Timothy J. Keyes

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Education

Stanford University School of Medicine - Stanford, CA
MD/PhD candidate (PhD expected 04/2023, MD expected 07/2024)
- PhD Program in Cancer Biology
- Advisors: Kara Davis and Garry Nolan
- Thesis Committee: Jonathan Chen, Crystal Mackall, Sylvia Plevritis

Master of Science in Biomedical Informatics (expected 07/2022)

Princeton University - Princeton, NJ
Bachelor of Arts in Psychology and Neuroscience, 2014
- Concentrations: Neurobiology, Quantitative and Computational Neuroscience
- *Summa cum laude*

St Edmund Hall, **University of Oxford** - Oxfordshire, United Kingdom
Year Abroad, Fall-Spring 2013
- Concentrations: Biochemistry, Experimental Psychology

Awards, Honors, and Distinctions

Undergraduate:

2011-12 Shapiro Prize for Academic Excellence, *Princeton University*
- Awarded Freshmen and Sophomore years for superior academic standing

2013 Phi Beta Kappa, *Princeton University*
- Inducted in fall 2013 for achieving academic standing within the highest 1% of Princeton's graduating class

2013-14 Howard Crosby Warren Junior and Senior Prizes in Psychology, *Princeton University*
- Awarded for academic excellence in psychology, neuroscience, and independent research during junior and senior years

2014 Award for Academic Excellence, *Princeton Neuroscience Institute*
- Awarded to the undergraduate with the highest academic standing in neuroscience of the graduating class

Medical/Graduate School:

2018 Award for Excellence in Promotion of Diversity and Societal Citizenship, *Stanford University School of Medicine*
- Awarded annually to recognize individuals that have made significant contributions to the promotion of the principles of diversity and societal citizenship at the Stanford School of Medicine

2019 LGBT Workforce Junior Leadership Award, *Building the Next Generation of Academic Physicians (BNGAP)*
- Awarded annually to recognize a health-related graduate school trainee who has led activities to promote the development of a health workforce responsive to the needs of LGBT communities

2019 Integrated Strategic Plan Star Award, *Stanford Medicine*
- Established to recognize individuals whose work embodies Stanford Medicine's three strategic priorities: being value focused, digitally driven, and "uniquely Stanford"

2019 Community Impact Award, *Stanford University*
- Recognizes graduate students who have enhanced the Stanford Community through leadership, advocacy, or service

2019 Ruth L. Kirschstein Pre-doctoral National Research Service Award (F31), *National Institutes of Health*
- Fellowship awarded to provide predoctoral individuals with supervised research training in specified health and health-related areas leading toward the research doctoral degree

2020 Point Graduate Student Scholarship, *Point Foundation*
- Awarded to LGBTQ-identifying graduate students for distinction in three areas: leadership, scholarship, and activism

2021 rstudio::global(2021) Diversity Scholarship, *RStudio*
- Applicants from underrepresented groups were selected to join in networking and educational programming at the rstudio:global conference in 2021

Research Experience

2010-14 Gould Laboratory, Princeton University – *Research Assistant – Princeton, NJ*

- Assisted investigation of genes responsible for resistance of rat spinal nucleus of the bulbocavernosus motor neurons to atrophy in neurodegenerative disease
- Investigated effects of physical activity and norepinephrine signaling on astrocyte and microglial morphology and function in the adult rat hippocampus and medial prefrontal cortex

2014-15 Kipnis Laboratory, University of Virginia – *Laboratory Technician II – Charlottesville, VA*

- Contributed to the novel characterization of meningeal lymphatic vessels in the mouse and human central nervous system and their role in draining cerebrospinal fluid and CNS-resident immune cells into central circulation
- Conducted an independent project characterizing microglial dysfunction in genetic models of autism spectrum disorders and potential immune-targeted treatment strategies
- Led the construction of a three-dimensional model of meningeal lymphatic vessels in the mouse head by applying computational image processing tools to fluorescent images obtained using confocal microscopy

2018- Davis and Nolan Laboratories, Stanford University – *MD/PhD Student – Stanford, CA*

- Designed and developed reagents for a mass cytometry (CyTOF) panel used to investigate the single-cell proteomic profile of cancer cells in human pediatric acute myeloid leukemia (AML) diagnostic bone marrow samples.
- Developed {tidytof}, a data analysis pipeline to parse heterogeneity in populations of cells analyzed using mass cytometry (CyTOF)
- Analyzing mass cytometry data from pediatric AML diagnostic samples using machine learning algorithms in order to predict chemotherapy response and relapse of individual patients to drive novel personalized-medicine and risk-stratification strategies

2022- Oncology Bioinformatics Department, Genentech, Inc. – *Graduate Intern – South San Francisco, CA*

- Developing a novel algorithm to detect transcription factor network perturbations in cancer tissue using Bayesian network modeling
- Automating data processing pipelines to integrate datasets collected using multiple -omic modalities including next-generation genome sequencing, ATAC-seq, and RNAseq

R Packages

- **CytofIn:** An R package for integrating mass cytometry data from heterogeneous sources (role: author)
- **tidytof**: A high-level API for analyzing single-cell data using a tidy interface (role: author, maintainer)

Peer-reviewed Publications

- **Keyes TJ**, Nolan GP, Davis KL. {tidytof}: A user-friendly framework for scalable and highly reproducible mass cytometry data analysis. Submitted.

- **Keyes TJ*,** Zucker S,* Jia JL, Goetz TG, and Subak L**.** Sexual and gender minority identity disclosure from undergraduate to graduate medical education: Perceptions of Professional "Outness." *Annals of LGBTQ Public and Population Health*. In press.

- Lo YC, **Keyes TJ**, Jager A, Sarno J, Domizi P, Majeti R, Sakamoto KM, Lacayo N, Mulligan CG, Waters J, Sahaf B, Bendall SC, Davis KL. CytofIn enables Integrated Analysis of Public Mass Cytometry Datasets using Generalized Anchors. (2022) *Nature Communications*. 13: 934. https://doi.org/10.1038/s41467-022-28484-5

- Lin CH, Kuehn HS, Thauland TJ, Lee CM, De Ravin SS, Malech HL, **Keyes TJ**, Jager A, Davis KL, Garcia-Lloret MI, Rosenzweig SD, Butte MJ. Progressive B-cell loss in revertant X-SCID. (2020) *Journal of Clinical Immunology*.

- **Keyes TJ**, Domizi P, Lo YC, Nolan GP, and Davis KL. A cancer biologist's primer on machine learning applications in high-dimensional cytometry. (2020) *Cytometry*, **97** (8):782-799. doi: 10.1002/cyto.a.24158.

- Bunting SR, Battes TJ, **Keyes TJ**, Garber SS, Goldstein RH, Ritchie TD. Student Education About Pre-Exposure Prophylaxis (PrEP) Varies Between Regions of the United States. *Journal of General Internal Medicine*. (2020). *Journal of General Internal Medicine*. doi: 10.1007/s11606-020-05736-y

- Goetz TG*, Zucker S*, **Keyes TJ***, Gisondi MA. Medical Student Pride Alliance: The First National LGBTQ+ Medical Student Affinity Organization. (2020) *Medical Education*, **54** (5): 471-472. doi: 10.111/medu.14112

- Jia J, Kamceva M, and **Keyes TJ.** Navigating Controversy: A Critical Element of Medical Education. (2018). *Academic Medicine*, **93** (12): 1750. 2018. doi: 10.1097/ACM.0000000000002454.

- Louveau A, Smirnov I, **Keyes TJ**, Eccels J, Rouhani SJ, Peske JD, Mandell JM, Derecki NC, Harris TH, and Kipnis J. Structural and functional features of central nervous system lymphatic vessels. (2015) *Nature*, **523**: 337-341. doi: 10.1038/nature14432

Posters and Oral Presentations

- **Keyes T**, Nolan GP, Davis KL. "{tidytof}: A user-friendly pipeline for scalable and highly-reproducible analysis of mass cytometry data using tidy data principles." Invited presentation for the Stanford University Institute for Immunity, Transplantation, and Infection Speaker Series. Stanford, CA. March 2022.

- **Keyes T**. "The Doctor (to be) Is In." Invited speaker for Princeton University Health Professions Advising. Princeton, NJ (Virtual). Jan. 2022.

- **Keyes T**. "Keys to Success: Physician-scientist Well-being." Invited panelist at the American Physician-Scientist Association Northeast Regional Conference. Pittsburgh, PA (Virtual). Jan. 2022.

- Keyes T, Nolan GP, Davis KL. "{tidytof}: Predicting Patient Outcomes from Single-cell Data using Tidy Data Principles." Oral presentation at R/Medicine 2021. Philadelphia, PA (Virtual). Aug. 2021.

- Gisondi MA, Zucker S, **Keyes TJ**, Bottini W, Bumgardner DM. "The Making of Stanford's Teaching LGBTQ+ Health Course: Training a New Generation of Affirming Providers and Educators." University of California San Diego, Department of Emergency Medicine, Grand Rounds. May 2021.

- **Keyes T**, Gisondi MA Zucker S, Bottini W, Bumgardner DM. "The Making of Stanford's Teaching LGBTQ+ Health Course: Training a New Generation of Affirming Providers and Educators." Stanford University, Pre-Clinical Directors Meeting. May 2021.

- **Keyes T**, Zucker S**,** Goetz L**,** Jia JL**,** Muñoz R**,** Carlsen T**,** Kamceva M**,** Kanuparthy M**,** Matheson M**,** Zucker S**,** Subak L**.** Sexual and Gender Minority (SGM) Affinity Groups at U.S. Schools: A Needs-Assessment Towards a National Forum. Poster at the 37th Annual GLMA Conference on LGBTQ Health. New Orleans, LA. Sept. 2019.

- **Keyes T**, Goetz LG, Zucker S, Carlsen T. Student Led LGBT Health Initiatives. Oral presentation at the Building the Next Generation of Academic Physicians (BNGAP) LGBT Health Workforce Conference. New York, NY. May 2019.

- **Keyes T**, Jia JL**,** Goetz L**,** Muñoz R**,** Carlsen T**,** Kamceva M**,** Kanuparthy M**,** Matheson M**,** Zucker S**,** Subak L**.** Sexual and Gender Minority (SGM) Affinity Groups at U.S. Medical Schools: A Needs-Assessment Towards A National Medical Student Forum. Poster at the Q-Forward (formerly Q-Med) LGBTQI+ Leadership Conference. New Haven, CT. Mar. 2019.

- **Keyes T***, Paloma M*, Garcia R, and Mendoza F. Building an Alliance between Affinity Groups at an Academic Medical Center: A Medical Student-led Partnership for Planning Diversity Initiatives. Poster at the American Association of Medical Colleges Group for Diversity and Inclusion Professional Development Conference. New Orleans, LA. May 2018.

- Louveau A, Smirnov I, Eccels J, Rouhani SJ, Peske JD, **Keyes T**, Derecki NC, Lee KS, Harris TH, and Kipnis J. Structural and functional features of central nervous system lymphatics. Poster at the meeting for the International Society of Neuroimmunology. May 2014

- Hillis J, **Keyes T**, Szele F. The role of Galectin-3 in oligodendrogenesis in the subependymal zone after cuprizone demyelination. Poster at *Society for Neuroscience 2013.*

- Opendak M, **Keyes T**, Brockett A, Kane G, Gould E. "Living in a social hierarchy reduces adult neurogenesis and increases oxytocin receptors in the hippocampus." Poster at *Society for Neuroscience 2013.*

Leadership and Advocacy

2015-2016	President	Student Interest Group in Neurology (SIGN), Stanford School of Medicine
2015-2016	Treasurer	LGBTQ-Meds (a chapter of the Medical Student Pride Alliance), Stanford School of Medicine

2016-2018	President	LGBTQ-Meds (a chapter of the Medical Student Pride Alliance), Stanford School of Medicine
2018-2019	Founder; Steering Committee Chair	First Annual Stanford Medicine LGBTQ+ Forum: Celebrating Visibility, Stanford University School of Medicine
2018-2019	Co-chair	Stanford University Minority Medical Alliance (SUMMA), Stanford University School of Medicine
2016-Present	Student Representative	Diversity Cabinet Subcommittee for LGBTQ+ Affairs, Stanford University School of Medicine
2018-Present	Founder; Research & Analytics Director	The Medical Student Pride Alliance (MSPA), 501(c)(3)
2019-2021	Health Professionals in Training (HPiT) Ambassador	GLMA: Health Professionals Advancing LGBTQ Equality (formerly the Gay and Lesbian Medical Association)

Teaching & Curriculum Development

2016	Teaching Assistant	NENS 206 – "Introduction to Neurology," Stanford School of Medicine
2017	Teaching Assistant	NENS 204 – "Introduction to Stroke," Stanford School of Medicine
2016-2019	Committee Member	Sexuality, Gender, and Sexual Function Curriculum Working Group, Stanford School of Medicine
2017	Lecturer; Curriculum Development Assistant	INDE 201 – "Practice of Medicine I," Stanford School of Medicine. Lectured the session entitled "Introduction to LGBTQ+ Health"
2017-2019	Teaching Assistant	IMM 205 – "Immunology in Health and Disease," Stanford School of Medicine
2017-2019	Teaching Assistant; Curriculum Development Assistant	INDE 215 – "Queer Health and Medicine," Stanford School of Medicine
2019-Present	Investigator; Project Lead for CME Course in LGBTQ+ Health	Precision Education and Assessment Research Lab (PEARL), Stanford School of Medicine (mentored by Mike Gisondi, MD)

Grants and Fellowship Support

5/2021-5/2024
Principal Investigator: Davis, KL
Co-Investigator: Keyes, TJ
"Deep Neural Network Prediction of Relapse in Pediatric Acute Leukemia"
Mark Foundation for Cancer Research (ASPIRE II Award): $750,000

11/2018-11/2021
Principal Investigator: Davis, KL
Co-Investigator: Keyes TJ
"Computational Approaches to Predicting Post-treatment Relapse in Pediatric Acute Myeloid Leukemia"
The Andrew McDonough B+ (Be Positive) Foundation: $150,000

9/2019-9/2021
Principal Investigator: Keyes TJ
Co-Investigators: Nolan GP, Davis KL
"Predicting Post-treatment Relapse in Pediatric Acute Myeloid Leukemia Using Single-cell Proteomics"
Grant Number: 1F31CA239365-01
National Institutes of Health (National Cancer Institute): $77,300

5/2019-5/2021
Principal Investigator: Davis KL
Co-Investigator: Keyes TJ
"Assessing Cell Subtype-specific Effects of Liposomal Cytarabine and Daunorubicin (CPX-351) in Acute Myeloid Leukemia"
Grant Number: IST-18-10788
Jazz Pharmaceuticals, Inc. Research Grant: $305,006

10/2019 - 8/2020
Principal Investigator: Keyes TJ
Co-Investigators: Sebok-Syer S, Zucker S, Gisondi MA
"School of Medicine Faculty Training in LGBTQIA+ Health: Design of a New Online CME Course"
Stanford School of Medicine Teaching and Mentoring Academy Innovation Grant: $19,701

Interviews and Alternative Media

3/2017	Interview, 1:2:1 Podcast – "Portraits of Stanford Medicine: Timothy Keyes"
3/2017	Personal reflection (invited), Stanford Medicine Scope Blog – "Identity and Medicine: A med student's reflection on what makes us who we are"
1/2018	Interview, Stanford Medicine Scope Blog – "LGBTQ town hall aimed to spur creation of a stronger community at Stanford Medicine"
9/2018	Interview, Stanford Medicine Scope Blog – "Visible and Valued: Stanford Medicine's First LGBTQ+ Forum"
12/2018	Interview, US News – "What LGBTQ Applicants Should Know About Med Schools"
11/2019	Blog post, Stanford Medicine Scope Blog – "Finding a lab that feels like home"
12/2019	Blog post, Stanford Medicine Scope Blog – "Advice for LGBTQ+ medical school applicants"
2/2020	Blog post, Stanford Medicine Scope Blog – "Is becoming a physician-scientist worth sacrificing work-life balance?"
2/2020	Featured Interview, *New York Times* – "U.S. medical schools boost LGBTQ students, doctor training"
2/2020	Featured Interview, *Washington Post* – "U.S. medical schools boost LGBTQ students, doctor training"
2/2020	Featured Interview, *Associated Press* – "U.S. medical schools boost LGBTQ students, doctor training"
3/2020	Blog post, Stanford Medicine Scope Blog – "Why being a programmer will make me a better doctor"
6/2020	Featured Bio: The Advocate – "Meet the Point Foundation's Class of 2020"

Technical Skills

Programming Languages
- Advanced: R
- Proficient: Python, MATLAB
- Familiar: C++, JavaScript, Julia, SQL

Data Analysis
- Advanced: Linear models (GLM, GLMM), factor analysis (MDS, PCA), exploratory data analysis, data visualization (e.g., ggplot2), data wrangling (e.g. dplyr, tidyverse)
- Proficient: Deep Learning (Keras, Tensorflow, PyTorch)
- Familiar: Support Vector Machines, Tree-based models (e.g. bagging, boosting, random forests)

Literate Coding
- Advanced: R markdown
- Proficient: LaTeX
- Familiar: flexdashboards, xaringan, blogdown/bookdown

Version control
- Git/GitHub

Bioinformatics
- Advanced: Single-cell analysis, machine learning (clustering, dimensionality reduction, generalized linear models), algorithm development and testing, data cleaning, visualization
- Proficient: Natural-language processing, deep learning (TensorFlow, Keras, PyTorch), NGS analysis

Molecular Biology

- Proficient: immunohistochemistry, confocal and epifluorescent microscopy, light microscopy, PCR, murine tissue dissection, rodent handling, mass cytometry
- Familiar: cell culture, neurosphere culture, 2-photon microscopy, electrophysiology

Last updated: 4/01/2022