Juliana J. Lee

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EDUCATION

University of Oxford, Nuffield Department of Clinical Medicine — Oxford, UK
MSc by Research, Clinical Medicine — 2018-2021

Dissertation: A CRISPR-Cas9 screen for hepatocyte receptors for malaria parasite invasion (🔗)
Advisor: Dr. Alexander (Sandy) Douglas (🔗)

University of Toronto, Faculty of Arts and Science — Toronto, ON, Canada
Honours Bachelor of Science (with high distinction) — 2014-2018

Majors: Immunology and Biochemistry
Dissertation: Effect of Type I and Type II interferons (IFNs) on GITR ligand expression in inflammatory monocyte-derived antigen presenting cells (moAPCs).
Undergraduate research advisor: Dr. Tania Watts (🔗)

CERTIFICATE

Harvard Extension School — Boston, MA, US
Bioinformatics Graduate Certificate — 2021-2022

Relevant courses: Epigenetics (BIOSE30; grade A), Bioinformatics (BIOTE104; grade A-), Biostatistics (STATS E-102; grade A-), Artificial Intelligence (CSCI E-80; grade B)

RESEARCH EXPERIENCE

Harvard Medical School – Harvard University, Department of Immunology — Boston, MA, US
Research Assistant with Dr. Christophe Benoist (🔗) — 2020-present

Project 1: Mapping genome-wide epigenomic modifications by DNA-associated proteins in immune cell-types using Cleavage Under Targets & Release Using Nuclease (CUT&RUN) as an Immunological Genome (ImmGen) consortium project (🔗).

- Collaborated with EpiCypher (🔗), an epigenetics company that launched CUT&RUN, to establish a robust CUT&RUN protocol ('low cell input CUT&RUN') and make it applicable for all immune cell-types of varying abundancy.
    - Tested various cell storage conditions, buffers with different chemical compositions, enzyme:cell ratios and salt:enzyme ratios to decrease the required number of purified cells by five-fold
    - H3K4me1, H3K4me3, H3K27me3, H4K16ac, H3K9me3, H3K36me3, H3K27ac, H3.3, and CTCF were tested to find the ones most compatible with the CUT&RUN protocol and the scope of the project.
    - Developed a data analysis pipeline for processing low cell input CUT&RUN data resulting in in a communal use for other lab members.
    - Success in CUT&RUN optimization and data analysis pipeline were demonstrated in a submitted manuscript (Nature Immunology; revision stage) that produced CUT&RUN data of follicular B

cells from intraperitoneally injected C57BL/6 mice with IL-4 or PBS. Data can be found through GEO Series accession number GSE208138 (🔗).

- Orchestrated work amongst 15 scientists from eight ImmGen labs to collect 120 immune cell-types and profile epigenomic modifications of H3K4me1, H3K4me3, H3K27me3, H3K36me3, H3K27ac, H3.3 and CTCF using the low input CUT&RUN method.
    - Used C57BL/6 x Cast/EiJ F1 mice to investigate relationships between genetic variants and chromosome structures by comparing allele-specific signals.
    - Performed ultra-low input RNAseq (ULI RNAseq) and ATACseq in parallel to incorporate transcriptome and chromatin accessibility data and study how physical interaction of DNA and chromatin affect gene expression.
    - Results will be made publicly available on www.immgen.org for global users.

Project 2: Management of ULI RNAseq samples, and communal lab reagents.

- Collaborated with Broad Institute to facilitate 1) generation of ULI RNAseq data produced by SMART-Seq2 sequencing kits in batch-mode and 2) distribution of data to sample owners.
    - Managed more than 2,500 ULI RNAseq samples from eight labs from Harvard Medical School and University of California San Diego to help produce high quality data, which are used in two publications, six manuscripts in progress and one grant proposal.
- Carefully planned usage of easily backordered ULI RNAseq materials for 25 lab members to prevent them from being out-of-stock, resulting in expedient and efficient sample collection and data generation without any delays caused by lack of materials.
- Organized and ordered common laboratory materials, resulting in lab members being able to conduct experiments on time with all reagents.

University of Oxford, Jenner Institute Oxford, UK

Graduate Researcher with Dr. Alexander (Sandy) Douglas (🔗) 2018-2020

Project: A CRISPR-Cas9 screen for hepatocyte receptors for malaria parasite invasion (🔗)

- Studied liver stage of malaria by performing high-throughput CRISPR-Cas9 screens to uncover new hepatocyte surface receptors involved in sporozoite invasion
    - Knocked out 470 genes, ranked by most to least abundant human hepatocyte surface protein, in Cas9-expressing HC-04, a human hepatocyte cell line made susceptible to rodent sporozoite invasion, using CRISPR-Cas9.
    - Dissected *Anopheles* mosquitoes to harvest fresh transgenic mCherry-expressing rodent sporozoites and infected mutated HC-04 cells twice a month. Identified and FACS-sorted invaded cells 22 hours post infection for next-generation sequencing.
    - Analyzed high-throughput data using linux-based computational tools and identified 25 genes (i.e. *Itgav, Rpn1, Tmem30a, Atp2b1, Itgb5, Slc35a2, Mgat1, Fcgr2b, Emc1, Apoh)* as significant genes in sporozoite invasion.
    - Collaborated with Dr. Wright from Wellcome Sanger Institute to plan and execute follow-up experiments on *Itgav* and *Itgb5* using avidity-based extracellular interaction screens (AVEXIS) and additional sporozoite invasion assays using single-gene knockout cell-lines.
    - Also targeted *Slc35a2* and *Mgat1* as candidates for further studies; however, due to laboratory shutdown during COVID-19 pandemic, no further experiments could be performed on the new results. Screen results are actively being investigated at the lab by other members for a manuscript in progress

University of Toronto, Department of Immunology Toronto, ON, Canada

Undergraduate Researcher with Dr. Tania Watts (🔗) Summer 2017-2018

Project 1: Introduction of rs4761847 SNP in *Traf1* using CRISPR-Cas9 to investigate its effect in rheumatoid arthritis.

- Used CRISPR-Cas to introduce a single base change (rs4761847; A to G mutation) in *Traf1* gene in THP-1 cells, a human monocyte-like cell line
    - Designed three sgRNA candidates and two repair templates to introduce rs4761847
    - Ligated sgRNAs to a Cas9-expressing vector and transfected THP-1 cells with this mutated vector and repair templates

Project 2: Effect of Type I and Type II IFNs on GITR ligand expression in (moAPCs).

- Investigated causal transcription factor binding sites for GITR ligand expression in response to type I and II IFNs in RAW264.7, a macrophage-like mouse cell line, using Gaussia-Cypridina luciferase reporter assays.
    - Deleted STAT5, IRF7, ISRE, STAT3 and STAT6 transcription factor motifs on GITR ligand promoter (predicted by using MatInspector) using site-directed mutagenesis on a plasmid vector expressing GITR ligand and Cypridina-luciferase.
    - Transfected RAW264.7 with the mutated GITR ligand-Cypridina plasmid and Gaussia-luciferase plasmid, which was used for background bioluminescence measurement, followed by stimulation of RAW264.7 cells with IFN-**α**, IFN-**β** and IFN-**γ** 24 hours post transfection.
    - Recorded GITR ligand activity 24 hours post stimulation by measuring Cypridina:Gaussia bioluminescence ratio
    - Results identified ISRE, STAT3 and STAT6 binding sites as players in GITR ligand expression in response to interferon stimulation.

National Institute of Immunology New Delhi, India

Queen Elizabeth II Diamond Jubilee Intern with Dr. Prafullakumar Tailor (🔗) Summer 2016

Project: Optimization of CRISPR-Cas9 to investigate the role of *Irf8* in CD8+ dendritic cell development.

- Generated lentivirus containing plasmid expressing Irf8-targeting sgRNA and Cas9 enzyme from HEK293T.
- Resulted in successful knock-out of *Irf8* in bone marrow mononuclear cells harvested from Balb/c mice for common lab use

PUBLICATIONS

Baysoy A, Seddu K, Salloum T, Dawson C, **Lee J**, [11 authors], Benoist C. (2022) The interweaved signatures of common-gamma-chain cytokines across immunologic lineages. (Submitted to Nature Immunology; under revision)

Lee, J. (2021). A CRISPR-Cas9 screen for hepatocyte receptors for malaria parasite invasion [Master's thesis]. University of Oxford. (🔗)

Lee J, Reddy RS, Douglas S. (2022) CRISPR-Cas9 screen for identifying essential hepatocyte receptors in sporozoite invasion [manuscript in preparation]

AWARDS

Graduate prize 2021

- Awarded yearly to twelve students by Governing Body at Trinity College, University of Oxford

2020 U of T COVID-19 student engagement award (🔗) 2020

- Awarded grant for COVID19 Recovery project for the summer of 2020

The Provost W.T. Delworth Graduation Scholarship + secondary merit award 2018

- Awarded to the graduating class of Trinity College, University of Toronto based on their student debt and grade point average.

Immunology Summer Student Research Program (🔗) 2017

- Awarded to undergraduate summer research interns to conduct laboratory research project at a lab from the Department of Immunology, University of Toronto from May to August.
- Successful internship resulted in project continuation from September 2017 to April 2018 as a part of IMM450, a full-year research course.

Queen Elizabeth II Diamond Jubilee Scholarship (🔗) 2016

- Awarded to 15 students every year to conduct a research project as an intern at a lab in a Commonwealth country for three months

Dean's List Scholar 2016 – 2018

- Yearly awarded for receiving cumulative GPA of higher than 3.50 (top 20%)

Chemistry Connections Challenge, winning entry 2017

Trinity College Admission Scholarships 2014

- Awarded to 90 incoming first-year students

University of Toronto President's Entrance Scholarship 2014

- Awarded to incoming first-year students with a final admission grade of 95% and above

PUBLIC ENGAGEMENT

COVID19 Recovery Project – bringing positive news to you (🔗) 2020-2021

Founder and Team Leader

- To bring positive, heartwarming news and lessen negative impact the COVID19 pandemic had on everyone around the world, www.covid19recovery.net website was created (total of 55,000+ visitors and 200 visits/day).
- Led a group of 15 students from five countries to update website with positive news articles, pictures, and interviews with people of various occupations from professor to social worker.
- Managed social media accounts such as Instagram and Facebook to bring news about website updates and guidelines on how to stay safe during the pandemic. Service was provided in three languages: English, French and Mandarin.
- Received COVID-19 Student Engagement Award ($3000) from the University of Toronto (🔗).

- Project success was featured on 11Alive (🔗), University of Toronto News (🔗), and Toronto CityNews (🔗) news articles.

KSEAUK Bio-Medical Symposium Nov 2019

Invited presenter

- Presented research work on how CRISPR-Cas9 helps to understand human-parasite relationship

Jenner Institute Student Symposium Oct 2019

Invited presenter

- Highlighted and shared research discoveries to other students, research assistants and group leaders of the Jenner Institute, University of Oxford

Trinity College MCR Gaudy May 2019

Invited presenter

- Invited to showcase research to the benefactors as one of the representatives of the Trinity College Middle Common Room (MCR) community

Trinity College MCR Committee 2019-2020

Secretary

- Managed more than 200 MCR and SCR members, and organized college-wide events such networking with alumni and other Oxford college students, resulting in a two-fold increase in events specific for tackling diversity and mental health issues
- Organized committee meetings and produced weekly newsletters with updates on college activity.

Mount Sinai Hospital Toronto, ON, Canada

Volunteer

Unit 1) Ben and Hilda Katz Acute Care for Elders (ACE) unit Sept 2015 – Nov 2016

- Prepared meals, helped mobility and provided entertainment to elderly patients for 100+ hours
- Occasionally contributed as a Korean interpreter for Korean patients

Unit 2) Pathology and Laboratory Medicine May 2015 – Aug 2015

- Organized patients' blood, stool, and urine samples to different testing stations for 40+ hours

Toronto Life Sciences Toronto, ON, Canada

Staff member Sept 2016 – Sept 2017

- Organized seminars for 200 undergraduate students in preparation for their course examinations