expert to rerate the appropriateness and clarity of each item of the modified version and provide comments.

**Conclusion:** Substance Use Management protocol is a promising tool that will enable community pharmacists helping people who suffer from substance use disorder through organized and validated steps. The protocol is useful in screening for risky drinking and substance use, provide brief intervention and provide referral based on the client identified need(s).

**Keywords:** Substance use disorder, Community, Pharmacists, Addiction, Protocol, dependence

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 111. The lifetime cardiovascular disease risk of young adult Canadians and the association between dietary patterns prevalent among this age group

**Presenter: Zeinab Hosseini**

College of Pharmacy and Nutrition

Supervisor(s): Hassan Vatanparast, and Susan Whiting

**Background:** Atherosclerotic cardiovascular disease (ASCVD) is one of the leading causes of mortality in Canada. One approach in preventing ASCVD is to identify people with a high risk of developing these diseases in the future using approaches such as the lifetime ASCVD risk assessment tool. Diet as an important factor in developing and preventing ASCVD has made the investigation of the association of diet and ASCVD of interest to researchers. Dietary patterns present a holistic picture of the real-life usual diet.

**Methods:** In this study, for the first time in Canada, we aimed to determine the lifetime ASCVD risk of young adult Canadians and the association between dietary patterns prevalent among this age group and lifetime ASCVD risk. Health measures and dietary intake information of Canadian young adults aged 20-39y were obtained from the Canadian Health Measures Survey combined Cycles 1 and 2 data. The dietary patterns were emerged using the principal component analysis method from 32 food groups. Using logistic regression the association between lifetime ASCVD risk and dietary patterns, controlling for potential covariates, was investigated for ages of 20-39y. Survey data were weighted and bootstrapped to be representative at the national level.

**Results:** Results of this study showed that more than half of Canadians 20-39y had a high risk for ASCVD within 50 years, while having a low 10-year ASCVD risk. The dietary patterns emerged from this population were as follows, “Salad, greens and condiments”, “Dairy, cereal and fruit”, “High carbohydrate and protein” and the “Fast food” dietary patterns. Our results showed that having a higher score of the “High carbohydrate and protein” dietary pattern was associated with 35% (OR=1.35, 95% CI: 1.03-1.78, p-value= 0.030) higher likelihood of having a high lifetime ASCVD risk compared to lower scores of this dietary pattern, adjusted for covariates.

**Conclusion:** The “High carbohydrate and protein” dietary pattern was positively loaded with French/home/hash brown fries, hot dogs, baked/boiled, mashed potatoes, red meat, sausage, egg and ice-cream/frozen yoghurt. Interventions for a healthy dietary pattern for the young adult population would be beneficial to reduce ASCVD later in life.

**Keywords:** lifetime cardiovascular disease risk, Canadian Health Measures Survey, young population, dietary patterns

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 112. Neighborhood environment correlates of physical activity and sedentary behavior in 10- to 14- year- old Canadian children

**Presenter: Shatabdi Goon**

College of Medicine

Supervisor(s): Nazeem Muhajarine

**Background:** The evidence based on the associations between neighborhood environments and children's physical activity is still developing, compared to that among adults. A better understanding whether and how neighborhood environments influence children's physical activity is therefore necessary to promote health and well-being in children. This study aimed to understand how the objective and perceptual measures of the neighborhood environment predict children's physical activity(PA) and sedentary time(ST).

**Methods:** This longitudinal study builds on Smart Cities Healthy Kid's study conducted in Saskatoon during the 2009-2015 school years. The perceived and objective measures of neighborhood environments were collected by both children using surveys and independent trained assessors using two validated, replicable tools (Neighborhood Active Living Potential, NALP, and Irvine Minnesota Inventory, IMI). Linear mixed-effect models estimated the associations between neighborhood environments and children's activity across the four seasons in a given year.

**Results:** After adjusting for individual's demographics, we found that, children residing in neighborhoods perceived as safe, with good services/facilities, and sidewalks/parks were significantly more likely to be physically active and to engage in less of sedentary behavior. We observed some mixed evidence for the associations between physical activity and objectively measured neighborhood environment. For example, objective safety (NALP) showed a positive, strong association with moderate-to-vigorous PA, however, a negative association with light PA. Activity friendliness (NALP) and accessibility (IMI) were associated with decreased ST, however, contrary to our hypothesis, we found safety from crime (IMI) to be associated with increased ST.

**Conclusion:** The findings suggest physical activity may be increased and sedentary behaviours reduced through 1) increasing access to parks, playgrounds, and play spaces, 2) provision of sidewalks/street lighting such that children can walk or bike safely and comfortably, and 3) ensuring safety from crime, traffic, and scary people/pets. Further context-specific studies are required.

**Keywords:** Neighborhood environment, physical activity, sedentary behavior, children.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## **Undergraduate – Group research**

### 113. Dental Tissue Regeneration Using Co-Cultured Dental Epithelial and Pulp Stem Cells

**Presenter: Abdul El-Rabbany and Davin Truong**

College of Dentistry

Supervisor(s): Petros Papagerakis, and Silvana Papagerakis

**Background:** The development of methods in the regeneration of autologous tissues is a major goal across many disciplines in current research. The ability to regenerate various dental histological structures is widely considered to be the greatest goal of Dental research. As such, the proposed outcomes of this project are of pronounced importance. This project is a crucial part of a much larger project, for which the end-goal is the regeneration of dental tissues in-vivo. The project as a whole aims to develop methods for the use of dual-compartment 3D printed polymeric scaffolds impregnated with Dental Epithelial and Pulp Stem Cells (DESCs and DPSCs) in the regeneration of dental tissues. In an in-vivo environment, various, crucial signaling events occur, between the different cell types, and between the cells and the extracellular matrix (ECM). Thus, one objective of this particular project is to identify and characterize the molecular factors involved in this cell-cell communication, as well as those involved in ECM-cell signaling, and utilize them to facilitate differentiation of the dental epithelial stem cells. The second objective of this project is to optimize conditions under which the two stem-cell lineages may be co-cultured. In normal dental tissue embryological development, two cell layers are generated in the tooth germ. The top layer consists of epithelial stem cells, which later develop into enamel matrix-secreting ameloblasts. The lower layer consists of mesenchymal stem cells, which later develop into dentin matrix-secreting odontoblasts following the differentiation of the ameloblasts. These two cell layers reciprocally induce each other throughout the maturation of the tooth germ, seemingly beginning with signaling from the differentiated ameloblasts. As such, it is hypothesized that co-culturing of dental pulp stem cells with differentiated dental epithelial stem cells is crucial to the normal development of the tooth.

**Methods:** To begin, differing combinations and concentrations of several molecular factors reported in the literature to be involved in dental tissue generation, such as BMP's (Montiero and Yelick, 2016), TBX1, and Pax9 (Caton et al., 2009), and particularly those involved in ameloblast differentiation, will be explored and possibly employed to identify optimal tissue growth conditions. The information gathered will be used to further the project's progression towards complete tissue regeneration. Upon identification of the main signaling factor(s), a number of gene delivery methods, including lipofectamine and gemini particles, will be utilized in order to optimize expression of such factors, allowing differentiation of DESCs into ameloblasts. Western blot and RT-qPCT assays will be used to assess protein and gene expression respectively. Following this, co-culture plates will be utilized to grow DESCs and DPSCs on opposite sides of a semi-permeable membrane, allowing soluble signaling factors, but not cells, to cross over. Gene and protein expression will similarly be assessed, along with observation of dental matrix deposition.

**Results:** Orientation of DESCs and DPSCs in co-culture plates played a role in gene expression indicative of dental stem cell differentiation. We varied the orientation of co-culturing stem cells to test whether this would influence their differentiation, measured by gene expression. In one configuration, DESCs were cultured above in an insert, with DPSCs seeded below. In the second configuration, the positions were switched. Our results indicated that differentiation of DESCs into ameloblasts and DPSCs into odontoblasts

were highest when DESCs were cultured below in the well, and DPSCs cultured above in the insert. This was measured through expression of amelogenin and enamel for DESC differentiation, and DSPP expression for DPSC differentiation. We also tested lipofectamine as a gene delivery method for TBX-1 growth factor to stimulate DESC differentiation into ameloblasts. Results showed that TBX-1 was indeed inducing DESC differentiation into ameloblasts, however, live-dead assays indicated that lipofectamine was cytotoxic at all tested concentration levels. Future experiments involve testing gemini particles as a gene delivery method.

**Conclusion:** Our findings concluded that orientation of dental stem cells in co-culturing plating plays a crucial role in their differentiation into tissue-producing organs. Separated by a semi-permeable membrane, the plating of DESCs in a co-culture insert and DPSCs seeded below in the well results in higher gene expressions indicative of stem cell differentiation. However, the level of expression seen was minimal, indicating the need for differentiated ameloblasts in order to induce the co-cultured DPSCs. These findings will be important in the next step of our experiment, which involves using the perfected gene delivery methods to deliver TBX1 and stimulate ameloblast differentiation, in order to observe organoid formation and dentinal matrix deposition.

**Keywords:** Dentistry, Tissue Regeneration, Stem Cells

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

#### 114. Oral/Head and Neck Cancer in Saskatchewan: an evaluation of patient profiling and outcome over 5-year follow up (a physician office retrospective chart review)

**Presenters:** Bilawal Hussain, Miles Kinch, and Alex Kost

College of Dentistry

Supervisor(s): Silvana Papagerakis, and Peter Spafford

**Background:** Oral Cancer Defined: Presents as a malignant tumor in the mouth that has the potential to metastasize to other areas of the body (Canadian Cancer Society (CCS), 2015) Provincially, in Saskatchewan in 2009, 55 new cases of oral cancer were diagnosed while 25 deaths were attributed to the disease (CCS, 2015). Initial Consultation – General Practitioner Versus Dentist: According to the CDA, when seeking initial consultation regarding oral lesions, 78.4% of patients saw their family physician rather than their dentist. HPV: HPV are members of the family, Papovaviridae. It is a DNA virus lacking a lipid envelope and has a double-stranded DNA genome. HPV-16 and HPV-18 are associated with invasive cervical cancer. Also, HPV-16 and 18 are suggested to be associated with malignancies in the nasopharynx and the oral cavity The correlations are not as clear as that of HPV with cervical carcinoma.

**Methods:** Data will be collected from the Saskatchewan Cancer Agency. Patient charts will be reviewed for every patient in Saskatchewan with oral and pharyngeal SCC from January 2009 to December 2017. Patients will be deidentified for data collection purposes ensuring privacy is maintained Chart information will be extracted using Citrix Workspace. Data will be aggregated using RED CAP Statistical analysis Data will be reviewed for whom the condition of cancer was first presented to, the stage of the disease, the time delay between presentation and initial treatment. The survival rate of such treatment. Demographics in questions and tumour stage. In addition, we will look at the sites of the tumour, variables such as tobacco or alcohol use, treatment status, hpv status, comorbidities, patterns of relapse and incidence of recurrences.

**Results:** In Progress. General trends are collected.

**Conclusion:** In Progress to find more evidence, however data is collected to conclude.

**Keywords:** Oral Cancer, HPV, Dentistry, Diagnosis, head and neck.

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

### 115. Effects on *C. albicans* and cytotoxicity to human gingival epithelial cells of silver microparticles incorporated in an acrylic denture based material: An invitro study.

**Presenters:** Connor Gorman, On Cho, and Liubov Lobanova

College of Dentistry

Supervisor(s): Jay Hoover, Vincent Torresyap and Petros Papagerakis

**Background:** Polymethyl methacrylate (PMMA) denture materials are often associated with the incidence of denture stomatitis and oral thrush - as a result of *Candida albicans*. Denture cleanser is effective in controlling the fungus, but often leads to increased surface roughness, hardness and colour instability. Silver is an excellent antimicrobial agent with a relatively low toxicity and costs. However, biologically active silver ions in PMMA denture material could have cytotoxic effects on human cells in the oral cavity.

**Methods:** Four groups of PMMA denture based materials with different percentages of silver microparticles by volume: 1: 0% (control) , 2: 0.25% , 3: 0.5% , 4: 1% . The material will be molded into disc shaped samples (10mm diameter by 3mm thickness) for antifungal activity assay and cytotoxicity assays. A total of 80 PMMA discs will be prepared: -40 discs for anti-fungal assay: 10 discs for each concentration of silver -40 discs for cytotoxicity assay: 10 discs for each concentration of silver The silver microparticles will be incorporated into the PMMA denture material during processing. The *C. albicans* strains will be placed on Sabouraud Dextrose Agar with disc samples of different silver contents and incubated at 37°C for 48 hours. After the incubation, the numbers of colony forming units of the fungus will be determined; the reduction in viable, adherent cells will be calculated by comparison with control specimens. PMMA denture based material discs with different silver contents will also be placed in tubes of eluted gingival epithelial cell culture medium. They will be incubated at 37°C for 1, 2, and 5 days in a humidified atmosphere of 5% CO<sub>2</sub> and 95% air. Real-time cell analysis assay will be used to evaluate cell viability according to the manufacturer's protocol.

**Results:** With the increase of the silver percentage in the PMMA denture based materials, higher anti-fungal effect will be observed. At the same time, higher level of cytotoxicity to the gingival epithelial cells will be observed with higher silver percentage in the sample discs.

**Keywords:** *Candida albicans*, Cytotoxicity, human gingival epithelial cells, silver microparticles, acrylic denture material, PMMA denture material, oral stomatitis, anti-fungal

**Self-assessment of research as interprofessional/interdisciplinary:** No

### 116. Oral Health Underserviced Schools Within Saskatchewan

**Presenters:** Caitlin Martinson, Kyle Roesslein, and Vanja Golubovic

College of Dentistry

Supervisor(s): Silvana Papagerakis

**Background:** Oral health is a subject that is hardly covered by the educational system in Canada. It is also an area where most adults are not well versed themselves. This lack of knowledge provided by the educational system and by parents is carrying through to the younger generations. On top of this Saskatchewan has an overwhelming problem with access to care even within urban populations. Education, financial difficulties and sparsity of dental clinics are just some forms of barriers to care. These barriers are creating a disconnect between the dental profession and the general population which can have disastrous effects, both on the overall health of individuals throughout the country and well as on our reputation as healthcare providers. In our study we hope to take a step in repairing this disconnect.

**Methods:** We conducted literature reviews to gather information about preventative dentistry with emphasize on school-aged children. This information was used to form a presentation for children that can be both visually stimulating and information. A questionnaire will be distributed to the class prior to our presentation, which will cover topics presented on the questionnaire. A few weeks after the presentation, the class will be given the same questionnaire in hopes that they retained the information we presented and improved their oral hygiene. The questionnaires will be evaluated looking at changes in scores prior to the presentation versus the same questionnaire 4 weeks later. The questionnaires include questions that will test the participants' respect, attitudes, knowledge and habits involving oral health, which we will use to measure any improvements.

**Results:** We are expecting to see an increase in these student's oral health knowledge We are hoping to see an attitude change in the students toward dentists and other dental healthcare professionals With the increase in knowledge and attitude, we would ultimately like to see an increase in the dental IQ of these students.

**Conclusion:** Our idea of educating children will hopefully extend beyond this presentation and lead to changes in their daily lives. By educating children in an informative, yet engaging way, we hope that those listening are able to retain the information we present to them. Our aim is to raise awareness of the importance of maintaining good oral health which in turn, will act as a form of preventative dentistry and decrease one of the barriers of access to care.

**Keywords:** Oral Health, Preventative Dentistry, Underserved Populations

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 117. Predisposing Factors for Children 2-5 Year Old Receiving Dental Treatment Under General Anesthesia in a Saskatoon Surgical Centre

**Presenters:** Erica Seebach, Jordyn Heisler, and Alyssa Weninger

College of Dentistry

Supervisor(s): Carol Nagle, Petros Papagerakis, Jessica Leiffers, and Keith Da Silva

**Background:** Early childhood caries (ECC) is defined as “presence of 1 or more decayed, missing, or filled tooth surfaces in any primary tooth in a child under 6 yrs of age” (Nunn et al., 2009). It is the most common disease of childhood. It well known that forming a relationship with a dental practitioner before the age of one, can significantly lower this risk (Schroth, Pang, Levi, Martens & Brownell, 2018). Some risk factors for ECC are demographics, nutrition, and bacterial content in the saliva (Hallett & Rourket, 2003; Litsas, 2010; Nunn et al., 2009; Schroth, Carlos, Shwart & Wagar, 2016). Children living in rural communities face several access to care barriers including lack of services available and water fluoridation. Therefore, children in these communities are 3.2 times more likely to require dental surgery to treat ECC (Schroth, Carlos, Shwart & Wagar, 2016). Aboriginal families and families of low socioeconomic status are also more likely to be affected (Nunn et al., 2009; Schroth, Carlos, Shwart & Wagar, 2016). Certain dietary behaviours such as at-will breastfeeding, bottle use, and disregarding healthy food guidelines, are also known to increase the likelihood of ECC (Hallett & Rourket, 2003; Nunn et al., 2009). Bacteria species present in saliva that predict caries are *Streptococcus mutans* or *Lactobacillus* (Heymann, Swift, & Ritter, 2013). Abnormally high levels of *S. mutans* are present in children with ECC (Litsas, 2010). When treating ECC general anesthesia may be required if treatment is complex, requiring multiple restorations for children of a very young age (Schroth, Carlos, Shwart & Wagar, 2016). Children of this age range are often uncooperative and may have trouble enduring significant pain, therefore surgery under general anesthesia is the best treatment option (Arora et al., 2011). Currently, 1.2% of Canadian children require dental surgery to treat ECC. Determining the rates of children who require dental surgery for ECC is important, as it represents the health of the general population (Schroth, Carlos, Shwart & Wagar, 2016). The surgery is effective as it reduces the number of cariogenic bacteria, however current literature suggest additional caries develops within 2 years of the treatment (Litsas, 2010; Schroth, Pang, Levi, Martens & Brownell, 2018). The need for this extensive treatment also places a large financial burden on Canada’s healthcare system. In Saskatchewan alone, the average day surgery cost per child is \$1,699 and the average annual cost is \$3,292,791 (Schroth, Carlos, Shwart & Wagar, 2016). This demonstrates the significant need for oral health education, for primary and secondary prevention.

**Methods:** For this project, data will be collected using a questionnaire. After registration at the Prairieview Surgical Centre the parent or guardian of children 2-5 years of age coming for dental treatment under general anesthesia will be asked to be a participant of the study. They will be given an option between survey 1 and survey 2. Survey 1 includes only the questionnaire. Survey 2 includes the questionnaire, a 24-hour recall, and a saliva sample. Participants who complete survey 2 will be given a \$20 gift card to reimburse them for their time. The questionnaire will inquire about their child’s background information, dental treatment, dental experiences, oral habits, and nutrition. The 24-hour recall will record all the food and beverages the participant has consumed in the past 24 hours. A bacterial sample will be obtained from participants by having them eject 1 mL of saliva into a falcon tube that will be stored in a minus eighty degree freezer. Samples will be sent to the Prairie Diagnostic Services at the Western College of Veterinary Medicine for analysis. This will allow the participants bacterial profile to be obtained. Together with the questionnaire data, they will be analyzed to identify predisposing factors that contribute to early

childhood caries. In addition, data will be used to increase information about the population that a Saskatoon surgical centre serves and improve insufficiencies in oral health education.

**Results:** It is expected that many of the children and families accessing the Prairieview Surgical Centre will be from remote areas with poor access to dental care, especially northern Saskatchewan communities. It is anticipated that the participants will have a below average dental IQ. Consequently, they will have poor oral habits and lack of preventative dental treatment. In regard to the nutrition questions, it is expected that participants will have high consumption of simple sugars and low consumption of vegetables and fruit, in accordance with Canada's Food Guide. Participant's saliva will likely contain higher than average proportions of cariogenic bacteria, such as lactobacillus and streptococcus mutans. It is anticipated that there will be opportunities for providing education while the families are at the surgical centre. As a result of this research new programs may be implemented for oral health education at the surgical centre.

**Keywords:** Early Childhood Caries; General Anesthesia; Bacteria profiles; Nutritional Status; Demographics; Oral Hygiene

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 118. Canadian Dental School Curriculum Comparison

**Presenter:** Jillian Thomson, Cam Levac, and Nicole Kriel

College of Dentistry

Supervisor(s): Diego Ardenghi, and Renata Grazziotin-Soares

**Background:** Competent beginning general dentists are those that are able to successfully integrate the understanding, skills, and values of the following five competencies: patient centered care, professionalism, communication and collaboration, practice and information management, and health promotion (ACFD, 2016). The objective of this study is to compare the dental school curricula of the 10 Canadian dental schools, in terms of the course load provided, to ensure competent beginning general dentists graduate from each school.

**Methods:** To do this, we attempted to obtain curriculum data from each of the schools' Associate Deans of Academics and perform data analysis to determine if these curricula differ significantly from each other and contribute to graduating competent beginning general dentists from their programs. We received data from five of the ten schools, categorized the courses into 15 common topics and determined the percentage each course makes up in each school's program.

**Results:** We then focused on which categories made up the largest and smallest time spent in each school. The overall trend showed that the main focus was on prosthodontics (fixed, removable, implants) with less focus on "soft" skills such as professionalism, ethics, practice management, and patient care.

**Conclusion:** We will be focusing on the following discussion points: Why is prosthodontics and "hard" skills the main focus in dental schools? Is there a need for more "soft" skills preparation before entering the dental field? Is the changing population going to require curriculum modifications? How does USA compare?

**Keywords:** Competency Competent beginning general dentists Curriculum "hard" skills "soft" skills prosthodontics

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 119. A Survey of Emergency Dental Services in Saskatchewan

**Presenters: Joseph Peters, Coleton Blischak, and Arvind Kaushal**

College of Dentistry

Supervisor(s): Gerry Uswak

**Abstract:** According to the College of Dental Surgeon's of Saskatchewan (CDSS), private practices in the province have an obligation to provide emergency dental treatment and if they are unavailable they must provide another way of providing treatment for that emergency patient in another form, such as a phone number to refer them to other offices. We hypothesize that about 80% of offices will adhere to this policy and will successfully provide some form or access to treatment whereas 20% will simply be unavailable after regular office hours. Factors to be investigated during this study are what percentage of practices successfully abide by the CDSS policy, are emergency services orientated more so towards existing patients, and are group practices more likely to offer emergency treatment than solo practices. The data will be collected using two rounds of phone surveys: the first round will be calling during office hours whereas the other round of calling will be after office hours. A series of question entailing services for emergency treatments and what their protocol is during after hour emergencies will then be recorded and placed on an Excel spread sheet. The practices will then be grouped together into regions in Saskatchewan and be presented in that form to simplify the data. This information can then be analyzed and used by the CDSS to possibly implement future policies to help ensure that more emergency patients in Saskatchewan are properly and efficiently taken care of.

**Keywords:** Survey, Emergency, Treatment, Dental

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 120. Literature Review: Genomic, Nutritional and Developmental Risk Factors for Third Molar Impaction

**Presenter: Jesse Cockx, Marryum Ali, and Toniesha Gareau**

College of Dentistry

Supervisor(s): Julia Boughner, and Petros Papagerakis

**Background:** Tooth Impaction: Defined as a tooth that has failed to erupt

- Can be fully or partially impacted
- Can be up against adjacent teeth, bone, or soft tissue
- Lots of debate centered around this topic- often surgically removed

Vitamin D deficiency: Results from a lack in vitamin D from sun exposure and nutritional deficits

- Sunlight is the major source of Vitamin D (25-hydroxyvitamin D)
- Vitamin D plays a vital role in the development of bone

Low vitamin D → Rickets + growth retardation

- Less bone development could lead to increased risk of third molar impaction

**Methods:**

1. Web-based literature search
2. Documenting and charting search terms
3. Analyzing and summarizing existing literature
4. Writing a literature review

**Results:** Expected Results:

- To find that there is limited information on genetics pertaining to third molar impaction risk
- To find a positive correlation between low vitamin D intake and increased third molar impaction
- To find information illustrating increased level of PTH along with vitamin D deficiency is positively correlated to third molar impaction

**Conclusion:** Our research is currently in progress. There is a need for a comprehensive literature review as a first step to help dentists and the research community determine the risk factors for third molar impaction.

**Keywords:** Third molars, impaction, vitamin D, genes, nutrition, development

**Self-assessment of research as interprofessional/interdisciplinary:** Yes

## 121. Exploring Students' Confidence and Detecting Misconceptions in Dentistry – Endodontics

**Presenters:** Kristen Tochor, Rachel Feraro and Coca Blue

College of Dentistry

Supervisor(s): Renata Grazziotin-Soares, and Diego Ardenghi

**Background:** Dental education institutions tend to focus on the cultivation of factual knowledge in the biomedical sciences. Students' understanding is typically estimated by the percentage of questions answered correctly on an examination. Such assessments require students to merely memorize or recognize the correct answers, as opposed to using their understanding to explain or construct the answer. Misconceptions among students are rarely identified and subsequently confronted. Our purpose was to identify and compare the frequency of misconceptions amongst dental students resulting from a multiple-choice assessment in endodontics.

**Methods:** A total of 29 second year dental students from College of Dentistry the University of Saskatchewan completed an assessment that comprised of 20 multiple-choice questions, followed by a scaling of their confidence in their answer selection. The assessment consisted of "easy" and "intermediate" difficulty questions. The data was organized into 4 different categories: situation 1 – correct and confident, situation 2 - correct and non-confident, situation 3 - incorrect and confident, situation 4 – incorrect and non-confident. A misconception was identified as situation 3 - an incorrect answer selection followed by self-reporting of high confidence in that selection. The data analysis consisted of two different views: the students as a unit of analysis, as well as the question as a unit of analysis. The frequency of correct responses, incorrect responses, situation 1, situation 2, situation 3 and situation 4 was calculated for each student and for each question.

**Results:** As expected, it was found that a greater proportion of incorrect answers and misconceptions were correlated to the most difficult questions. The intermediate difficulty questions accounted for 83.3

percent of all misconceptions. Students generally had an adequate understanding of the material as no individual student has a frequency of misconceptions greater than 15 percent.

**Conclusion:** This study confirmed the existence of misconceptions among dental students and that scaling student confidence can provide insight into students' understanding. Further research is needed to explore solutions that will minimize misconceptions and to ensure that misconceptions can be identified and rectified prior to graduation of dental students. This will minimize the likelihood of post graduate complications in patient care and will optimize the quality of patient outcomes.

**Keywords:** Misconception, Confidence, Assessment

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 122. Knowledge and expectations of dental implants among University of Saskatchewan Dental Clinic patients

**Presenters:** Madison Hart, Alyssa Freitas, and Amrita Lione

College of Dentistry

Supervisor(s): Vincent Torresyap, and J. Hoover

**Background:** Dental implants have become an established alternative for the replacement of missing teeth in a wide segment of the population in many parts of the world. Technological advancements in the field of implants have led to substantial improvement in oral rehabilitation of edentulous patients. However, data concerning the public's perception, awareness and expectations towards implants is limited.

**Methods:** 300 patients at the University of Saskatchewan dental clinic will be administered a structured questionnaire during regularly scheduled appointments. Questionnaire will include demographic information -age, gender, highest level of education, occupation reason for visit, knowledge and awareness of dental implants and expectation toward implant therapy.

**Results:** Expected results: Patients are expected to have a low level of awareness of dental implants based on findings of similar studies conducted in Austria, Finland, Nigeria and Japan. The higher level of education and young age are expected to be positively correlated with knowledge and awareness of implants.

**Conclusion:** N/A, no results as of yet

**Keywords:** Awareness, patient expectations, dental implants, Canada, questionnaire

**Self-assessment of research as interprofessional/interdisciplinary:** No

## 123. Relevance of the Current Dental Neuroanatomy Curriculum

**Presenters: Richard Kerby, Ace Young, and Shazaib Randhawa**

College of Dentistry

Supervisor(s): Jen Chlan

**Background:** Neuroanatomy has generally been accepted as an important subject in the training of students within both the dental and medical fields. However, with that being said the knowledge applicable to each field varies greatly. The study of subjects such as the cranial nerves and facial or oral pain are of special interest to dentists, while detailed specifics of the brains anatomical features would see little clinical value. Despite the vast differences in preferred learning outcomes many dental schools across the continent have combined their neuroanatomy courses with those of medical schools (Gould et al. 2014). Even among those who do not follow this method, there are no definitive guidelines or set of topics which have been determined to be clinically relevant and are to be focussed on for the progression of dental education. In 1981 the American Association of Dental Schools Anatomical Science Section put out a set of guidelines for the teaching of neuroanatomy to dental students, but it mostly followed the same basic outline as a medical course of the same subject. In 1992 these guidelines were revised, giving a large drop in the amount of material to be covered, focussing more on a deeper understanding of the control of the head and neck, as well as the perception of pain (Klueber, 2003). Then in 1995 the Institute of Medicine performed an analysis of the oral health profession and education giving 22 recommendations. One of these recommendations essentially stated that predoctoral education should focus on what is clinically relevant as well as scientifically based education in clinical care (Klueber, 2003). Since then very few publications have been found attempting to guide the curriculums of dental schools. The most recent attempt was published in the European Journal of Anatomy in 2015 and included a recommended neuroanatomy syllabus for dental students. Unfortunately, this proposed syllabus merely states the topics which the authors believed to be important with no explanations of clinical relevance or possible time allotments (Moxham, Plaisant, and Pais, 2015). The result of this lack of direction has been hugely varying course loads and teaching styles (Gould et al. 2014). While many simply focus on material relevant to the national board exams, at the end of the day it is up to each individual school to decide what sort of competencies they wish to put forth for their students to work towards (Guttman, 2003). Our goal would be to determine what exactly are the most clinically relevant topics for the practicing dentist to be well versed in. This knowledge would be gained through a number of surveys and interviews with both dental students as well as practicing dentists. Even back in 2003 there were calls for research such as this to be completed in order to standardize, or at the very least get a better idea of what is needed to best prepare future generations of dentists.

**Methods:** This study will consist of a thorough yet concise questionnaire seeking to answer our research question of whether or not a knowledge gap is present which is leading to a lack of clinically relevant knowledge as students transition into private practice. Our survey will primarily consist of a paper copy that will be personally distributed to our sample group. Along with these hard copies we hope to establish a website that will serve as an alternative means to participate in the survey. Once participants have completed either the paper copy or digital copy of this survey we will provide them with the opportunity to attend a follow up interview. This interview will provide them with the opportunity to contribute any additional information they may have regarding the research question. In regards to designing our questionnaire we will first begin by establishing a clear research goal. Once our research goal is established we will create a rough draft of our questionnaire to serve as a base to start from. Each question will aim to extract the most information possible from the participant while remaining clear, concise and free of bias. We will also ensure statements are normalised to better suit the language level of our target

demographic. The esthetics and question order of the survey must also be taken into account as questionnaires can seem tedious and dull if not properly developed. Using the techniques of Jones, Baxter and Khanduja from the University of Cambridge, we will position easier important questions at the beginning of the questionnaire and group common themes into the middle leaving questions regarding demographics for the end (Jones, Baxter and Khanduja, 2013). After completing the survey, we will begin to distribute it to our research population, which in this circumstance consists of practicing dentists, dental professors and dental students. During the distribution process of the paper copy we will make an effort to be present during the distribution to create a focus group-type atmosphere where participants may feel free to ask questions about the survey. The electronic version of our survey will be posted online for participants to access on their own time, this will hopefully provide a greater response rate as we will not be interfering with participant's schedules.

**Keywords:** Dentistry, Neuroanatomy, Clinical Relevance

**Self-assessment of research as interprofessional/interdisciplinary:** No

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Trask, Catherine .....	54		
<b>Truong, Davin</b> .....	115		
Tupper, Susan M. ....	50		

group #	Winner (1st place/2nd place)	Poster #	Poster presenter's name	College/School	Supervisor's name	co-supervisor (if applicable)
Basic Science 1	1st place	3	Juveriya Qamar Khan	Medicine	Joyce Wilson	
Basic Science 1	2nd place	1	Ayat Zagzoog	Pharmacy and Nutrition	Robert B. Laprairie	
Basic Science 2	1st place	11	Asher L. Brandt	Pharmacy and Nutrition	Robert B. Laprairie	
Basic Science 2	2nd place	13	Breanne Murray	Veterinary Medicine	Karen Machin	
Basic Science 3	1st place	26	Shelby Landreth	Public Health	Yan Zhou	
Basic Science 3	2nd place	25	Sarah C. Wood	Veterinary Medicine	Elemir Simko	
Basic Science 4	1st place	59	Anand Krishnan Nambisan	Graduate and Postdoctoral Studies	Adelaine Leung	
Basic Science 4	2nd place	62	Mays Al-Dulaymi	Pharmacy and Nutrition	Darryl Adamko	Anas El-Aneed
Basic Science 5	1st place	75	Narsimha Pujari	Veterinary Medicine	Adelaine Leung	
Basic Science 5	2nd place	69	Anna Maria Smolyakova	Pharmacy and Nutrition	Robert B. Laprairie	John G. Howland
Basic Science 6	1st place	83	Ivanna Kozii	Veterinary Medicine	Elemir Simko	
Basic Science 6	2nd place	81	Fatma M. Elessawy	Pharmacy and Nutrition	Randy Purves	Anas El-Aneed

group #	Winner (1st place/2nd place)	Poster #	Poster presenter's name	College/School	Supervisor's name	co-supervisor (if applicable)
Clinical 1	1st place	37	Ruwani Karunarathna	Veterinary Medicine	Susantha Gomis	
Clinical 1	2nd place	36	Petros Kechagioglou	Dentistry	Silvana Papagerakis	Petros Papagerakis
Clinical 2	1st place	88	Natasha Breward	Pharmacy and Nutrition	Charity Evans	Jane Alcorn
Clinical 2	2nd place	98	Samantha Steinke	Engineering	Julia Montgomery	
Social Population Health 1	1st place	45	Kavitha Ramachandran	Medicine	Anne Leis	
Social Population Health 1	2nd place	48	Robyn Reist	Medicine	Catherine Trask	
Social Population Health 2	1st place	107	Mahasti Khakpour	Pharmacy and Nutrition	Hassan Vatanparast	
Social Population Health 2	2nd place	103	Deanna Bickford	Nursing	Pammla Petrucka	
Undergraduate - Individual Research	1st place	53	Kawthar Mohamed	Pharmacy and Nutrition	Robert B Laprairie	
Undergraduate - Individual Research	2nd place	52	Corey Blushke	Kinesiology	Corey Tomczak	
Undergraduate group research	1st place	113	Abdul El-Rabbany, and Davin Truong	Dentistry	Petros Papagerakis	Silvana Papagerakis
Undergraduate group research	2nd place	117	Erica Seebach, Jordyn Heisler, and Alyssa	Dentistry	Carol Nagle	Petros Papagerakis, Jessica Leiffers, and Keith

group #	Winner (1st place/2nd place)	Poster #	Poster presenter's name	College/School	Supervisor's name	co-supervisor (if applicable)
Best Interdisciplinary	1st place	80	Fatemeh Mohabatpour	Dentistry	Petros Papagerakis	Daniel Chen
Best Interdisciplinary	2nd place	22	Kirstin Olsen	Engineering	Emily J. McWalter	



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