Stanford

Michael Angelo

Associate Professor of Pathology

Bio

BIO

Michael Angelo, MD PhD is a board-certified pathologist and assistant professor in the department of Pathology at Stanford University School of Medicine. Dr. Angelo is a leader in high dimensional imaging with expertise in tissue homeostasis, tumor immunology, and infectious disease. His lab has pioneered the construction and development of Multiplexed Ion Beam Imaging by time of flight (MIBI-TOF). MIBI-TOF uses secondary ion mass spectrometry and metal-tagged antibodies to achieve rapid, simultaneous imaging of dozens of proteins at subcellular resolution. In recognition of this achievement, Dr. Angelo received the NIH Director's Early Independence award in 2014. His lab has since used this novel technology to discover previously unknown rule sets governing the spatial organization and cellular composition of immune, stromal, and tumor cells within the tumor microenvironment in triple negative breast cancer. These findings were found to be predictive of single cell expression of several immunotherapy drug targets and of 10-year overall survival. This effort has led to ongoing work aimed at elucidating structural mechanisms in the TME that promote recruitment of cancer associated fibroblasts, tumor associated macrophages, and extracellular matrix remodeling. Dr. Angelo is the recipient of the 2020 DOD Era of Hope Award and a principal investigator on multiple extramural awards from the National Cancer Institute, Breast Cancer Research Foundation, Parker Institute for Cancer Immunotherapy, the Bill and Melinda Gates Foundation, and the Human Biomolecular Atlas (HuBMAP) initiative.

ACADEMIC APPOINTMENTS

- Associate Professor, Pathology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Stanford Cancer Institute

LINKS

- Lab Website: https://www.angelolab.com

Teaching

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Jessica Diarra, Markus Diehl, Kristen Frombach, Nicole Horsley, Shuaitong Liu, Brennan Simon, Izumi de los Rios Kobara

Postdoctoral Faculty Sponsor

Kelly Bruton, Jolene Ranek

Doctoral Dissertation Advisor (AC)

Potchara Boonrat, Nadia Grishanina, Mikaela Ribi, Cameron Walker

Doctoral Dissertation Co-Advisor (AC)

Alea Delmastro, Ryan Feitzinger

Postdoctoral Research Mentor

Ke Leow

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Cancer Biology (Phd Program)
- Immunology (Phd Program)

Publications

PUBLICATIONS

- **Multi-omic landscape of human gliomas from diagnosis to treatment and recurrence.** *bioRxiv : the preprint server for biology*
  Piyadasa, H., Oberlton, B., Ribi, M., Ranek, J. S., Averbukh, I., Leow, K., Amouzgar, M., Liu, C. C., Greenwald, N. F., McCaffrey, E. F., Kumar, R., Ferrian, S., Tsai, et al
  2025

- **The immunometabolic topography of tuberculosis granulomas governs cellular organization and bacterial control.** *bioRxiv : the preprint server for biology*
  McCaffrey, E. F., Delmastro, A. C., Fitzhugh, I., Ranek, J. S., Douglas, S., Peters, J. M., Fullaway, C. C., Bosse, M., Liu, C. C., Gillen, C., Greenwald, N. F., Anzick, S., Martens, et al
  2025

- **Temporal and spatial composition of the tumor microenvironment predicts response to immune checkpoint inhibition.** *bioRxiv : the preprint server for biology*
  Greenwald, N. F., Nederlof, I., Sowers, C., Ding, D. Y., Park, S., Kong, A., Houlahan, K. E., Varra, S. R., de Graaf, M., Geurts, V., Liu, C. C., Ranek, J. S., Voorwerk, et al
  2025

- **Highly multiplexed imaging reveals prognostic immune and stromal spatial biomarkers in breast cancer.** *JCI insight*
  Eng, J. R., Bucher, E., Hu, Z., Walker, C. R., Risom, T., Angelo, M., Gonzalez-Ericsson, P., Sanders, M. E., Chakravarthy, A. B., Pietenpol, J. A., Gibbs, S. L., Sears, R. C., Chin, et al
  2025

- **Society for Immunotherapy of Cancer: updates and best practices for multiplex immunohistochemistry (IHC) and immunofluorescence (IF) image analysis and data sharing.** *Journal for immunotherapy of cancer*
  Taube, J. M., Sunshine, J. C., Angelo, M., Akturk, G., Eminizer, M., Engle, L. L., Ferreira, C. S., Gnjatic, S., Green, B., Greenbaum, S., Greenwald, N. F., Hedvat, C. V., Hollmann, et al
  2025; 13 (1)

- **Toward clinical applications of spatial-omics in cancer research.** *Nature cancer*
  Walker, C., Angelo, M.
  2024

- **Multi-ancestry GWAS of severe pregnancy nausea and vomiting identifies risk loci associated with appetite, insulin signaling, and brain plasticity.** *Research square*
  Fejzo, M., Wang, X., Zöllner, J., Pujol-Gualdo, N., Laisk, T., Finer, S., van Heel, D. A., Brumpton, B., Bhatta, L., Hveem, K., Jasper, E. A., Velez Edwards, D. R., Hellwege, et al
  2024

- **Multi-ancestry GWAS of severe pregnancy nausea and vomiting identifies risk loci associated with appetite, insulin signaling, and brain plasticity.** *medRxiv : the preprint server for health sciences*
  Fejzo, M., Wang, X., Zöllner, J., Pujol-Gualdo, N., Laisk, T., Finer, S., van Heel, D. A., Brumpton, B., Bhatta, L., Hveem, K., Jasper, E. A., Velez Edwards, D. R., Hellwege, et al
  2024

- **Automated classification of cellular expression in multiplexed imaging data with Nimbus.** *bioRxiv : the preprint server for biology*
  Rumberger, J. L., Greenwald, N. F., Ranek, J. S., Boonrat, P., Walker, C., Franzen, J., Varra, S. R., Kong, A., Sowers, C., Liu, C. C., Averbukh, I., Piyadasa, H., Vanguri, et al
  2024

- **Germline-mediated immunoediting sculpts breast cancer subtypes and metastatic proclivity.** *Science (New York, N.Y.)*
  Houlahan, K. E., Khan, A., Greenwald, N. F., Vivas, C. S., West, R. B., Angelo, M., Curtis, C.
  2024; 384 (6699): eadh8697

- **Insights and Opportunity Costs in Applying Spatial Biology to Study the Tumor Microenvironment.** *Cancer discovery*
  Walker, C. R., Angelo, M.
  2024: OF1-OF4

- **Author Correction: Advances and prospects for the Human BioMolecular Atlas Program (HuBMAP).** *Nature cell biology*
  Jain, S., Pei, L., Spraggins, J. M., Angelo, M., Carson, J. P., Gehlenborg, N., Ginty, F., Goncalves, J. P., Hagood, J. S., Hickey, J. W., Kelleher, N. L., Laurent, L. C., Lin, et al
  2024

- **Harmonizing the Generation and Pre-publication Stewardship of FAIR Image data.** *ArXiv*
  Bialy, N., Alber, F., Andrews, B., Angelo, M., Beliveau, B., Bintu, L., Boettiger, A., Boehm, U., Brown, C. M., Maina, M. B., Chambers, J. J., Cimini, B. A., Eliceiri, et al
  2024

- **Spatiotemporal Immune Cells Profiling in Gastrointestinal Tissue Biopsies to Detect Oral Immunotherapy Induced Changes in Peanut Allergic Individuals**
  Kaushik, A., Angoshtari, R., Kwow, S., Kambham, N., Fernandez-Becker, N., Manohar, M., Angelo, M., Galli, S., Nadeau, K., Dekruyff, R., Chinthrajah, S.
  MOSBY-ELSEVIER.2024: AB371

- **Single-Cell Imaging Maps Inflammatory Cell Subsets to Pulmonary Arterial Hypertension Vasculopathy.** *American journal of respiratory and critical care medicine*
  Ferrian, S., Cao, A., McCaffrey, E. F., Saito, T., Greenwald, N. F., Nicolls, M. R., Bruce, T., Zamanian, R. T., Del Rosario, P., Rabinovitch, M., Angelo, M.
  2023

- **SPATIALLY-RESOLVED TRANSCRIPTOME ANALYSIS OF BRAIN METASTATIC BREAST CANCER REVEAL KEY MEDIATORS OF BRAIN-TROPIC METASTATIC POTENTIAL**
  Umeh-Garcia, M., Godfrey, B., Perez, P., Varma, S., Ahmadian, S., Toland, A., Granucci, M., Averbukh, I., Tian, L., West, R., Angelo, M., Plevritis, S., Gephart, et al
  OXFORD UNIV PRESS INC.2023

- **A platform-independent framework for phenotyping of multiplex tissue imaging data.** *PLoS computational biology*
  Ahmadian, M., Rickert, C., Minic, A., Wrobel, J., Bitler, B. G., Xing, F., Angelo, M., Hsieh, E. W., Ghosh, D., Jordan, K. R.
  2023; 19 (9): e1011432

- **Loss-of-function mutations in Dnmt3a and Tet2 lead to accelerated atherosclerosis and concordant macrophage phenotypes** *NATURE CARDIOVASCULAR RESEARCH*
  Rauch, P. J., Gopakumar, J., Silver, A. J., Nachun, D., Ahmad, H., Mcconkey, M., Nakao, T., Bosse, M., Rentz, T., Gonzalez, N., Greenwald, N. F., Mccaffrey, E. F., Khair, et al
  2023; 2 (9): 805-+

- **Loss-of-function mutations in Dnmt3a and Tet2 lead to accelerated atherosclerosis and concordant macrophage phenotypes.** *Nature cardiovascular research*
  Rauch, P. J., Gopakumar, J., Silver, A. J., Nachun, D., Ahmad, H., McConkey, M., Nakao, T., Bosse, M., Rentz, T., Vivanco Gonzalez, N., Greenwald, N. F., McCaffrey, E. F., Khair, et al
  2023; 2 (9): 805-818

- **Robust phenotyping of highly multiplexed tissue imaging data using pixel-level clustering.** *Nature communications*
  Liu, C. C., Greenwald, N. F., Kong, A., McCaffrey, E. F., Leow, K. X., Mrdjen, D., Cannon, B. J., Rumberger, J. L., Varra, S. R., Angelo, M.
  2023; 14 (1): 4618

- **Advances and prospects for the Human BioMolecular Atlas Program (HuBMAP).** *Nature cell biology*
  Jain, S., Pei, L., Spraggins, J. M., Angelo, M., Carson, J. P., Gehlenborg, N., Ginty, F., Gonçalves, J. P., Hagood, J. S., Hickey, J. W., Kelleher, N. L., Laurent, L. C., Lin, et al
  2023

- **Expanded vacuum-stable gels for multiplexed high-resolution spatial histopathology.** *Nature communications*
  Bai, Y., Zhu, B., Oliveria, J., Cannon, B. J., Feyaerts, D., Bosse, M., Vijayaragavan, K., Greenwald, N. F., Phillips, D., Schurch, C. M., Naik, S. M., Ganio, E. A., Gaudilliere, et al
  2023; 14 (1): 4013

- **A spatially resolved timeline of the human maternal-fetal interface.** *Nature*
  Greenbaum, S., Averbukh, I., Soon, E., Rizzuto, G., Baranski, A., Greenwald, N. F., Kagel, A., Bosse, M., Jaswa, E. G., Khair, Z., Kwok, S., Warshawsky, S., Piyadasa, et al
  2023; 619 (7970): 595-605

- **Synthesis, Characterization, and Applications of a Superior Dendrimer-Based Polymer for Multiplexed Ion Beam Imaging Time-of-Flight Analysis.** *Biomacromolecules*
  Kumar, R., Liu, C. C., Bendall, S. C., Angelo, M.
  2023

- **Spatial proteomics reveals human microglial states shaped by anatomy and neuropathology.** *Research square*
  Mrdjen, D., Amouzgar, M., Cannon, B., Liu, C., Spence, A., McCaffrey, E., Bharadwaj, A., Tebaykin, D., Bukhari, S., Hartmann, F. J., Kagel, A., Vijayaragavan, K., Oliveria, et al
  2023

- **Spatial proteomics of tumor microenvironments reveal why location matters.** *Nature immunology*
  Piyadasa, H., Angelo, M., Bendall, S. C.
  2023

- **Germline-mediated immunoediting sculpts breast cancer subtypes and metastatic proclivity.** *bioRxiv : the preprint server for biology*
  Houlahan, K. E., Khan, A., Greenwald, N. F., West, R. B., Angelo, M., Curtis, C.
  2023

- **Dynamic CD8+ T cell responses to cancer immunotherapy in human regional lymph nodes are disrupted in metastatic lymph nodes.** *Cell*
  Rahim, M. K., Okholm, T. L., Jones, K. B., McCarthy, E. E., Liu, C. C., Yee, J. L., Tamaki, S. J., Marquez, D. M., Tenvooren, I., Wai, K., Cheung, A., Davidson, B. R., Johri, et al
  2023; 186 (6): 1127-1143.e18

- **Multiplexed Tissue Imaging for Immune Cells Profiling During Peanut Allergy Immunotherapy**
  Kaushik, A., Angoshtari, R., Kwow, S., Kambham, N., Fernandez-Becker, N., Manohar, M., Angelo, M., Galli, S., Nadeau, K., Dekruyff, R., Chinthrajah, S.
  MOSBY-ELSEVIER.2023: AB34

- **Characterizing N-glycan profiles of DCIS progression using tissue imaging MALDI mass spectrometry**
  Wallace, E. N., Grimsley, G., Strand, S. H., Angelo, R., Colditz, G., Hwang, E., West, R., Marks, J. R., Angel, P. M., Drake, R. R.
  AMER ASSOC CANCER RESEARCH.2022

- **Characterizing N-glycan profiles of DCIS progression using tissue imaging MALDI mass spectrometry.**
  Wallace, E. N., Grimsley, G., Strand, S. H., Angelo, R., Colditz, G., Hwang, E., West, R., Marks, J. R., Angel, P. M., Drake, R. R.
  AMER ASSOC CANCER RESEARCH.2022: 8-9

- **A SOX9-B7x axis safeguards dedifferentiated tumor cells from immunosurveillance to enable DCIS progression**
  Wallace, E. N., Grimsley, G., Strand, S. H., Angelo, R., Colditz, G., Hwang, E., West, R., Marks, J. R., Angel, P. M., Drake, R. R.
  AMER ASSOC CANCER RESEARCH.2022

- **Discrete regulation of the collagen proteome among pathological features in DCIS and invasive breast cancer by mass spectrometry tissue imaging**
  Hulahan, T. S., Wallace, E. N., Strand, S. H., Angelo, R., Colditz, G., Hwang, E., West, R., Spruill, L., Marks, J. R., Drake, R. R., Angel, P. M.
  AMER ASSOC CANCER RESEARCH.2022

- **Discrete regulation of the collagen proteome among pathological features in DCIS and invasive breast cancer by mass spectrometry tissue imaging**
  Hulahan, T. S., Wallace, E. N., Strand, S. H., Angelo, R., Colditz, G., Hwang, E., West, R., Spruill, L., Marks, J. R., Drake, R. R., Angel, P. M.
  AMER ASSOC CANCER RESEARCH.2022

- **Gestationally dependent immune organization at the maternal-fetal interface.** *Cell reports*
  Moore, A. R., Vivanco Gonzalez, N., Plummer, K. A., Mitchel, O. R., Kaur, H., Rivera, M., Collica, B., Goldston, M., Filiz, F., Angelo, M., Palmer, T. D., Bendall, S. C.
  2022; 41 (7): 111651

- **Molecular classification and biomarkers of clinical outcome in breast ductal carcinoma in situ: Analysis of TBCRC 038 and RAHBT cohorts.** *Cancer cell*
  Strand, S. H., Rivero-Gutierrez, B., Houlahan, K. E., Seoane, J. A., King, L. M., Risom, T., Simpson, L. A., Vennam, S., Khan, A., Cisneros, L., Hardman, T., Harmon, B., Couch, et al
  2022

- **Single-cell spatial proteomic imaging for human neuropathology.** *Acta neuropathologica communications*
  Vijayaragavan, K., Cannon, B. J., Tebaykin, D., Bosse, M., Baranski, A., Oliveria, J. P., Bukhari, S. A., Mrdjen, D., Corces, M. R., McCaffrey, E. F., Greenwald, N. F., Sigal, Y., Marquez, et al
  2022; 10 (1): 158

- **Spatial epitope barcoding reveals clonal tumor patch behaviors.** *Cancer cell*
  Rovira-Clave, X., Drainas, A. P., Jiang, S., Bai, Y., Baron, M., Zhu, B., Dallas, A. E., Lee, M. C., Chu, T. P., Holzem, A., Ayyagari, R., Bhattacharya, D., McCaffrey, et al
  2022

- **Role of IDO-signaling blockade in reactivation of TB in latent Rhesus macaques co-infected with SIV**
  Singh, B., Moodley, C., Singh, D., Ganatra, S., McCaffrey, E., Angelo, M., Kaushal, D., Mehra, S.
  WILEY.2022: 323

- **Combined protein and nucleic acid imaging reveals virus-dependent B cell and macrophage immunosuppression of tissue microenvironments.** *Immunity*
  Jiang, S., Chan, C. N., Rovira-Clave, X., Chen, H., Bai, Y., Zhu, B., McCaffrey, E., Greenwald, N. F., Liu, C., Barlow, G. L., Weirather, J. L., Oliveria, J. P., Nakayama, et al
  2022

- **Deep learning-inferred multiplex immunofluorescence for immunohistochemical image quantification** *NATURE MACHINE INTELLIGENCE*
  Ghahremani, P., Li, Y., Kaufman, A., Vanguri, R., Greenwald, N., Angelo, M., Hollmann, T. J., Nadeem, S.
  2022

- **Deep Learning-Inferred Multiplex ImmunoFluorescence for Immunohistochemical Image Quantification.** *Nature machine intelligence*
  Ghahremani, P., Li, Y., Kaufman, A., Vanguri, R., Greenwald, N., Angelo, M., Hollmann, T. J., Nadeem, S.
  2022; 4 (4): 401-412

- **Reproducible, high-dimensional imaging in archival human tissue by multiplexed ion beam imaging by time-of-flight (MIBI-TOF).** *Laboratory investigation; a journal of technical methods and pathology*
  Liu, C. C., Bosse, M., Kong, A., Kagel, A., Kinders, R., Hewitt, S. M., Varma, S., van de Rijn, M., Nowak, S. H., Bendall, S. C., Angelo, M.
  2022

- **Author Correction: The immunoregulatory landscape of human tuberculosis granulomas.** *Nature immunology*
  McCaffrey, E. F., Donato, M., Keren, L., Chen, Z., Delmastro, A., Fitzpatrick, M. B., Gupta, S., Greenwald, N. F., Baranski, A., Graf, W., Kumar, R., Bosse, M., Fullaway, et al
  2022

- **MITI minimum information guidelines for highly multiplexed tissue images.** *Nature methods*
  Schapiro, D., Yapp, C., Sokolov, A., Reynolds, S. M., Chen, Y., Sudar, D., Xie, Y., Muhlich, J., Arias-Camison, R., Arena, S., Taylor, A. J., Nikolov, M., Tyler, et al
  2022; 19 (3): 262-267

- **High-Dimensional Tissue Profiling by Multiplexed Ion Beam Imaging.** *Methods in molecular biology (Clifton, N.J.)*
  Elhanani, O., Keren, L., Angelo, M.

2022; 2386: 147-156

- **The immunoregulatory landscape of human tuberculosis granulomas.** *Nature immunology*
  McCaffrey, E. F., Donato, M., Keren, L., Chen, Z., Delmastro, A., Fitzpatrick, M. B., Gupta, S., Greenwald, N. F., Baranski, A., Graf, W., Kumar, R., Bosse, M., Fullaway, et al
  2022
- **Transition to invasive breast cancer is associated with progressive changes in the structure and composition of tumor stroma.** *Cell*
  Risom, T., Glass, D. R., Averbukh, I., Liu, C. C., Baranski, A., Kagel, A., McCaffrey, E. F., Greenwald, N. F., Rivero-Gutiérrez, B., Strand, S. H., Varma, S., Kong, A., Keren, et al
  2022; 185 (2): 299-310.e18
- **Single-synapse analyses of Alzheimer's disease implicate pathologic tau, DJ1, CD47, and ApoE.** *Science advances*
  Phongpreecha, T., Gajera, C. R., Liu, C. C., Vijayaragavan, K., Chang, A. L., Becker, M., Fallahzadeh, R., Fernandez, R., Postupna, N., Sherfield, E., Tebaykin, D., Latimer, C., Shively, et al
  1800; 7 (51): eabk0473
- **Spatial mapping of protein composition and tissue organization: a primer for multiplexed antibody-based imaging.** *Nature methods*
  Hickey, J. W., Neumann, E. K., Radtke, A. J., Camarillo, J. M., Beuschel, R. T., Albanese, A., McDonough, E., Hatler, J., Wiblin, A. E., Fisher, J., Croteau, J., Small, E. C., Sood, et al
  2021
- **Whole-cell segmentation of tissue images with human-level performance using large-scale data annotation and deep learning.** *Nature biotechnology*
  Greenwald, N. F., Miller, G., Moen, E., Kong, A., Kagel, A., Dougherty, T., Fullaway, C. C., McIntosh, B. J., Leow, K. X., Schwartz, M. S., Pavelchek, C., Cui, S., Camplisson, et al
  2021
- **Multiplexed Ion Beam Imaging: Insights into Pathobiology.** *Annual review of pathology*
  Liu, C. C., McCaffrey, E. F., Greenwald, N. F., Soon, E., Risom, T., Vijayaragavan, K., Oliveria, J., Mrdjen, D., Bosse, M., Tebaykin, D., Bendall, S. C., Angelo, M.
  2021
- **Multiplexed imaging reveals an IFN-gamma-driven inflammatory state in nivolumab-associated gastritis** *CELL REPORTS MEDICINE*
  Ferrian, S., Liu, C. C., McCaffrey, E. F., Kumar, R., Nowicki, T. S., Dawson, D. W., Baranski, A., Glaspy, J. A., Ribas, A., Bendall, S. C., Angelo, M.
  2021; 2 (10)
- **Multiplexed imaging reveals an IFN-γ-driven inflammatory state in nivolumab-associated gastritis.** *Cell reports. Medicine*
  Ferrian, S., Liu, C. C., McCaffrey, E. F., Kumar, R., Nowicki, T. S., Dawson, D. W., Baranski, A., Glaspy, J. A., Ribas, A., Bendall, S. C., Angelo, M.
  2021; 2 (10): 100419
- **Multiplexed imaging analysis of the tumor-immune microenvironment reveals predictors of outcome in triple-negative breast cancer.** *Communications biology*
  Patwa, A., Yamashita, R., Long, J., Risom, T., Angelo, M., Keren, L., Rubin, D. L.
  2021; 4 (1): 852
- **Multiplexed Ion Beam Imaging Readout of Single-Cell Immunoblotting.** *Analytical chemistry*
  Lomeli, G., Bosse, M., Bendall, S. C., Angelo, M., Herr, A. E.
  2021
- **MAUI (MBI Analysis User Interface)-An image processing pipeline for Multiplexed Mass Based Imaging.** *PLoS computational biology*
  Baranski, A., Milo, I., Greenbaum, S., Oliveria, J., Mrdjen, D., Angelo, M., Keren, L.
  2021; 17 (4): e1008887
- **The human tumor atlas network (HTAN) breast pre cancer atlas: A multi-omic integrative analysis of ductal carcinoma in situ (DCIS) and correlation with clinical outcomes**
  Hwang, S., Strand, S. H., Rivero, B., King, L., Risom, T., Harmon, B., Couch, F., Gallagher, K., Kilgore, M., Wei, S., DeMichele, A., King, T., McAuliffe, et al
  AMER ASSOC CANCER RESEARCH.2021
- **Mapping the tumor and microenvironmental evolution underlying DCIS progression throughmultiplexed ion beam imaging**
  Angelo, M.

AMER ASSOC CANCER RESEARCH.2021

- **Evaluation of Geuenich et al.: Targeting a crucial bottleneck for analyzing single-cell multiplexed imaging data.** *Cell systems*
  Averbukh, I., Greenwald, N. F., Liu, C. C., Angelo, M.
  2021; 12 (12): 1121-1123

- **Multiplexed ion beam imaging to describe tumor-immune microenvironment and tumor heterogeneity in neuroblastoma.**
  Kammersgaard, M. B., Bosse, M., Martinez, D., Bosse, K. R., Maris, J. M., Mackall, C. L., Angelo, R. M., Davis, K. L.
  AMER ASSOC CANCER RESEARCH.2020

- **Mapping the tumor and microenvironmental evolution underlying DCIS progression through multiplexed ion beam imaging.**
  Risom, T., Rivero, B., Liu, C., Baranski, A., Strand, S., Greenwald, N., McCaffrey, E., Varma, S., Keren, L., Srivastava, S., Zhu, C., Vennam, S., Hwang, et al
  AMER ASSOC CANCER RESEARCH.2020

- **The Human Tumor Atlas Network: Charting Tumor Transitions across Space and Time at Single-Cell Resolution.** *Cell*
  Rozenblatt-Rosen, O., Regev, A., Oberdoerffer, P., Nawy, T., Hupalowska, A., Rood, J. E., Ashenberg, O., Cerami, E., Coffey, R. J., Demir, E., Ding, L., Esplin, E. D., Ford, et al
  2020; 181 (2): 236–49

- **Mapping cell phenotypes in breast cancer.** *Nature cancer*
  Keren, L., Angelo, M.
  2020; 1 (2): 156-157

- **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*
  Taube, J. M., Akturk, G. n., Angelo, M. n., Engle, E. L., Gnjatic, S. n., Greenbaum, S. n., Greenwald, N. F., Hedvat, C. V., Hollmann, T. J., Juco, J. n., Parra, E. R., Rebelatto, M. C., Rimm, et al
  2020; 8 (1)

- **Single-cell metabolic profiling of human cytotoxic T cells.** *Nature biotechnology*
  Hartmann, F. J., Mrdjen, D. n., McCaffrey, E. n., Glass, D. R., Greenwald, N. F., Bharadwaj, A. n., Khair, Z. n., Verberk, S. G., Baranski, A. n., Baskar, R. n., Graf, W. n., Van Valen, D. n., Van den Bossche, et al
  2020

- **Mass spectroscopy-based highly multiplexed super-resolution imaging method for fine details of tumor microenvironment monitoring and tumor-immune cell interactions**
  Bai, Y., Zhu, B., Angelo, M., Zhao, Y., Jiang, S., Clave, X., Nolan, G.
  BMC.2019

- **Gastric toxicity associated with PD-1 blockade therapy revealed by Multiplexed Ion Beam Imaging**
  Ferrian, S., Nowicki, T., Dawson, D., Baranski, A., Glaspy, J., Ribas, A., Angelo, M.
  BMC.2019

- **Combining Multiplexed Ion Beam Imaging (MIBI) with Convolutional Neural Networks to accurately segment cells in human tissue**
  Greenwald, N., Keren, L., Greenbaum, S., Fong, M., Chaudhry, G., Abraham, Z., Moseley, J., Van Valen, D., Angelo, M.
  BMC.2019

- **Multiplexed Imaging for the simultaneous detection of nucleic acids and proteins to dissect the tissue immune landscape and microenvironment of viral diseases**
  Jiang, S., Clave, X., Chan, C., Zhu, B., Bai, Y., Bosse, M., McIlwain, D., Bendall, S., Angelo, M., Estes, J., Nolan, G.
  BMC.2019

- **Mapping the spatial architecture of acute myeloid leukemia in the bone marrow microenvironment by multiplexed ion beam imaging**
  Rovira-Clave, X., Jiang, S., Bai, Y., Zhu, B., Bosse, M., Angelo, M., Banz, Y., Schurch, C., Nolan, G.
  BMC.2019

- **MIBI-TOF: A multiplexed imaging platform relates cellular phenotypes and tissue structure.** *Science advances*
  Keren, L., Bosse, M., Thompson, S., Risom, T., Vijayaragavan, K., McCaffrey, E., Marquez, D., Angoshtari, R., Greenwald, N. F., Fienberg, H., Wang, J., Kambham, N., Kirkwood, et al
  2019; 5 (10): eaax5851

- **Glucose Metabolism Drives Histone Acetylation Landscape Transitions that Dictate Muscle Stem Cell Function.** *Cell reports*
  Yucel, N., Wang, Y. X., Mai, T., Porpiglia, E., Lund, P. J., Markov, G., Garcia, B. A., Bendall, S. C., Angelo, M., Blau, H. M.
  2019; 27 (13): 3939

- **Mass synaptometry: High-dimensional multi parametric assay for single synapses** *JOURNAL OF NEUROSCIENCE METHODS*
  Gajera, C. R., Fernandez, R., Postupna, N., Montine, K. S., Fox, E. J., Tebaykin, D., Angelo, M., Bendall, S. C., Keene, C., Montine, T. J.
  2019; 312: 73–83

- **Mass synaptometry: High-dimensional multi parametric assay for single synapses.** *Journal of neuroscience methods*
  Gajera, C. R., Fernandez, R., Postupna, N., Montine, K. S., Fox, E. J., Tebaykin, D., Angelo, M., Bendall, S. C., Keene, C. D., Montine, T. J.
  2018

- **A Structured Tumor-Immune Microenvironment in Triple Negative Breast Cancer Revealed by Multiplexed Ion Beam Imaging.** *Cell*
  Keren, L., Bosse, M., Marquez, D., Angoshtari, R., Jain, S., Varma, S., Yang, S., Kurian, A., Van Valen, D., West, R., Bendall, S. C., Angelo, M.
  2018; 174 (6): 1373

- **A Structured Tumor-Immune Microenvironment in Triple Negative Breast Cancer Revealed by Multiplexed Ion Beam Imaging** *CELL*
  Keren, L., Bosse, M., Marquez, D., Angoshtari, R., Jain, S., Varma, S., Yang, S., Kurian, A., Van Valen, D., West, R., Bendall, S. C., Angelo, M.
  2018; 174 (6): 1373-+

- **Immunohistochemistry and mass spectrometry for highly multiplexed cellular molecular imaging** *LABORATORY INVESTIGATION*
  Levenson, R. M., Borowsky, A. D., Angelo, M.
  2015; 95 (4): 397-405

- **Multiplexed ion beam imaging of human breast tumors.** *Nature medicine*
  Angelo, M., Bendall, S. C., Finck, R., Hale, M. B., Hitzman, C., Borowsky, A. D., Levenson, R. M., Lowe, J. B., Liu, S. D., Zhao, S., Natkunam, Y., Nolan, G. P.
  2014; 20 (4): 436-442

- **Multiplexed ion beam imaging of human breast tumors.** *Nature medicine*
  Angelo, M., Bendall, S. C., Finck, R., Hale, M. B., Hitzman, C., Borowsky, A. D., Levenson, R. M., Lowe, J. B., Liu, S. D., Zhao, S., Natkunam, Y., Nolan, G. P.
  2014; 20 (4): 436-442