

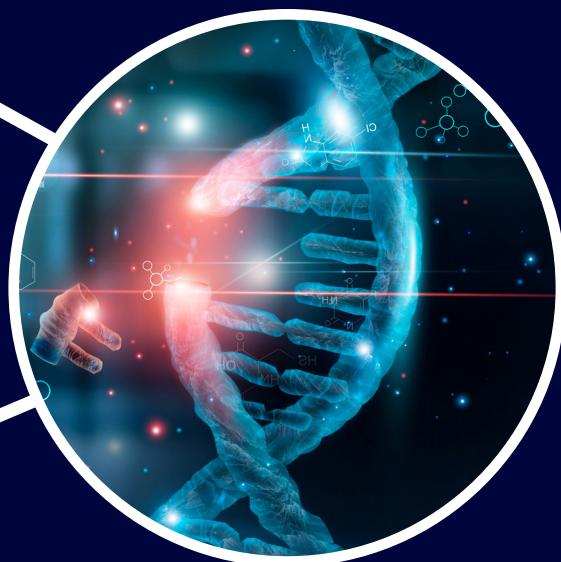


THE UNIVERSITY OF BRITISH COLUMBIA

Nanomedicine and Chemical Biology

Faculty of Pharmaceutical Sciences

# Annual Report 2021-2022



## Table of Contents

Overview .....	2
Highlights .....	3
Our Research Areas .....	4
Faculty List .....	5
Trainees List .....	7
Teaching .....	9
Funding .....	10
Publications .....	13
NCB Retreat 2022 .....	22
Acknowledgements .....	23
Contact Information .....	24

## Overview



Nanomedicine and Chemical Biology (NCB) is one of three research themes within the UBC Faculty of Pharmaceutical Sciences which specializes in studying atomic and nano-scale drug interactions. This theme is a collective of nine independent research groups who are all working together towards a unified goal of improving the efficacy and safety of pharmaceuticals. Through internal, national, and international collaborations, the NCB research groups are expanding the knowledge and skill set accessible to the Pharmaceutical Sciences community.

Research interests of the NCB can broadly be included under the arches of pharmacokinetics and pharmacodynamics. Specific research of the independent groups of NCB include; drug interaction and action, theranostics and bioimaging, drug formulations and nanomedicines, medical genetics and gene editing. The NCB groups utilize cutting edge technologies to meet their research aims, some technologies include; 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. Each research group is backed by traditional and current scientific techniques instilled by experienced faculty and trainees. Through this diverse portfolio of techniques and research interests, the NCB group is able to develop, assay and screen selective compounds, design new technologies and models for analysis of target validation and drug distribution, and model original delivery systems. The ultimate goal of NCB is to improve the outcome of pharmaceuticals through advanced science.

## Highlights

### Journal Publications



78

### Trainees



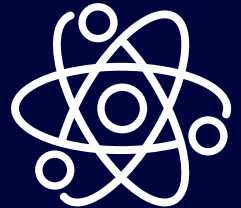
61 Active  
30 Completed

### Courses



26

### Funding



\$8.61M+

## Recruitment and Recognition



Dr. Simon Wisnovsky:

2022 - Canadian Society of Pharmaceutical Sciences Early Career Award  
2021 - Royal Society of Chemistry Horizon Prize

## Our Research Areas



## Faculty List



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**Harvey Wong**, BSc (Pharm), PhD  
Associate Professor  
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## Trainees List

### Combined Lab Trainees List

9 active post docs  
 6 completed post docs  
 Total 15 post docs

24 active PhDs	11 active MSc	17 active Undergraduates
6 completed	3 completed MSc	15 completed undergraduates
Total 30 PhDs	Total 14 MSc	Total 32 undergrads

**Total trainees in 2021-2022: ACTIVE: 61, GRAND TOTAL: 91**

Active	Completed	
Partho Adhikary Fatemeh Mohabatpour Nidhi Raval Quan Le Jennifer Brown Henok Sahile Neel Mehta Miguel Cordova John Daly	Elham Rouhollahi Temi Idowu Rosanne Persaud Britt Drogemoller Galen Wright Tim Chow	Postdoctoral Fellow
Michael Rowley Tanya Saxena Marta Bergamo Lennart Bohrmann Tullio Esposito Zheng Tan Belal Tafech Lukas Hohenwarter Po-Han Chao Jiamin Wu Petar Iliev Danielle Hanke Jafar Hasbullah Tiffany Carlaw Alice Yu Erika Scott Kristen Gibson Spencer Anderson Vignesh Krishnamoorhty Yao Chen Louis Lin Lisa Cheng Jeffrey Proctor Anita Moein	Jennifer Brown Rawan Charbaji Anne Eichhorst Patrick Graff Nojoud AL Fayez Anne Nugyen	PhD



Active	Completed	
Riley Prout-Holm Aurelio Morales Juliana de Andrada Bolsoni Leah Mappalakayil Chun Yat Ong Christopher Hoang Tessa Morin Sandy Morrison Alexandra Birkenshaw Natalie Stewart Olivia Drummond	Sogand Assarnia Nida Bilal Monica Yu	MSc
Molly Benbow Verena Mailänder Cat Zhang Yushi Nakajima Chin Yueh Cheng Alex Liang Shawna Lu Sean Leong Romina Amir Sardari Connor Chiu Tyler Thompson Liam O'keeffe Sarah Ng Cassie Huang Kurbaan Shergil Jimmy Kim May Zhao	Courtney Ng Angela Matyas Colin Blackadar Danny Liu Emily Chow Yuegun Guo Brenna Reimer Oscar Xu Chantane Yeung Samuel Chu Aliyana Ladha Martin Wong Emily Tsui Madeline Chan Kodee Bao	Undergraduate

## Teaching

**Total courses taught: 26**

**Total Undergraduate courses: 14**

- PHRM100 Foundations of Pharmacy
- PHRM111 Medication Management I
- PHRM211 Medication Management II
- PHRM212 Medication Management III
- PHAR 303 - Nanomedicine
- PHRM311 Medication Management IV
- PHRM312 Medication Management V
- PHRM 325 Advanced Clinical Pharmacokinetics
- PHRM 327 - Pharm Toxicology & Precision Med.
- PHRM 453 Applied Pharmacokinetics and Pharmacogenomics
- PHAR203 Drug Delivery Technologies and Personalized Medicine Theory and Laboratory
- PHAR280 - Pharmaceutical Topics and Communication Seminar II
- PHAR 306 - Medicinal Chemistry of High-Impact Pharmaceuticals in Major Diseases
- MEDG 420 - Human Genomics and Medical Genetics

**Total Graduate courses: 12**

- MEDG 595- Remote learning course for genetic counselling students
- MEDG 505 - Genome Science
- PHAR 502 Advanced Concepts in Pharmacokinetics
- PHAR 515 Nanomedicine
- PHAR 518 Diagnostic imaging and radiopharmaceuticals
- PHAR521 Basic Theory & Practice of Scanning Electron Microscopy and Dynamic Light Scattering
- PHAR 523 Basic Theory & Practice of Isothermal Titration Calorimetry
- PHAR540C Applied Omics for Drug Discovery and Development
- PHAR 548/648 Seminars in Pharmaceutical Science
- PHAR550 Directed Studies
- PHAR590 Research in the Pharmaceutical Sciences: Principles and Methods
- PHAR591 - Scholarly Integrity and Research Ethics

## Funding

Source	Project Title	NCB Lead PI
NSERC Discovery + Launch Supplement	Exploiting protein stability changes to identify next generation chemical probes and target engagement technologies	Brent Page
CIHR Project Grant - Bridge Funding	Targeting Metastatic Breast Cancer	Brent Page
CIHR Project Grant	Overcoming Dihydrofolate Reductase Inhibitor Resistance Using Pyrimethamine-inspired Proteolysis Targeting Chimeras	Brent Page, Adam Frankel
BC Knowledge Development Fund	Targeted inhibition of oncogenic STAT3 signaling using cutting edge chemical biology techniques	Brent Page
Canada Foundation for Innovation - John Evans Leadership Fund	A Functional Genetics Platform for Analysis of Cancer-Associated Glycosylation	Simon Wisnovsky
Natural Sciences and Engineering Research Council of Canada - Discovery Grant	Development of genetic screening methods for functional characterization of cell-surface glycans	Simon Wisnovsky
Cancer Research Society - Operating Grant	Defining new glyco-immune checkpoint ligands as next-generation targets for leukemia immunotherapy	Simon Wisnovsky
Canadian Institutes of Health Research - Project Grant - Priority Announcement (Bridge Funding)	Systematic Characterization of Glyco-Immune Signaling Networks with High-Throughput Functional Genomics	Simon Wisnovsky
Grants for Catalyzing Research Clusters (GCRC)	Cluster for Microplastics, Health and the Environment	Urs Häfeli
New Frontiers in Research Fund	Adipose tissue-targeted drug delivery for the treatment of metabolic disease	Urs Häfeli
NSERC Alliance Grants - Plastics Science for a Cleaner Futures	Sources, sinks and fate of microplastics in the Strait of Georgia and its urbanized watershed: a solution-oriented natural mesocosm study	Urs Häfeli
NSERC Discovery Grant	Microfluidic systems for high efficiency radiolabeling and purification of nanomedicines	Urs Häfeli
Novo Nordisk Foundation Challenge Grant	Centre for Biopharmaceuticals and Biobarriers in Drug Delivery	Urs Häfeli
CIHR	Magnetic resonance navigation of drug eluting beads for liver cancer therapy: in-vitro optimization and preclinical safety efficacy study	Urs Häfeli

Source	Project Title	NCB Lead PI
National Centres of Excellence (NCE): Nanomedicines Innovation Network (NMIN)	Development and utilization of in vivo systems to optimize lipid nanoparticles for therapeutic genome editing	Colin Ross
National Research Council (NRC) of Canada	AAV Gene Therapy for the Treatment of Lipoprotein Lipase Deficiency - Cell and Gene Therapy Challenge Program	Colin Ross
Evidence to Innovation Research Theme, BCCH	Development of a pharmacokinetic-pharmacogenomic model to enhance morphine-based pain management in children	Colin Ross
BC Children’s Hospital Foundation	Enabling CRISPR - Based therapies for children	Colin Ross
National Research Council (NRC) of Canada	Renewal: AAV Gene Therapy for the Treatment of Lipoprotein Lipase Deficiency - Cell and Gene Therapy Challenge Program	Colin Ross
UBC Faculty of Medicine: Precision Health Catalyst Grant	Uncovering patient-specific genetic factors that can be used to optimize morphine-based pain relief while avoiding harm	Colin Ross
National Centres of Excellence (NCE): Nanomedicines Innovation Network (NMIN)	Grand Challenge: Development, optimization and evaluation of novel nanoparticle formulations for extra-hepatic targeted gene therapy	Colin Ross
NSERC	Development of active loading technologies for encapsulating highly charged molecules into liposomes	Shyh-Dar Li
National Organization for Rare Disorders	Modulation of Tumor Immune Microenvironment for Enhanced Therapy of Pseudomyxoma Peritonei	Shyh-Dar Li
Canadian Cancer Society	A drug delivery technology for activating the tumor immune microenvironment of peritoneal metastases	Shyh-Dar Li
Michael Smith Health Research Foundation, Innovation to Commercialization Grant	Developing a safe and effective analgesic for chronic pain relief	Shyh-Dar Li
CIHR	Validation and commercialization of an innovative analgesic for chronic pain	Shyh-Dar Li
National Centres of Excellence	Lipid Nanoparticle-mediated Immunotherapy for Pseudomyxoma Peritonei	Shyh-Dar Li, Sarah Hedtrich
National Centres of Excellence	Research and KTEE accelerator	Shyh-Dar Li
MITACS Accelerate	High Performance Lipid Nanoparticle Production System	Shyh-Dar Li
Genentech	Understanding the Determinants of Oral Absorption of Poorly Soluble Drug Candidates	Harvey Wong

Source	Project Title	NCB Lead PI
Genome Canada	Precision Medicine CanPREVENT AMR: Applying precision medicine technologies in Canada to prevent antibody-mediated rejection and premature kidney transplant loss	Harvey Wong
Barbara Opperman Kidney Research Fund	Implementation of a Canadian Willingness to Cross Program: a Strategy to Increase Access to Kidney Transplantation for Highly Sensitized Patients	Harvey Wong
LEO Foundation	Towards a cure for genodermatoses: Intraepidermal delivery of gene editing tools leveraging smart delivery systems	Sarah Hedtrich
NSERC	Methylarginine Dynamics in Cellular Processes	Adam Frankel
CIHR	Overcoming Dihydrofolate Reductase Inhibitor Resistance Using Pyrimethamine-inspired Proteolysis Targeting Chimeras	Brent Page

## Publications

Adhikary PP, Tan Z, **Page BDG**, **Hedtrich S**. TSLP as druggable target - a silver-lining for atopic diseases? *Pharmacol Ther.* 2021 Jan;217:107648. doi: 10.1016/j.pharmthera.2020.107648. Epub 2020 Aug 3. PMID: 32758645.

### HIGHLIGHT

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### HIGHLIGHT

Ain QU, Campos EVR, Huynh A, Witzigmann D, **Hedtrich S**. Gene Delivery to the Skin - How Far Have We Come? *Trends Biotechnol.* 2021 May;39(5):474-487. doi: 10.1016/j.tibtech.2020.07.012. Epub 2020 Aug 29. PMID: 32873394; PMCID: PMC7456264. - **IF = 19.536**

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Babity S, Couture F, Campos EVR, **Hedtrich S**, Hagen R, Fehr D, Bonmarin M, Brambilla D. A Naked Eye-Invisible Ratiometric Fluorescent Microneedle Tattoo for Real-Time Monitoring of Inflammatory Skin Conditions. *Adv Healthc Mater.* 2022 Mar;11(6):e2102070. doi: 10.1002/adhm.202102070. Epub 2021 Dec 23. PMID: 34921529.

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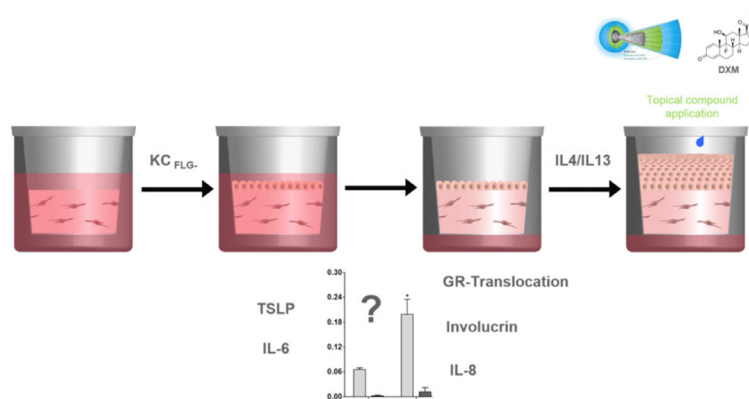
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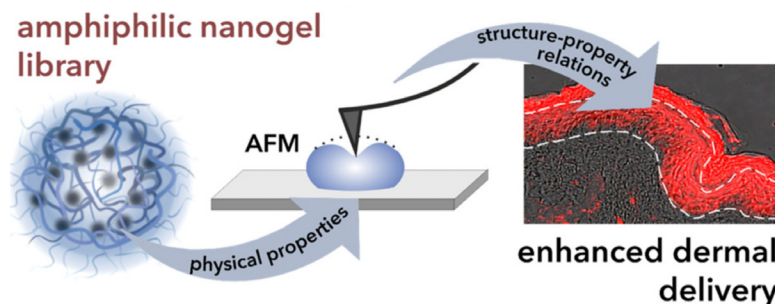
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Gruber A, Joshi AA, Graff P, Cuéllar-Camacho JL, **Hedtrich S**, Klinger D. Influence of Nanogel Amphiphilicity on Dermal Delivery: Balancing Surface Hydrophobicity and Network Rigidity. *Biomacromolecules*. 2022 Jan 10;23(1):112-127. doi: 10.1021/acs.biomac.1c01100. Epub 2021 Dec 7. PMID: 34874701.



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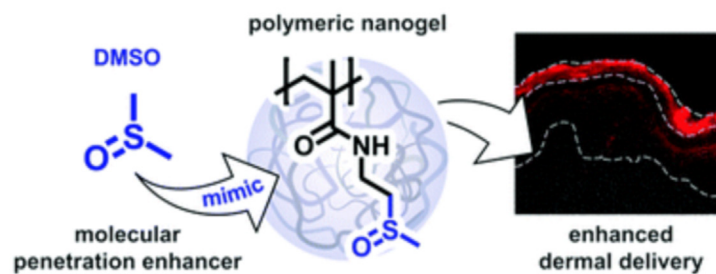


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Holzknacht J, Dubrac S, **Hedtrich S**, Galgóczy L, Marx F. Small, Cationic Antifungal Proteins from Filamentous Fungi Inhibit *Candida albicans* Growth in 3D Skin Infection Models. *Microbiol Spectr*. 2022 Jun 29;10(3):e0029922. doi: 10.1128/spectrum.00299-22. Epub 2022 May 2. PMID: 35499318; PMCID: PMC9241769.

Iliev P, Hanke D, **Page BDG**. STAT Protein Thermal Shift Assays to Monitor Protein-Inhibitor Interactions. *Chembiochem*. 2022 Jun 13:e202200039. doi: 10.1002/cbic.202200039. Epub ahead of print. PMID: 35698729

Işık D, Joshi AA, Guo X, Rancan F, Klossek A, Vogt A, Rühl E, **Hedtrich S**, Klinger D. Sulfoxide-functionalized nanogels inspired by the skin penetration properties of DMSO. *Biomater Sci*. 2021 Feb 9;9(3):712-725. doi: 10.1039/d0bm01717e. PMID: 33285562.



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Lin JJ, Loucks CM, Trueman JN, Drögemöller BI, Wright GEB, Yoshida EM, Ford JA, Lee SS, Kim RB, Al-Judaibi B, Schwarz UI, Ramji A, Tam E, **Ross CJ**, Carleton BC. Novel variant in glycophorin c gene protects against ribavirin-induced anemia during chronic hepatitis C treatment. *Biomed Pharmacother*. 2021 Nov;143:112195. PMID: 34562771

Lin L, Wright MR, Hop CECA, **Wong H**. Physiologically-Based Pharmacokinetic Models Can be used to Predict the Unique Nonlinear Absorption Profiles of Vismodegib. *Drug Metab Dispos*. 2022 Jul 2: DMD-AR-2022-000885. doi: 10.1124/dmd.122.000885. Epub ahead of print. PMID: 35779865.

Loucks CM, Yan K, Tanoshima R, **Ross CJ**, Rassekh SR, Carleton BC. Pharmacogenetic testing to guide therapeutic decision-making and improve outcomes for children undergoing anthracycline-based chemotherapy. *Basic Clin Pharmacol Toxicol*. 130, 95-99, 2022 Jan. PMID: 33900042.

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### HIGHLIGHT

Magdy T, Jiang Z, Jouni M, Fonoudi H, Lyra-Leite D, Jung G, Romero-Tejeda M, Kuo HH, Fetterman KA, Gharib M, Burmeister BT, Zhao M, Sapkota Y, Carleton BC, Ross CJD, Bernstein D, Burrridge PW. RARG variant predictive of doxorubicin-induced cardiotoxicity identifies a cardioprotective therapy. *Cell Stem Cell*. 2021 Sep 14:S1934-5909(21)00343-X. PMID: 34525346. IF = 24.63

*This paper describes a series of comprehensive functional validation studies of the RARG gene (which my team identified in 2015) as a genetic risk factor of anthracycline-induced heart failure in pediatric cancer patients who receive doxorubicin chemotherapy.*

### HIGHLIGHT

Magdy, T., Jouni, M., Kuo, H.-H., Weddle, C.J., Lyra-Leite, D., Fonoudi, H., Romero-Tejeda, M., Gharib, M., Javed, H., Fajardo, G., Ross, C.J. Carleton, B.C., Bernstein, D., and Burrridge, P.W. Identification of Drug Transporter Genomic Variants and Inhibitors that Protect Against Doxorubicin-Induced Cardiotoxicity. *Circulation*. 2022 Jan 25;145(4):279-294. Epub 2021 Dec 7. PMID: 34874743. IF = 29.69

*This paper describes functional studies that validate the role of the SLC28A3 gene (which my team identified in 2012 and replicated in 2013) as a genetic risk factor of anthracycline-induced heart failure in pediatric cancer patients who receive doxorubicin chemotherapy.*

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## NCB Retreat 2022



After a COVID induced hiatus, the Nanomedicine and Chemical Biology Group (NCB; a.k.a. NaCho) was able to meet for our annual retreat on March 7, 2022. We were thrilled to be able to host the retreat in person at the Vancouver Rowing Club in Stanley Park thanks to the generous support from our sponsor, Precision Nanosystems Inc.

We had a busy day starting with a lab-themed Jeopardy ice breaker where we were blessed with an acapella excerpt from the little mermaid by Brent Page to prove that his vocal skills were everything he claimed them to be. Throughout the day PIs gave 10-minute talks to refresh everyone's memory on what their labs are up to and facilitate future collaborations between labs. After a few talks we headed out to our second fun activity of the day.

Next on the schedule was our mystery-filled aquarium visit where we challenged everyone to solve riddles and take pictures of various animals. There was even a sighting of the ultra-rare Frankel fish! Later in the evening, in a wild turn of events students took to judging PIs in a series of hilarious Dragon's Den presentations featuring custom made hats and innovative pipette belts.

Before dinner we were lucky to have a talk from Dr. Reka Geczy, a scientist in product development at Precision Nanosystems Inc. and former student of the Hafeli lab. Her presented work on novel RNA Lipid Nanoparticle Platforms for creating gene editing CAR T cells was very exciting to hear about.

All in all, it was a great day of team building between lab members and between groups. After a few years of zoom and social distancing it was great to have NCB members mingling again. A big thank you to the organizing committee of Tanya Saxena, Po-Han Chao, Chris Hoang, Jeff Proctor, Karan Khanna, Alex Birkenshaw, and faculty representative Dr. Urs Häfeli for their work on organizing this year's retreat!

Thanks to everyone who attended! See you next year!

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Frankel Lab

<https://twitter.com/labfrankel?lang=en>

Hafeli Lab

[http://www.magneticmicrosphere.com/hafeli\\_lab/index.php](http://www.magneticmicrosphere.com/hafeli_lab/index.php)

Hedtrich Lab

<https://hedtrichlab.pharmsci.ubc.ca>

Page Lab

<https://www.brentpagelab.com>

Li Lab

<https://lilab-tddn.pharmsci.ubc.ca/people/>

Ross Lab

<https://colinrosslab.com/>

Wong Lab

<https://pharmsci.ubc.ca/directory/harvey-wong>

Wisnovsky Lab

<https://wisnovskylab.ca>