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
Angelo Lab Computational Team Lead — 2020-Present

- Conceptualized and supervised the creation of the open-source image analysis pipeline which forms the backbone for all imaging projects in the Angelo lab
- Managed and directed team of computational research assistants, undergraduate interns, and high school students to design algorithms for image processing, clustering, and spatial analyses

Stanford University School of Medicine — Stanford, CA
Graduate Researcher — 2017-Present
Advisors: Dr. Michael Angelo and Dr. Christina Curtis
Thesis Committee: Dr. Edgar Engleman, Dr. Andrew Gentles, Dr. Nima Aghaeepour

- Developed novel deep-learning algorithm to identify the location of cells across tissue types and microscope platforms
- Integrated genomics with multiplexed imaging to characterize the evolution of the metastatic tumor microenvironment 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 2017-2020
Lucille P. Markey Biomedical Research Fellow

RESEARCH FUNDING

NIH/NCI F99/K00 CA264307 (PI Greenwald) 2021-2027
"Comprehensive profiling of the tumor microenvironment to predict patient response to immunotherapy"
Role: PI
Summary: Using sequencing, multiplexed imaging, and experimental models to better understand the mechanism of immunotherapy in breast cancer

DOD W81XWH2110143 (PI Angelo) 2021-2025
"Relating the interplay of tumor function and host response to clinical outcome in triple negative breast cancer"
Role: Co-wrote Aims
Summary: Identifying the underlying features of the tumor microenvironment which modulate response to therapy in breast cancer across disease subtypes and treatment regimes

NIH/NCI F31 CA246880 (PI Greenwald) 2020-2021
"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: Co-wrote 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

Cami Sowers, computational research associate 2022-present
"Accurate and automated processing of multiplexed imaging data"

Sri Varra, computational research associate 2022-present
"Developing a framework for scalable analysis of large image datasets"

Cameron Walker, rotation student 2022
"Analysis of imaging data from pre-invasive breast cancer"

Brian Collica, computational research associate 2021
"Identifying recurring patterns in the spatial organization of cell populations"

Christine Yeh, rotation student 2020
"Predicting response to checkpoint blockade from DNA sequencing data"

Kevin Wang, high school student 2020
"Visualizing cell populations in multiplexed images"

Jaiveer Singh, undergraduate student 2020
"Calculating spatial enrichment of distinct cell subtypes"

Alex Kong, computational research associate 2020-present
"Building a user-friendly pipeline for image analysis"

Adam Kagel, computational research associate 2020-2022
"Optimizing algorithms for spatial analysis of image data"

Zion Abraham, Gautam Chaudhry, Mara Fong, and Jackson Moseley, high school students 2019
"Curating image data to train machine learning algorithms"

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"

TEACHING

Stanford University

CBIO 275: Tumor Immunology 2021
Teaching Assistant

"Profiling the tumor microenvironment with high-dimensional imaging" 2021
CBIO 275 Guest Lecture

"How to analyze multiplexed imaging data" 2021
Immunology 206 Guest Lecture

PROFESSIONAL DEVELOPMENT

LAW 7807: Facilitation 2021
A three-day workshop introducing key techniques for effective facilitation

SGSI: Negotiation 2021
A week-long workshop detailing how to approach multi-party negotiations

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

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

Grant Writing Academy 2018
An eight-week course to develop core grant writing skills

SERVICE AND LEADERSHIP

Stanford Cancer Biology Seminar Series Co-organizer 2021-2022
Solicited program input to create schedule of external faculty speakers. Worked with the Cancer Biology Racial Justice group to add talks from post-docs from historically under-represented populations.

Advance Undergraduate Institute Mentor 2021
Provided guidance on applying to graduate school for students from under-represented backgrounds via panel discussions and mock interviews, as well as one-on-one mentoring throughout the summer.

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 2019-2022
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

Research Articles

* indicates equal contribution | § indicates co-corresponding | Doe J indicates those I directly mentored

Dubois FPB, Shapira O, **Greenwald NF**, Zack T, Wala J, Tsai JW, Crane A, Baguette A, Hadjadj D, Harutyunyan AS, Kumar KH, Blattner-Johnson M, Vogelzang J, Sousa C, Kang KS, Sinai C, Wang DK, Khadka P, Lewis K, Nguyen L, Malkin H, Ho P, O'Rourke R, Zhang S, Gold R, Deng D, Serrano J, Snuderl M, Jones C, Wright KD, Chi SN, Grill J, Kleinman CL, Goumnerova LC, Jabado N, Jones DTW, Kieran MW, Ligon KL§, Beroukhim R§, Bandopadhayay P§. Structural variants shape driver combinations and outcomes in pediatric high-grade glioma. **Nature Cancer** (2022). DOI: 10.1038/s43018-022-00403-z

Ghahremani P, Li Y, Kaufman A, Vanguri R, **Greenwald NF**, Angelo M, Hollmann TJ, Nadeem S. Deep learning-inferred multiplex immunofluorescence for immunohistochemical image quantification. **Nature Machine Intelligence** (2022). DOI: 10.1038/s42256-022-00471-x

Jiang S, Chan CN, Rovira-Clavé X, Chen H, Bai Y, Zhu B, McCaffrey E, **Greenwald NF**, Liu C, Barlow GL, Weirather JL, Oliveria JP, Nakayama T, Lee IT, Matter MS, Carlisle AE, Philips D, Vazquez G, Mukherjee N, Busman-Sahay K, Nekorchuk M, Terry M, Younger S, Bosse M, Demeter J, Rodig SJ, Tzankov A, Goltsev Y, McIlwain DR, Angelo M, Estes JD§, Nolan GP§. Combined protein and nucleic acid imaging reveals virus-dependent B cell and macrophage immunosuppression of tissue microenvironments. **Immunity** (2022). DOI: 10.1016/j.immuni.2022.03.020.

- Preprint: bioRxiv (2021). DOI: 10.1101/2021.05.21.444548

Khadka P, Reitman ZJ, Lu S, Buchan G, Gionet G, Dubois F, Carvalho DM, Shih J, Zhang S, **Greenwald NF**, Zack T, Shapira O, Pelton K, Hartley R, Bear H, Georgis Y, Jarmale S, Melanson R, Bonanno K, Schoolcraft K, Miller PG, Condurat AL, Gonzalez EM, Qian K, Morin E, Langhnoja J, Lupien LE, Rendo V, Digiacomo J, Wang D, Zhou K, Kumbhani R, Guerra Garcia ME, Sinai CE, Becker S, Schneider R, Vogelzang J, Krug K, Goodale A, Abid T, Kalani Z, Piccioni F, Beroukhim R, Persky NS, Root DE, Carcaboso AM, Ebert BL, Fuller C, Babur O, Kieran MW, Jones C, Keshishian H, Ligon KL, Carr SA, Phoenix TN, Bandopadhayay P. PPM1D mutations are oncogenic drivers of de novo diffuse midline glioma formation. **Nature Communications** (2022). DOI: 10.1038/s41467-022-28198-8

Risom T, Glass DR, Averbukh I, Liu CC, Baranski A, Kagel A, McCaffrey EF, **Greenwald NF**, Rivero-Gutiérrez B, Strand SH, Varma S, Kong A, Keren L, Srivastava S, Zhu C, Khair Z, Veis DJ, Deschryver K, Vennam S, Maley C, Hwang ES, Marks JR, Bendall SC, Colditz GA, West RB, Angelo M. Transition to invasive breast cancer is associated with progressive changes in the structure and composition of tumor stroma. **Cell** (2022). DOI: 10.1016/j.cell.2021.12.023.

- Preprint: bioRxiv (2021). DOI: 10.1101/2021.01.05.425362

McCaffrey EF, Donato M, Keren L, Chen Z, Delmastro A, Fitzpatrick MB, Gupta S, **Greenwald NF**, Baranski A, Graf W, Kumar R, Bosse M, Fullaway CC, Ramdial PK, Forgó E, Jojic V, Van Valen D, Mehra S, Khader SA, Bendall SC, van de Rijn M, Kalman D, Kaushal D, Hunter RL, Banaei N, Steyn AJC, Khatri P, Angelo M. The immunoregulatory landscape of human tuberculosis granulomas. **Nature Immunology** (2022). DOI: 10.1038/s41590-021-01121-x.

- Preprint: bioRxiv (2020). DOI: 10.1101/2020.06.08.140426

Greenwald NF*, Miller G*, Moen E, Kong A, Kagel A, Fullaway CC, McIntosh BJ, Leow K, Schwartz MS, Dougherty T, Pavelchek C, Cui S, Camplisson I, Bar-Tal O, Singh J, Fong M, Chaudhry G, Abraham Z, Mosely J, Warshawsky S, Soon E, Greenbaum S, Risom T, Hollmann T, Keren L, Graf W, Angelo M§, Van Valen D§. Whole-cell segmentation of tissue images with human-level performance using large-scale data annotation and deep learning. **Nature Biotechnology** (2021). DOI: 10.1038/s41587-021-01094-0.

- Preprint: bioRxiv (2021). DOI: 10.1101/2021.03.01.431313

Driver J, Hoffman SE, Tavakol S, Woodward E, Maury EA, Bhave V, **Greenwald NF**, Nassiri F, Aldape K, Zadeh G, Choudhury A, Vasudevan HN, Magill ST, Raleigh DR, Abedalthagafi M, Aizer AA, Alexander BM, Ligon KL, Reardon DA, Wen PY, Al-Mefty O, Ligon AH, Dubuc AM, Beroukhim R, Claus EB, Dunn IF, Santagata S, Bi WL. A molecularly integrated grade for Meningioma. **Neuro Oncology** (2021). DOI: 10.1093/neuonc/noab213.

Bannon D, Moen E, Schwartz M, Borba E, Kudo T, **Greenwald NF**, Vijayakumar V, Chang B, Pao E, Osterman E, Graf W, Van Valen D. DeepCell Kiosk: Scaling deep learning-enabled cellular image analysis with Kubernetes. **Nature Methods** (2021). DOI: 10.1038/s41592-020-01023-0.

- Preprint: bioRxiv (2020). DOI: 10.1101/505032.

Hartmann FJ, Mrdjen D, McCaffrey E, Glass DR, **Greenwald NF**, Bharadwaj A, Khair Z, Verberk SGS, Baranski A, Baskar R, Graf W, Van Valen D, Van den Bossche J, Angelo M, Bendall SC. Single-cell metabolic profiling of human cytotoxic T cells. **Nature Biotechnology** (2020). DOI: 10.1038/s41587-020-0651-8.

- Preprint: bioRxiv (2019). DOI: 10.1101/2020.01.17.909796.
- Related coverage: Nature Methods

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). DOI: 10.3174/ajnr.A6546.

Peter Brown P, **RELISH Consortium**, Zhou Y. Large expert-curated database for benchmarking document similarity detection in biomedical literature search. **Database** (2019). DOI: 10.1093/database/baz085.

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). DOI: 10.1126/sciadv.aax5851.

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). DOI: 10.1038/s41467-019-10307-9.

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). DOI: 10.1101/gr.221028.117.

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). DOI: 10.1371/journal.pone.0187908.

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). DOI: 10.1038/ng.3967.

- Related coverage: Nature Genetics, 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). DOI: 10.1186/s12964-017-0189-7.

Mei Y, Bi WL, **Greenwald NF**, Agar NY, Beroukhim R, Dunn GP, Dunn IF. Genomic profile of human meningioma cell lines. **PLoS One** (2017). DOI: 10.1371/journal.pone.0178322.

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). DOI: 10.1210/en.2016-1967.

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). DOI: 10.1038/s41525-017-0014-7.

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). DOI: 10.1093/neuonc/now294.

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). DOI: 10.1158/1078-0432.CCR-16-0790.

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). DOI:10.18632/oncotarget.12088.

Review Articles

Liu CC, McCaffrey EF, **Greenwald NF**, Soon E, Risom T, Vijayaragavan K, Oliveria JP, Mrdjen D, Bosse M, Tebaykin D, Bendall SC, Angelo M. Multiplexed Ion Beam Imaging: Insights into Pathobiology. **Annual Review of Pathology** (2021). DOI: 10.1146/annurev-pathmechdis-030321-091459.

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). DOI: 10.1136/jitc-2019-000155.

Other Publications

Averbukh I, **Greenwald NF**, Liu CC, Angelo M. Evaluation of Geuenich et al.: Targeting a crucial bottleneck for analyzing single-cell multiplexed imaging data. **Cell Systems** (2021). DOI: 10.1016/j.cels.2021.11.003

Cable J, Elowitz MB, Domingos AI, Habib N, Itzkovitz S, Hamidzada H, Balzer MS, Yanai I, Liberali P, Whited J, Streets A, Cai L, Stergachis AB, Hong CKY, Keren L, Guilliams M, Alon U, Shalek AK, Hamel R, Pfau SJ, Raj A, Quake SR, Zhang NR, Fan J, Trapnell C, Wang B, **Greenwald NF**, Vento-Tormo R, Santos SDM, Spencer SL, Garcia HG, Arekatla G, Gaiti F, Arbel-Goren R, Rulands S, Junker JP, Klein AM, Morris SA, Murray JI, Galloway KE, Ratz M, Romeike M. Single-cell biology-a Keystone Symposia report. **Annals of The New York Academy of Sciences** (2021). DOI: 10.1111/nyas.14692

Greenwald NF, Bandopadhayay P, Beroukhim R. Open data: Spot data glitches before publication. **Nature** (2017). DOI: 10.1038/550333c.

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). DOI: 10.1126/science.357.6346.28.

PRESENTATIONS

Talks

Greenwald NF*, Miller G*, Moen E, Dougherty T, Singh J, Fong M, Chaudhry G, Abraham Z, Mosely J, Soon E, Greenbaum S, Keren L, Graf W, Angelo M§, Van Valen D§. Accurate whole-cell segmentation by combining convolutional neural networks and high-dimensional imaging. **Keystone Symposia: Single Cell Biology**. March 2020; Virtual.

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.