Noah F. Greenwald

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EDUCATION

Stanford University — Stanford, CA
Ph.D. Candidate in Cancer Biology — 2017-Present

Harvard University — Cambridge, MA
A.B. in Biophysics. High Honors, *magna cum laude.* GPA 3.88 — 2015

RESEARCH EXPERIENCE

Stanford University School of Medicine — Stanford, CA
Graduate Researcher — 2018-Present
Advisors: Dr. Michael Angelo and Dr. Christina Curtis
Thesis Committee: Dr. Edgar Engleman, Dr. Andrew Gentles, Dr. Nima Aghaeepour

- Integrated genomics with multiplexed imaging to characterize the dynamics of resistance and response to checkpoint blockade in triple negative breast cancer

Harvard Medical School — Boston, MA
Research Assistant — 2015-2017
Advisors: Dr. Rameen Beroukhim and Dr. Ian Dunn

- Profiled large cohort of pituitary adenomas with whole-exome sequencing to define landscape of mutations and copy-number alterations
- Investigated the patterns of driver alterations which distinguish low- and high-grade meningiomas by integrating whole-genome, whole-exome, and targeted sequencing

Harvard University Department of Chemistry — Cambridge, MA
Undergraduate Research Assistant — 2014
Advisor: Dr. George Whitesides

- Explored the hydrophobic effect in protein-ligand binding through bacterial production of proteins followed by analysis of binding kinetics
- Investigated whether nanofabrication of antennas by photolithography could aid in detection of binding events of immobilized proteins through signal amplification

Vaxess Technologies — Cambridge, MA
Summer Intern — Summer 2014

- Implemented, ran, and optimized potency assay to measure vaccine activity after long-term storage, then scaled up from bench scale
- Researched and presented competitive analysis of other vaccine preservation companies

Chilean Ministry of Energy — Santiago, Chile
Summer Intern — Summer 2013

- Helped draft preliminary analytical framework for assessing volatility in fuel storage levels

- Revamped template for subsequent analysis of entire energy sector to guide creation of federal storage level minimums

HONORS AND AWARDS

Stanford University SGF Program 2017-Present
Lucille P. Markey Biomedical Research Fellow

RESEARCH FUNDING

NIH/NCI F31 CA246880-01(PI Greenwald) 2020-2023
"Predicting response to anti-PD-1 therapy in triple negative breast cancer by comprehensive profiling of the tumor microenvironment"
Role: PI
Summary: Integrated analysis of the tumor microenvironment by combining sequencing and multiplexed imaging to better understand response to immunotherapy

NIH/NCI UH3 CA24663301 (PI Angelo) 2019-2022
"A robust platform for multiplexed, subcellular proteomic imaging in human tissue"
Role: Helped to conceive and write Aim 1
Summary: Develop robust analytical pipelines and reagents to enable large-scale adoption of MIBI technology across a wide range of normal and diseased tissue types

MENTORSHIP

Jaiveer Singh, college intern. 2020
"Calculating spatial enrichment of cell subtypes in imaging data."

Zion Abraham, Gautam Chaudhry, Mara Fong, and Jackson Moseley, high school interns. 2019
"Training machine learning algorithms to segment cells."

Candace Liu, rotation student. 2019
"Using convolutional neural networks to predict high resolution imaging data."

Erin Soon, rotation student. 2019
"Assessing the accuracy of cell segmentation algorithms."

PROFESSIONAL DEVELOPMENT

Effective Negotiation 2020
Attended full-day workshop on structuring productive negotiations

Alda Science Communication Workshop 2019
Attended half-day workshop on delivering dynamic and engaging presentations

Grant Writing Academy 2018
Attended eight-week course on effective grant writing

SERVICE AND LEADERSHIP

SSRP Admissions Committee Member 2020-Present
Reviewed applications for Stanford's summer undergraduate research program, which has a specific focus on preparing members of historically under-represented groups for STEM PhD programs

EPATT Tutor 2019-Present
Met one-on-one twice a week with students from East Palo Alto Middle School to help with specific coursework, as well as establish good academic habits and study skills

Stanford Cancer Biology Recruitment, Social Committee Chair 2018-2020
Organized and ran activities for prospective graduate students during interview week

Stanford Biosciences Student Association Grants Committee Co-Chair 2018-2019
Planned and ran informational workshops, as well as organized paired peer advising, for graduate students applying to NSF and NIH fellowships

PUBLICATIONS

Peer Reviewed Publications

Taube JM, Akturk G, Angelo M, Engle EL, Gnjatic S, Greenbaum S, **Greenwald NF**, Hedvat CV, Hollmann TJ, Juco J, Parra ER, Rebelatto MC, Rimm DL, Rodriguez-Canales J, Schalper KA, Stack EC, Ferreira CS, Korski K, Lako A, Rodig SJ, Schenck E, Steele KE, Surace MJ, Tetzlaff MT, von Loga K, Wistuba II, Bifulco CB, Society for Immunotherapy of Cancer (SITC) Pathology Task Force. The Society for Immunotherapy in Cancer statement on best practices for multiplex immunohistochemistry (IHC) and immunofluorescence (IF) staining and validation. **Journal for Immunotherapy of Cancer** (2020). PMID: 32414858

Jaimes C, Vajapeyam S, Brown D, Kao PC, Ma C, Greenspan L, Gupta N, Goumnerova L, Bandopahayay P, Dubois F, **Greenwald NF**, Zack T, Shapira O, Beroukhim R, Ligon KL, Chi S, Kieran MW, Wright KD, Poussaint TY**.** MR Imaging Correlates for Molecular and Mutational Analyses in Children with Diffuse Intrinsic Pontine Glioma. **American Journal of Neuroradiology** (2020). PMID: 32381545

Keren L, Bosse M, Thompson S, Risom T, Vijayaragavan K, McCaffrey E, Marquez D, Angoshtari R, **Greenwald NF**, Fienberg H, Wang J, Kambham N, Kirkwood D, Nolan G, Montine TJ, Galli SJ, West R, Bendall SC, Angelo M. MIBI-TOF: A multiplexed imaging platform relates cellular phenotypes and tissue structure. **Science Advances** (2019). PMID: 31633026

Bandopadhayay P, Piccioni F, O'Rourke R, Ho P, Gonzalez EM, Buchan G, Qian K, Gionet G, Girard E, Coxon M, Rees MG, Brenan L, Dubois F, Shapira O, **Greenwald NF**, Pages M, Balboni Iniguez A, Paolella BR, Meng A, Sinai C, Roti G, Dharia NV, Creech A, Tanenbaum B, Khadka P, Tracy A, Tiv HL, Hong AL, Coy S, Rashid R, Lin JR, Cowley GS, Lam FC, Goodale A, Lee Y, Schoolcraft K, Vazquez F, Hahn WC, Tsherniak A, Bradner JE, Yaffe MB, Milde T, Pfister SM, Qi J, Schenone M, Carr SA, Ligon KL, Kieran MW, Santagata S, Olson JM, Gokhale PC, Jaffe JD, Root DE, Stegmaier K, Johannessen CM, Beroukhim R. Neuronal differentiation and cell-cycle programs mediate response to

BET-bromodomain inhibition in MYC-driven medulloblastoma. **Nature Communications** (2019). PMID: 31160565

Wala JA, Bandopadhayay P, **Greenwald NF**, O'Rourke R, Sharpe T, Stewart C, Schumacher S, Li Y, Weischenfeldt J, Yao X, Nusbaum C, Campbell P, Getz G, Meyerson M, Zhang CZ, Imielinski M, Beroukhim R. SvABA: genome-wide detection of structural variants and indels by local assembly. **Genome Research** (2018). PMID: 29535149

Coroller TP*, Bi WL*, Huynh E, Abedalthagafi M, Aizer AA, **Greenwald NF**, Parmar C, Narayan V, Wu WW, Miranda de Moura S, Gupta S, Beroukhim R, Wen PY, Al-Mefty O, Dunn IF, Santagata S, Alexander BM, Huang RY, Aerts HJWL. Radiographic Prediction of Meningioma Grade by Semantic and Radiomic features. **PLoS One** (2017). PMID: 29145421

Ben-David U, Ha G, Tseng YY, **Greenwald NF**, Oh C, Shih J, McFarland JM, Wong B, Boehm JS, Beroukhim R, Golub TR. Patient-derived xenografts undergo mouse-specific tumor evolution. **Nature Genetics** (2017). PMID: 28991255

- Related coverage: Cancer-genome study challenges mouse 'avatars.' **Nature**.

Mei Y, Du Z, Hu C, **Greenwald NF**, Abedalthagafi M, Agar NYR, Dunn GP, Bi WL, Santagata S, Dunn IF. Osteoglycin promotes meningioma development through downregulation of NF2 and activation of mTOR signaling. **Cell Communication & Signaling** (2017). PMID: 28923059

Mei Y, Bi WL, **Greenwald NF**, Agar NY, Beroukhim R, Dunn GP, Dunn IF. Genomic profile of human meningioma cell lines. **PLoS One** (2017). PMID: 28552950

Bi WL*, **Greenwald NF***, Ramkissoon SH, Abedalthagafi M, Coy SM, Ligon KL, Mei Y, MacConaill L, Ducar M, Min L, Santagata S, Kaiser UB, Beroukhim R, Laws ER Jr, Dunn IF. Clinical identification of oncogenic drivers and copy number alterations in pituitary tumors. **Endocrinology** (2017). PMID: 28486603

Bi WL*, **Greenwald NF***, Abedalthagafi M*, Wala J, Gibson WJ, Agarwalla PK, Horowitz P, Schumacher S, Artomov M, Esaulova E, Chevalier A, Ducar M, Thorner A, van Hummelin P, Brastianos P, Al-Mefty O, Dunn GP, Santagata S, Dunn IF, Beroukhim R. Genomic landscape of high-grade meningioma. **npj Genomic Medicine** (2017). PMID: 28713588

Ramkissoon SH*, Bandopadhayay P*, Hwang J*, Ramkissoon LA*, **Greenwald NF**, Schumacher SE, O'Rourke R, Pinches N, Ho P, Malkin H, Sinai C, Filbin M, Plant A, Bi WL, Chang MS, Yang E, Wright KD, Manley PE, Ducar M, Alexandrescu S, Lidov H, Delalle I, Goumnerova LC, Church AJ, Janeway KA, Harris MH, MacConaill LE, Folkerth RD, Lindeman NI, Stiles CD, Kieran MW, Ligon AH, Santagata S, Dubuc AM, Chi SN, Beroukhim R, Ligon KL. Clinical targeted exome-based sequencing in combination with genome-wide copy number profiling: Precision medicine analysis of 203 pediatric brain tumors. **Neuro Oncology** (2017). PMID: 28104717

Bi WL*, Horowitz P*, **Greenwald NF***, Abedalthagafi M, Agarwalla PK, Gibson WJ, Mei Y, Schumacher S, Ben-David U, Chevalier A, Carter S, Tiao G, Brastianos P, Ligon AH, Laws ER Jr., Santagata S, Beroukhim R, Dunn IF. Landscape of genomic alterations in pituitary adenoma. **Clinical Cancer Research** (2016). PMID: 27707790

Mei Y*, Bi WL*, **Greenwald NF**, Du Z, Agar NYR, Kaiser UB, Woodmansee WW, Reardon DA, Freeman GJ, Fecci PE, Laws ER Jr., Santagata S, Dunn GP, Dunn IF. Increased expression of programmed death ligand 1 (PD-L1) in human pituitary tumors. **Oncotarget** (2016). PMID: 27655724

Equal contribution*

Other Publications

Greenwald NF, Bandopadhayay P, Beroukhim R. Open data: Spot data glitches before publication. **Nature** (2017). PMID: 29052624

Musib M*, Wang F*, Tarselli MA*, Yoho R*, Yu KH*, Andrés RM*, **Greenwald NF***, Pan X*, Lee CH*, Zhang J*, Dutton-Regester K*, Johnston JW*, Sharafeldin IM*. Artificial intelligence in research. **Science** (2017). PMID: 28684488

PRESENTATIONS

Talks

Bi WL, Horowitz P, **Greenwald NF**, Abedalthagafi M, Agarwalla PK, Schumacher S, Mei Y, Brastianos P, Santagata S, Laws ER Jr., Beroukhim R, Dunn IF. Landscape of genomic alterations in pituitary adenoma. New England Neurosurgical Society Annual Meeting. June 2016; Cape Cod, MA.

Bi WL, **Greenwald NF**, Abedalthagafi M, Agarwalla PK, Horowitz P, Gibson WJ, Al-Mefty O, Santagata S, Beroukhim R, Dunn IF. Landscape of genomic alterations in high-grade meningioma. Society for Neuro-Oncology Conference on Meningioma. June 2016; Toronto, Canada.

Posters

Greenwald NF, Keren L , Greenbaum S, Fong M, Chaudry G, Abraham Z, Moseley J, Van Valen D, Angelo M. Accurate whole-cell segmentation in clinical tissue samples by combining convolutional neural networks and multiplexed imaging. Allen Institute Bioimage Informatics. October 2019; Seattle, WA.

Greenwald NF, Keren L, Angelo M. Harnessing deep learning to enable multiplexed in situ cellular segmentation and morphological characterization. Cancer Biology Retreat. September 2018; San Jose, CA.

Bi WL, Coroller T, **Greenwald NF**, Beroukhim R, Dunn IF, Huang R, Aerts H. Radiographic prediction of meningioma grade and genotype. Cancer Biology Program Retreat. December 2016; Cambridge, MA.

Greenwald NF, Bi WL, Beroukhim R. Liquid Biopsies: Circulating Tumor DNA as a Clinical Marker. Broad Research Assistants and Technicians Poster Session. November 2015; Cambridge, MA.