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Overview

The Nanomedicine and Chemical Biology (NCB) research theme is a collective effort of participating labs to drive exchange of knowledge and academic excellence. Consisting of seven independent labs within the UBC Faculty of Pharmaceutical Sciences, NCB aims to utilize and develop innovative techniques in the fields of drug discovery, development and delivery with the unified goal of improving the efficacy and safety of pharmaceuticals. Each member of the NCB group, through internal, national and international collaborative efforts, contributes to the growing collaborations and skillset within the Pharmaceutical Sciences community.

Research of the NCB focuses primarily on the investigation of the molecular basis of drug interaction and action at the target of interest, theragnostic and bioimaging, drug formulation and nanomedicine as well as medical genetics and gene editing. Combining the disciplines of pharmacokinetics and pharmacodynamics, the NCB group specializes in techniques such as target engagement, lipid-based and polymeric nanoparticle delivery systems, small molecule synthesis, radiopharmaceuticals, ex vivo disease models, SPECT, PET and CT imaging as well as pre-clinical testing. All these research areas are supported by a strong foundation of established scientific techniques from experienced faculty and student scientists. The NCB group is able to apply these expert skills to design, synthesize and screen potent and selective compounds, develop new technologies and disease models for both compound and target validation, and engineer innovative delivery systems. All our efforts aim at the final objective of improving pharmaceutical outcomes through cutting edge science.
Highlights

Journal Publications
104

Trainees
49 Completed
45 Active

Courses
26

Funding
$17.1M

Recruitment and Recognition

Dr. Colin Ross: 2019 - Promoted to Associate Professor with Tenure
Dr. Shyh-Dar Li: 2019 - Promoted to Full Professor with Tenure
Dr. Brent Page: 2019 - Michael Smith Foundation for Health Research Scholar Award
Dr. Sarah Hedtrich: 2021 - Promoted to Associate Professor with Tenure
Our Research Areas

- Genetic Diseases
- Drug Discovery
- Biochemistry
- Chemical Biology
- Systems Pharmacology
- Adverse Drug Reactions
- Gene Therapy
- Therapeutic Gene Editing
- Nanomedicine
- Radiopharmaceuticals
- Drug Development
- Medicinal Chemistry
- Population Pharmacokinetics
- Physiology-based pharmacokinetics
Faculty List

Adam Frankel, PhD
Associate Professor in Nanomedicine and Chemical Biology
Email: adam.frankel@ubc.ca  Phone: 604-822-7146

Urs O. Häfeli, BSc (Pharm), PhD
Professor in Nanomedicine and Radiopharmaceuticals
Lundbeck Foundation Professor in Drug Delivery and Nanomedicines
Email: urs.hafeli@ubc.ca  Phone: 604-822-7133

Sarah Hedtrich, PhD
Associate Professor
Email: sarah.hedtrich@ubc.ca  Phone: 604-822-2466

Shyh-Dar Li, BSc (Pharm), MSc, PhD
Angiotech Professor in Drug Delivery
Chair, Nanomedicine and Chemical Biology Theme
Co-Lead, Theme 1, Nanomedicine Innovation Network
Email: shyh-dar.li@ubc.ca  Phone: 604-827-0675

Brent D.G. Page, PhD
Assistant Professor
Michael Smith Foundation for Health Research Scholar
Email: brent.page@ubc.ca  Phone: 236-808-6180

Colin Ross, BSc, MSc, PhD
Associate Professor of Pharmacogenomics
Scientist, Child & Family Research Institute, BC Children’s Hospital
Email: colin.ross@ubc.ca  Phone: 604-827-2017

Harvey Wong, BSc (Pharm), PhD
Associate Professor
Email: harvey.wong@ubc.ca  Phone: 604-822-4707
## Trainees List

Total Trainees from 2019–2020: 94

### Postdoctoral Fellows

<table>
<thead>
<tr>
<th>Completed</th>
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<tbody>
<tr>
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- Gokce Endugar
- Marijana Jevtic
- Estefania Campos
- Anna Loewa
- Katharina Hoerst
- Guy Yealland
- Nada Charbaji
- Leonie Verheyen
  (née Wallmeyer)
- Stefan Hönzke
- Madeleine Witting
- Kay Strüver
- Katja Fuchs
  (née Obst)
- KK Viswanadham
- Roland Boettger
- Britt Drogemoller
- Galen Wright
- Timothy Chow

- Qurrat Ul Ain
- Partho Adhikary
- Rosanne Persaud
- Temi Idowu, Elham (Neda)
- Rouhollahi
- Neel Mehta

### PhD

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- Monica Agnoletti
- Reka Geczy
- Zeynab Nosrati
- Jennifer Brown
- Michael Rowley
- Lennart Bohrmann
- Marta Bergamo
- Tanya Saxena
- Tullio Esposito
- Zheng Tan
- Belal Tafech
- Petar Iliev
- Anne Nguyen
- Lukas Hohenwarter
- Jamin Wu
- Po-Han Chao
- Nojoud AL Fayez
- Jafar Hasbullah
- Tiffany Carlaw
- Alice Yu
- Erika Scott
- Kristen Gibson
- Spencer Anderson
- Yao Chen
- Lisa Cheng
- Louis Lin
- Anita Moein
## Trainees List - continued

Total Trainees from 2019–2020: 94

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<tr>
<th></th>
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<td><strong>MSc</strong></td>
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<tr>
<td></td>
<td>Lovelyn Charles</td>
<td>Riley Prout-Holm</td>
</tr>
<tr>
<td></td>
<td>Aaroh Anand Joshi</td>
<td>Juliana Bolsoni</td>
</tr>
<tr>
<td></td>
<td>Tarada Tripetchr</td>
<td>Danielle Hanke</td>
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<tr>
<td></td>
<td>Natascha Eger</td>
<td>Sogand Assarnia</td>
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<td></td>
<td>Ana Rita Falcao</td>
<td>Tessa Morin</td>
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<tr>
<td></td>
<td>Conrad Heilmann</td>
<td>Nida Bilal</td>
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<tr>
<td></td>
<td>Monica Yu</td>
<td>Sandy Morrison</td>
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<td></td>
<td>Josephine Christenen</td>
<td>Kheireddin Mufti</td>
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<tr>
<td></td>
<td>Griffin Pauli</td>
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<tr>
<td><strong>Undergraduate</strong></td>
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<td>Total: 27</td>
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<td></td>
<td>Yun An Chen</td>
<td>Alana Hitsman</td>
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<td></td>
<td>Morris Baumgardt</td>
<td>Colin Blackadar</td>
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<tr>
<td></td>
<td>Amy Kang</td>
<td>Danny Liu</td>
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<td></td>
<td>Sahar Zandi Nia</td>
<td>Emily Chow</td>
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<tr>
<td></td>
<td>Gillian Cokura</td>
<td>Kurbaan Shergil</td>
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<tr>
<td></td>
<td>Kathleen Lau</td>
<td>Alexandra Birkenshaw</td>
</tr>
<tr>
<td></td>
<td>Andy Hur</td>
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<tr>
<td></td>
<td>Brandon Lee</td>
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<tr>
<td></td>
<td>Kaitlyn Roberts</td>
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<td></td>
<td>Dennis Lee</td>
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<td></td>
<td>Michael Lee</td>
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<tr>
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<td>Sreemoyee Ghosh</td>
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</tr>
<tr>
<td></td>
<td>Yuegun Guo</td>
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<tr>
<td></td>
<td>Brenna Reimer</td>
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</tr>
<tr>
<td></td>
<td>Oscar Xu</td>
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</tr>
<tr>
<td></td>
<td>Chantane Yeung</td>
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<tr>
<td></td>
<td>Samuel Chu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aliyana Ladha</td>
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<tr>
<td></td>
<td>Martin Wong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emily Tsui</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Madeline Chan</td>
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</table>
Teaching

Total Graduate Courses: 12

PHAR 502 - Advanced Concepts in Pharmacokinetics
PHAR 515 - Nanomedicines
PHAR 518 - Diagnostic imaging and radiopharmaceuticals
PHAR 523 - Basic Theory & Practice of Isothermal Titration Calorimetry
PHAR 548/648 - Seminars in Pharmaceutical Science
PHAR 550 - Directed Studies: SEM course
PHAR 590 - Research in the Pharmaceutical Sciences: Principles and Methods
PHAR 591 - Scholarly Integrity and Research Ethics
BMEG 590 - Biomedical Engineering Professional Skills
MEDG 505 - Genome Science
MEDG 520 - Advanced Human Molecular Genetics
MEDG 595 - Remote learning course for genetic counselling students

Total Undergraduate Courses: 13

PHRM 100 - Foundations of Pharmacy
PHRM 111 - Medication Management I
PHRM 211 - Medication Management II
PHRM 212 - Medication Management III
PHRM 311 - Medication Management IV
PHRM 312 - Medication Management V
PHRM 325 - Advanced Clinical Pharmacokinetics
PHRM 327 - Pharm Toxicology & Precision Med.
PHRM 453 - Applied Pharmacokinetics and Pharmacogenomics
MEDG 420 - Human Genomics and Medical Genetics
MEDG 421 - Genetics & Cell Biology of Cancer
PCTH 448 - Directed Studies in Pharmacology
ELEC 473 - Biological Micro-Electro-Mechanical Systems
## Funding

**Total Funding:** $17.1M

<table>
<thead>
<tr>
<th>Source</th>
<th>Project Title</th>
<th>NCB PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSERC</td>
<td>Methylarginine Dynamics in Cellular Processes</td>
<td>A. Frankel</td>
</tr>
<tr>
<td>NSERC RTI</td>
<td>Biomolecular Imaging System for Nanomedicine and Chemical Biology Applications in Pharmaceutical Sciences</td>
<td>A. Frankel (co-investigators U. Hafeli, S. Hedtrich, S. Li, B. Page, K. Williams)</td>
</tr>
<tr>
<td>Center for Brain Health - Innovation Fund Kickstart Award</td>
<td>Mechanisms of Peripheral Lipopolysaccharide (LPS) Induced Brain Inflammation</td>
<td>U. Hafeli</td>
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<tr>
<td>Grants for Catalyzing Research Clusters (GCRC)</td>
<td>Cluster for Microplastics, Health and the Environment</td>
<td>U. Hafeli</td>
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<tr>
<td>New Frontiers in Research Fund</td>
<td>Adipose tissue-targeted drug delivery for the treatment of metabolic disease</td>
<td>U. Hafeli</td>
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<tr>
<td>NSERC Alliance Grants - Plastics science for a cleaner future</td>
<td>Sources, sinks and fate of microplastics in the Strait of Georgia and its urbanized watershed: a solution-oriented natural mesocosm study</td>
<td>U. Hafeli</td>
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<tr>
<td>NSERC Discovery Grant</td>
<td>Microfluidic systems for high efficiency radiolabeling and purification of nanomedicines</td>
<td>U. Hafeli</td>
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<tr>
<td>Novo Nordisk Foundation Challenge Grant</td>
<td>Center for Biopharmaceuticals and Biobarriers in Drug Delivery</td>
<td>U. Hafeli</td>
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<tr>
<td>Lundbeck Foundation</td>
<td>Joint Professorship in Drug Delivery and Nanomedicine</td>
<td>U. Hafeli</td>
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<tr>
<td>CIHR</td>
<td>Magnetic resonance navigation of drug eluting beads for liver cancer therapy: in-vitro optimization and preclinical safety efficacy study</td>
<td>U. Hafeli</td>
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</table>
## Funding - continued

**Total Funding: $17.1M**

<table>
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<tr>
<td>MITACS Accelerate</td>
<td>Rational Nanoparticle Design for Efficient Transmucosal Gene Delivery</td>
<td>S. Hedtrich</td>
</tr>
<tr>
<td>CIHR</td>
<td>Development of novel small-molecule inhibitors of TSLP for the treatment and prevention of atopic diseases</td>
<td>S. Hedtrich, B. Page</td>
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<tr>
<td>BC Lung Association</td>
<td>Skin-Lung Crosstalk: Approaching the Atopic March</td>
<td>S. Hedtrich</td>
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<tr>
<td>NSERC Discovery Grant</td>
<td>Development of complex human-based tissue model</td>
<td>S. Hedtrich</td>
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<tr>
<td>CIHR</td>
<td>Development a topical approach for correcting monogenic skin diseases in situ using gene editing</td>
<td>S. Hedtrich (co-investigator C. Ross)</td>
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<tr>
<td>CFI JELF</td>
<td>Targeted inhibition of oncogenic STAT3 signaling using cutting edge chemical biology techniques</td>
<td>B. Page</td>
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<tr>
<td>Michael Smith Foundation for Health Research</td>
<td>Developing new anti-cancer drugs that target abnormal signaling networks in cancer</td>
<td>B. Page</td>
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<tr>
<td>NSERC</td>
<td>Development of active loading technologies for encapsulating highly charged molecules into liposomes</td>
<td>S. Li</td>
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<tr>
<td>Genome BC</td>
<td>In vivo genome editing by non-viral gene delivery</td>
<td>S. Li &amp; C. Ross</td>
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<td>MITACS Accelerate</td>
<td>Pilot-scale preparation of phospholipid-free small unilamellar vesicle formulations with potential in treatment of hepatic diseases</td>
<td>S. Li</td>
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## Funding - continued

**Total Funding: $17.1M**

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<th>Source</th>
<th>Project Title</th>
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<tr>
<td>National Organization for Rare Disorders</td>
<td>Modulation of Tumor Immune Microenvironment for Enhanced Therapy of Pseudomyxoma Peritonei</td>
<td>S. Li</td>
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<tr>
<td>Canadian Cancer Society</td>
<td>A drug delivery technology for activating the tumor immune microenvironment of peritoneal metastases</td>
<td>S. Li</td>
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<td>Michael Smith Health Research Foundation, Innovation to Commercialization Grant</td>
<td>Developing a safe and effective analgesic for chronic pain relief</td>
<td>S. Li</td>
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<tr>
<td>CIHR</td>
<td>Validation and commercialization of an innovative analgesic for chronic pain</td>
<td>S. Li</td>
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<tr>
<td>National Centres of Excellence</td>
<td>Lipid Nanoparticle-mediated Immunotherapy for Pseudomyxoma Peritonei</td>
<td>S. Li</td>
</tr>
<tr>
<td>Canada Breast Cancer Foundation</td>
<td>Identification of genetic biomarkers predictive of cardiotoxicity in adult breast-cancer patients</td>
<td>C. Ross</td>
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<tr>
<td>Genome BC</td>
<td><em>Sector Innovation Program</em>: In vivo genome editing by non-viral gene delivery</td>
<td>C. Ross</td>
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<tr>
<td>BC Children’s Hospital; Evidence to Innovation Research Theme</td>
<td><em>Seed Grant</em>: Investigating pharmacogenomic biomarkers of corticosteroid induced avascular necrosis</td>
<td>C. Ross</td>
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<td>CIHR Targeted Research</td>
<td>Active surveillance for evaluation of harm of direct acting oral anticoagulants (DOACs) in real-world patients</td>
<td>C. Ross</td>
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### Funding - continued

**Total Funding: $17.1M**

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<th>Source</th>
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<tbody>
<tr>
<td>CIHR</td>
<td>Clinical and Pharmacogenomics predictors of inter-patient variation in Direct Acting Oral Anticoagulant (DOAC) plasma concentrations in real-world patients</td>
<td>C. Ross</td>
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<td>UBC VP Research Strategic Research Opportunity Grant</td>
<td>Development of a novel reporter mouse model to explore <em>in vivo</em> ABE gene repair</td>
<td>C. Ross</td>
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<td>CIHR</td>
<td>Optimizing Chronic Hepatitis C Treatment</td>
<td>C. Ross</td>
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<tr>
<td>Canada Foundation for Innovation (CFI)</td>
<td>Personalized genomic medicine for improved paediatric drug safety and effectiveness</td>
<td>C. Ross</td>
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<td>CIHR Team Grant</td>
<td>DSEN-SEARCH &amp; PREVENT: (active Surveillance and Evaluation of Adverse Reactions in Canadian Healthcare) &amp; (Pharmacogenomics of Adverse Reaction EVEnts National Team)</td>
<td>C. Ross</td>
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<tr>
<td></td>
<td><em>(Role: Major role as co-PI and lead of all genomics studies)</em></td>
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<tr>
<td>CIHR Project Grant (PI)</td>
<td><em>Project Grant:</em> Discovery, validation, and pre-clinical development of targeted cardio-protectants for the prevention of anthracycline-induced cardiotoxicity</td>
<td>C. Ross</td>
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<td>Genome Canada</td>
<td><em>Large-scale Applied Research Research Project (LSARP):</em> Go-PGx: Genomic and Outcomes Databank for Pharmacogenomic and Implementation Studies</td>
<td>C. Ross</td>
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<td>(Major co-funders include: CIHR, BCCH Foundation; Genome BC)</td>
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## Funding - continued

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<td>National Centres of Excellence (NCE):</td>
<td>Development and utilization of in vivo systems to optimize lipid nanoparticles for therapeutic genome editing</td>
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<td>Nanomedicines Innovation Network (NMIN)</td>
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<td>National Research Council of Canada (NCE funded)</td>
<td>AV Gene Therapy for the Treatment of Lipoprotein Lipase Deficiency - Cell and Gene Therapy Challenge Program</td>
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<tr>
<td>Canadian Cancer Society</td>
<td>Preclinical therapeutic development of targeted cardio-protectants for use in cancer patients receiving anthracycline chemotherapy</td>
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<td>Genentech</td>
<td>Understanding the Determinants of Oral Absorption of Poorly Soluble Drug Candidates</td>
<td>H. Wong</td>
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<td>Genome Canada</td>
<td>Precision Medicine CanPREVENT AMR: Applying precision medicine technologies in Canada to prevent antibody-mediated rejection and premature kidney transplant loss</td>
<td>H. Wong</td>
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<tr>
<td>Barbara Opperman Kidney Research Fund</td>
<td>Implementation of a Canadian Willingness to Cross Program: a Strategy to Increase Access to Kidney Transplantation for Highly Sensitized Patients</td>
<td>H. Wong</td>
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Publications


Busker S, Page BDG, Arnér ESJ. To inhibit TrxR1 is to inactivate STAT3-Inhibition of TrxR1 enzymatic function by STAT3 small molecule inhibitors. *Redox Biol*. 2020;36:101646.

Publications - continued


Publications - continued


Publications - continued


Kalomoiri P, Rodríguez-Rodríguez C, Sørensen KK, Bergamo M, Saatchi K, Häfeli UO, Jensen KJ. Bioimaging and Biodistribution of the Metal-Ion-Controlled Self-Assembly of PYY<sub>3-36</sub> Studied by SPECT/CT. Chembiochem. 2020 Dec 1;21(23):3338-3348.


Publications - continued
Publications - continued


Publications - continued


Razzaghian, HR, Sharafian, Z Ashish A Sharma, Guilaine K Boyce, Kelsey Lee, Rachel Da Silva, Paul C Orban, Rafick-Pierre Sekaly, Ross, CJ Lavoie, PM. Neonatal T helper 17 responses are skewed towards an immunoregulatory interleukin-22 phenotype. Frontiers Immunology (Accepted).

Publications - continued


Publications - continued


Publication Highlights


Graphical Abstract:


Because of its key role in cancer development and progression, STAT3 has become an attractive target for developing novel cancer therapeutics. This paper highlights a series of compounds that potently block STAT3 activity in cancer cell lines by binding to Thioredoxin Reductase 1 (TrxR1). TrxR1 inhibition induces STAT3 oxidation, which compromises its activity. These results provide new insights into the complexities of STAT3 regulation while highlighting a novel mechanism to block aberrant STAT3 activity in cancer.
Publication Highlights - continued


Graphical Abstract:

Ranked #1 from 299 journals in General Engineering; and #2 in Nanoscience and Nanotechnology.

Monosized 12 µm biodegradable microspheres were made with the antimicrobial drug levofloxacin. After intravenous injection, they accumulated in the lungs and released there the antibiotic over 5 days, which would be useful for the treatment of lung infections. The excellent targeting was confirmed with radioactive SPECT/CT imaging.
**Publication Highlights - continued**


**Graphical Abstract:**

(IF 7.2). Ranked 16 of 261 journals in pharmacology (medical).

“This paper describes the identification of genetic variants in pediatric patients that predispose certain patients to serious vincristine-induced neurotoxicity. These findings contributed to the rationale for a new, large Genome Canada project to expand the scope of the genomic analyses for vincristine-toxicity and implement these findings for patients.”
NCB Retreat 2019

In July 2019, the Nanomedicine and Chemical Biology Group (NCB; a.k.a. NaCho) at UBC Pharmaceutical Sciences hosted its inaugural retreat. Seven independent lab groups joined for a day of teambuilding! The event was held at the Dunbar Community Center with generous funding from the Deans office. The day was centered on:

**Fostering partnerships between overlapping research interests**
**Strengthening connections between lab members**
**Recognizing and pursuing future research collaborations**
**Streamlining resource efficiency**

The day began with an introduction to the history and purpose of NCB by MSc. Student Griffin Pauli and NCB Chair Dr. Shyh-Dar Li. Following this, a terrific set of icebreakers were implemented by PhD Candidate Jen Brown. This led to the focus of the morning session which was dedicated to an exercise in creativity and team work wherein lab members from various groups were paired up and in charge of designing a PhD project. Groups were then required to pitch their project, and a vote determined the winning group. Next was another creative activity of the day - a real Nacho contest! Lab groups were tasked with coming up with some unique takes on the classic Nacho platter of chips, salsa and cheese.

In the afternoon Jen Brown hosted an insightful and productive brainstorming session on strengths, weaknesses, and possible future collaborations for the NCB group. The day concluded with a variety of engaging team building activities held outdoors and hosted by Tiffany Carlaw of the Dr. Ross lab.

A heartfelt thanks to the members of the NCB retreat organizing committee (Jen Brown, Tiffany Carlaw, Tanya Saxena, Partho Adhikary, Alice Yu and faculty representative Dr. Shyh-Dar Li) for their hard work in putting on the first ever NCB Retreat!
Acknowledgments

We would like to thank all participating members of the NCB group for their efforts and contributions to this report and extend our special thanks to the staff and student body that has been contributing to the successful existence of the NCB since 2019.

Our monthly NCB meetings including talks and research progress reports by individual labs, are organized and hosted by Lukas Hohenwarter (PhD student in the Li lab), the inaugural NCB Retreat 2019 was planned and organized by Griffin Pauli (MSc student in the Li lab), and the Annual NCB report is co-authored by Dr. Shyh-Dar Li and student members of the NCB labs including Marta Bergamo, Juliana Bolsoni, Tiffany Carlaw, Lisa Cheng, Danielle Hanke, Lukas Hohenwarter, and Riley Prout-Holm.

Report design by Jimi Galvão, Director, Communications and Marketing (UBC Faculty of Pharmaceutical Sciences). Photos by Justin Ohata, Digital Content Specialist (UBC Faculty of Pharmaceutical Sciences), Paul Joseph, and Griffin Pauli (MSc Student).
Faculty of Pharmaceutical Sciences
2405 Wesbrook Mall
Vancouver, BC Canada V6T 1Z3

https://pharmsci.ubc.ca/research/research-themes/nanomedicine-and-chemical-biology

Frankel Lab
https://twitter.com/labfrankel?lang=en

Hafeli Lab
http://www.magneticmicrosphere.com/hafeli_lab/index.php

Hedtrich Lab
https://hedtrichlab.pharmsci.ubc.ca

Page Lab
https://www.bretnpagelab.com

Li Lab
https://lilab-tddn.pharmsci.ubc.ca/people/

Ross Lab
https://colinrosslab.com/

Wong Lab
https://pharmsci.ubc.ca/directory/harvey-wong