

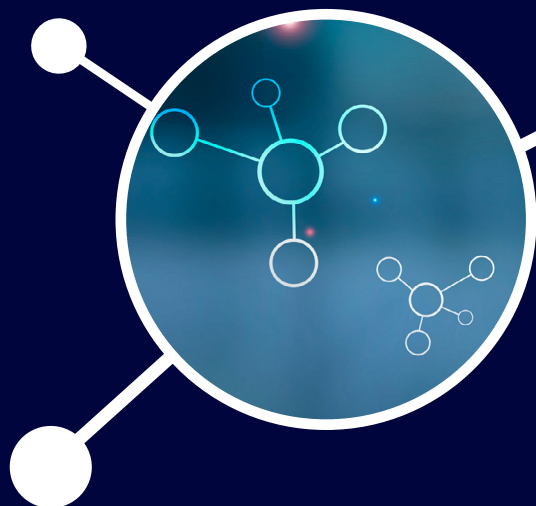
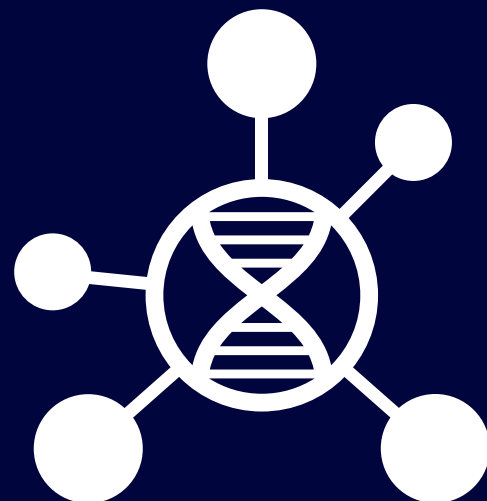


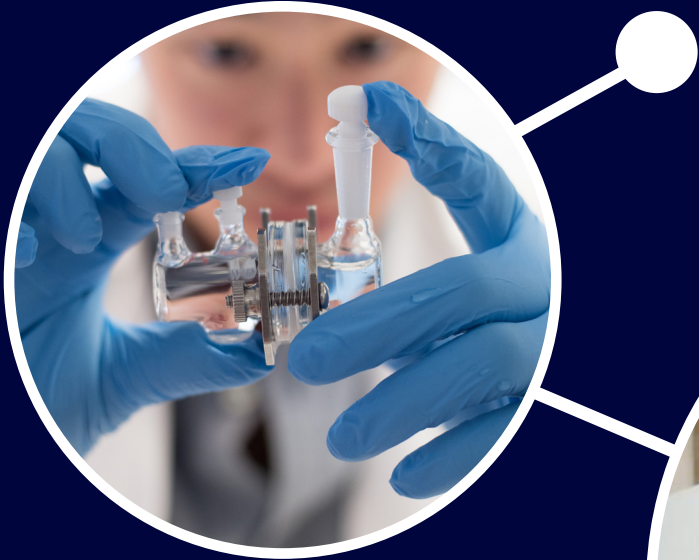
THE UNIVERSITY OF BRITISH COLUMBIA

Nanomedicine and Chemical Biology

Faculty of Pharmaceutical Sciences

# Annual Report 2019-2021





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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



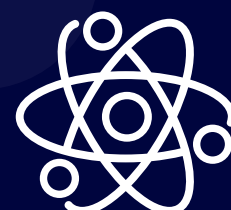
49 Completed  
45 Active

## 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



## Faculty List



**Adam Frankel, PhD**  
Associate Professor in Nanomedicine and Chemical Biology  
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**Urs O. Häfeli, BSc (Pharm), PhD**  
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Lundbeck Foundation Professor in Drug Delivery and Nanomedicines  
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**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

	Completed 17	Active 6
<b>Postdoctoral Fellows</b>  <b>Total: 23</b>	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

	Completed 3	Active 25
<b>PhD</b>  <b>Total: 27</b>	Monica Agnoletti Reka Geczy Zeynab Nosrati	Jennifer Brown Michael Rowley Lennart Bohrmann Marta Bergamo Tanya Saxena Tullio Esposito Zheng Tan Belal Tafach Petar Iliev Anne Nguyen Lukas Hohenwarter Jiamin 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

MSc Total: 17	Completed 9	Active 8
	Lovelyn Charles Aaroh Anand Joshi Tarada Tripetchr Natascha Eger Ana Rita Falcao Conrad Heilmann Monica Yu Josephine Christenen Griffin Pauli	Riley Prout-Holm Juliana Bolsoni Danielle Hanke Sogand Assarnia Tessa Morin Nida Bilal Sandy Morrison Kheireddin Mufti

Undergraduate Total: 27	Completed 21	Active 6																						
	<table border="0"> <tr> <td>Yun An Chen</td> <td>Sreemoyee Ghosh</td> </tr> <tr> <td>Morris Baumgardt</td> <td>Yuegun Guo</td> </tr> <tr> <td>Amy Kang</td> <td>Brenna Reimer</td> </tr> <tr> <td>Sahar Zandi Nia</td> <td>Oscar Xu</td> </tr> <tr> <td>Gillian Cokura</td> <td>Chantane Yeung</td> </tr> <tr> <td>Kathleen Lau</td> <td>Samuel Chu</td> </tr> <tr> <td>Andy Hur</td> <td>Aliyana Ladha</td> </tr> <tr> <td>Brandon Lee</td> <td>Martin Wong</td> </tr> <tr> <td>Kaitlyn Roberts</td> <td>Emily Tsui</td> </tr> <tr> <td>Dennis Lee</td> <td>Madeline Chan</td> </tr> <tr> <td>Michael Lee</td> <td></td> </tr> </table>	Yun An Chen	Sreemoyee Ghosh	Morris Baumgardt	Yuegun Guo	Amy Kang	Brenna Reimer	Sahar Zandi Nia	Oscar Xu	Gillian Cokura	Chantane Yeung	Kathleen Lau	Samuel Chu	Andy Hur	Aliyana Ladha	Brandon Lee	Martin Wong	Kaitlyn Roberts	Emily Tsui	Dennis Lee	Madeline Chan	Michael Lee		Alana Hitsman Colin Blackadar Danny Liu Emily Chow Kurbaan Shergil Alexandra Birkenshaw
Yun An Chen	Sreemoyee Ghosh																							
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Kathleen Lau	Samuel Chu																							
Andy Hur	Aliyana Ladha																							
Brandon Lee	Martin Wong																							
Kaitlyn Roberts	Emily Tsui																							
Dennis Lee	Madeline Chan																							
Michael Lee																								

## 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**

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

## Funding - continued

Total Funding: \$17.1M

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

## Funding - continued

Total Funding: \$17.1M

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

## Funding - continued

Total Funding: \$17.1M

Source	Project Title	NCB PI
CIHR	Clinical and Pharmacogenomics predictors of inter-patient variation in Direct Acting Oral Anticoagulant (DOAC) plasma concentrations in real-world patients	C. Ross
UBC VP Research Strategic Research Opportunity Grant	Development of a novel reporter mouse model to explore <i>in vivo</i> ABE gene repair	C. Ross
CIHR	Optimizing Chronic Hepatitis C Treatment	C. Ross
Canada Foundation for Innovation (CFI)	Personalized genomic medicine for improved paediatric drug safety and effectiveness	C. Ross
CIHR Team Grant	DSEN-SEARCH & PREVENT: (active <b>S</b> urveillance and <b>E</b> valuation of <b>A</b> dverse <b>R</b> eactions in <b>C</b> anadian <b>H</b> ealthcare) & ( <b>P</b> harmacogenomics of Adverse <b>R</b> eaction <b>E</b> vents <b>N</b> ational <b>T</b> eam)  <i>(Role: Major role as co-PI and lead of all genomics studies)</i>	C. Ross
CIHR Project Grant (PI)	<i>Project Grant:</i> Discovery, validation, and pre-clinical development of targeted cardio-protectants for the prevention of anthracycline-induced cardiotoxicity	C. Ross
Genome Canada  (Major co-funders include: CIHR, BCCH Foundation; Genome BC)	<i>Large-scale Applied Research Research Project (LSARP):</i> Go-PGx: Genomic and Outcomes Databank for Pharmacogenomic and Implementation Studies	C. Ross

## Funding - continued

**Total Funding: \$17.1M**

Source	Project Title	NCB 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	C. Ross
National Research Council of Canada (NCE funded)	AV Gene Therapy for the Treatment of Lipoprotein Lipase Deficiency - Cell and Gene Therapy Challenge Program	C. Ross
Canadian Cancer Society	Preclinical therapeutic development of targeted cardio-protectants for use in cancer patients receiving anthracycline chemotherapy	C. Ross
Genentech	Understanding the Determinants of Oral Absorption of Poorly Soluble Drug Candidates	H. Wong
Genome Canada	Precision Medicine CanPREVENT AMR: Applying precision medicine technologies in Canada to prevent antibody-mediated rejection and premature kidney transplant loss	H. 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	H. Wong

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Adhikary PP, UI Ain Q, Hocke AC, **Hedtrich S**. COVID-19 highlights the model dilemma in biomedical research. *Nat Rev Mater*. 2021 Mar 17;1:1-3. doi: 10.1038/s41578-021-00305-z.

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Drögemöller, B.I., Wright, G.E.B., Shih, J., Monzon, J.G., Gelmon, K.A., **Ross, C.J.**, Amstutz, U., Carleton, B.C., & CPNDS Clinical Recommendations Group. CYP2D6 as a treatment decision aid for ER-positive non-metastatic breast cancer patients: a systematic review with accompanying clinical practice guidelines. *Breast Cancer Research and Treatment*. 2019 Feb;173(3):521-532. PubMed PMID: 30411242.

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## Publications - continued

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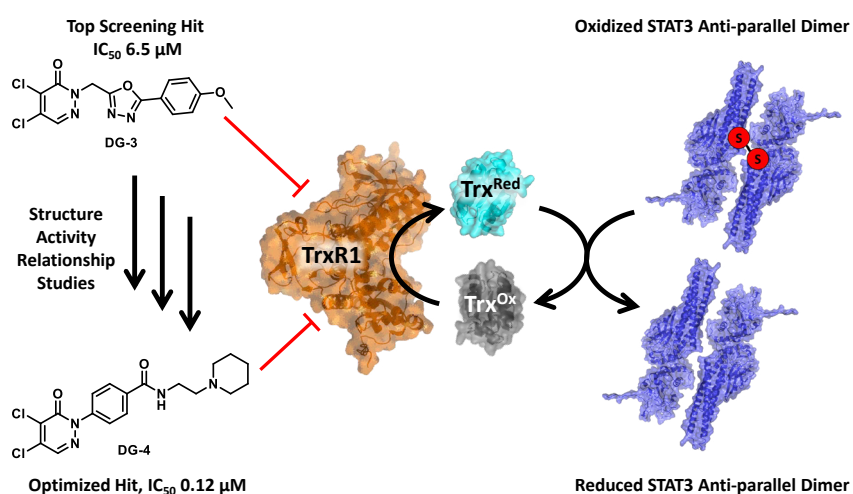
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## Publication Highlights

Busker S, Qian W, Haraldsson M, Espinosa B, Johansson L, Attarha S, Kolosenko I, Liu J, Dagnell M, Grandér D, Arnér ESJ, Tamm KP, **Page BDG**. Irreversible TrxR1 inhibitors block STAT3 activity and induce cancer cell death. *Sci Adv*. 2020 Mar 20;6(12):eaax7945.

### Graphical Abstract:



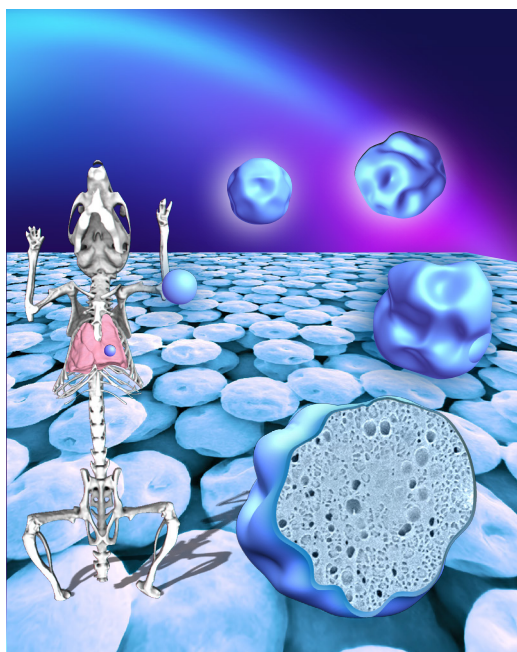
Science Advances 2019 impact factor is 13.116. Ranked #3 in Multidisciplinary Subjects.

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

Agnoletti M, Rodríguez-Rodríguez C, Kłodzińska SN, Esposito TVF, Saatchi K, Mørck Nielsen H, Häfeli UO. Monosized Polymeric Microspheres Designed for Passive Lung Targeting: Biodistribution and Pharmacokinetics after Intravenous Administration. *ACS Nano*. 2020 Jun 23;14(6):6693-6706. (IF 14.88)

### Graphical Abstract:



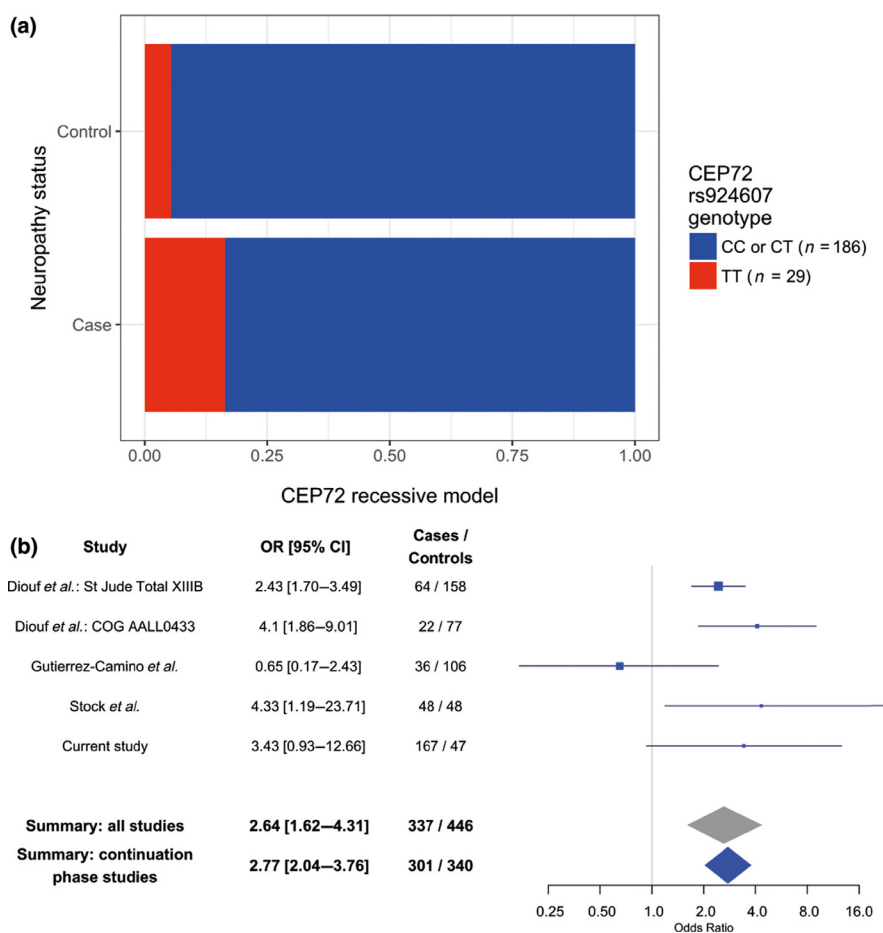
**Ranked #1 from 299 journals in General Engineering; and #2 in Nanoscience and Nanotechnology.**

Monosized 12  $\mu\text{m}$  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

\*Wright, GEB, Amstutz, U, Drögemöller, B.I., Shih, J., Rassekh, S.R., Carleton, BC, and Ross, CJ. Pharmacogenomics of vincristine-induced peripheral neuropathy implicates pharmacokinetic and inherited neuropathy genes. *Clinical Pharmacology & Therapeutics*. Feb 105(2):402-410. 2019. PMID: 29999516. (SA)

### 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.



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**Juliana Bolsoni**  
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<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](http://www.magneticmicrosphere.com/hafeli_lab/index.php)

Hedtrich Lab

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

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