Gregory J. Baker, PhD, PharmD

Postdoctoral Research Fellow

Laboratory of Peter K. Sorger
Department of Systems Biology
Harvard Program in Therapeutic Science (HiTS)
Ludwig Center at Harvard
Harvard Medical School
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Boston, MA 02115 USA

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GENERAL RESEARCH INTEREST

Cancer Systems Immunology

SPECIFIC

- Adult glioblastoma and other CNS malignancies
- Systemic immune response profiling and multi-omics data integration
- Cancer immunotherapy
- Preclinical cancer modeling
- Highly-multiplex tissue microscopy and spatial proteomics
- Machine learning and computer vision

EDUCATION

2008-2014 **PhD, Department of Molecular and Medical Pharmacology** Los Angeles, CA
University of California Los Angeles

2001-2007 **PharmD, College of Pharmacy** Kingston, RI
University of Rhode Island

ACADEMIC APPOINTMENTS

2015-Present **Postdoctoral Research Fellow,** Department of Systems Biology, Boston, MA
Laboratory of Systems Pharmacology**,** Harvard Medical School,
Advisor: Peter K. Sorger

2015-Present **Trainee,** Ludwig Center at Harvard Boston, MA

2011-2014 **PhD Candidate Cont.**, Department of Neurosurgery, University of Michigan Ann Arbor, MI

2008-2011 **PhD Candidate**, Department of Molecular and Medical Pharmacology Los Angeles, CA
University of California Los Angeles, Adviser: Pedro R. Lowenstein

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FUNDING

2017-2020 American Cancer Society (ACS) Postdoctoral Fellowship (PF-16-197-01–LIB). Role: PI
Title: *"Systems Biology Approaches to the Study of GBM-induced Immunosuppression"*

TECHNICAL PROFICIENCIES

Experimental

- Flow cytometry
- Microscopy: intravital, multi-photon, confocal, epifluorescence, scanning electron
- Immunofluorescence / immunohistochemistry
- Next generation RNA sequencing
- Tissue culture
- Genetic cloning
- Virus-mediated gene transfer
- Stereotactic brain tumor engraftment
- Stereology
- PCR/RT-PCR
- Western blot
- Use and handling of experimental mice and rats

Computational

- Python programming
- Data science libraries including, but not limited to, NumPy, Pandas, SciPy, Scikit-Learn, Scikit-Image, Zarr, TensorFlow, NetworkX, Plotly, Seaborn, Matplotlib
- User interface (UI) software development
- Deep convolutional generative adversarial networks (DCGANs)
- Variational autoencoders (VAEs)
- Convolutional networks for biomedical image segmentation (U-Net)
- Web development (HTML, CSS, Markdown)
- Git/Github

PUBLICATIONS

2021 Schapiro D, Sokolov A, Yapp C, Chen YA, Muhlich JL, Hess J, Creason AL, Nirmal AJ, **Baker GJ**, Nariya MK, Lin JR, Maliga Z, Jacobson CA, Hodgman MW, Ruokonen J, Farhi SL, Abbondanza D, McKinley ET, Persson D, Betts C, Sivagnanam S, Regev A, Goecks J, Coffey RJ, Coussens LM, Santagata S, Sorger PK. *MCMICRO: a scalable, modular image-processing pipeline for multiplexed t issue imaging.* **Nat Methods.** 2021 Nov 25;. doi: 10.1038/s41592-021-01308-y. [Epub ahead of print] PubMed PMID: 34824477; NIHMSID:NIHMS1760819.

Shah D, Comba A, Faisal SM, Kadiyala P, **Baker GJ**, Alghamri MS, Doherty R, Zamler D, Nuñez G, Castro MG, Lowenstein PR. *A novel miR1983-TLR7-IFNβ circuit licenses NK cells to kill glioma cells, and is under the control of galectin-1.* **Oncoimmunology.** 2021;10(1):1939601. doi: 10.1080/2162402X.2021.1939601. eCollection 2021. PubMed PMID: 34249474; PubMed Central PMCID: PMC8244780.

Iorgulescu JB, Gokhale PC, Speranza MC, Eschle BK, Poitras MJ, Wilkens MK, Soroko KM, Chhoeu C, Knott A, Gao Y, Lim-Fat MJ, **Baker GJ**, Bonal DM, Nguyen QD, Grant GRL, Ligon KL, Sorger PK, Chiocca EA, Anderson AC, Kirschmeier PT, Sharpe AH, Freeman GJ, Reardon DA. *Concurrent Dexamethasone Limits the Clinical Benefit of Immune Checkpoint Blockade in Glioblastoma.* **Clin Cancer Res.** 2021 Jan 1;27(1):276-287. doi: 10.1158/1078-0432.CCR-20-2291. Epub 2020 Nov 25. PubMed PMID: 33239433; PubMed Central PMCID: PMC8034990.

2020 Ringel AE, Drijvers JM, **Baker GJ**, Catozzi A, García-Cañaveras JC, Gassaway BM, Miller BC, Juneja VR, Nguyen TH, Joshi S, Yao CH, Yoon H, Sage PT, LaFleur MW, Trombley JD, Jacobson CA, Maliga

Z, Gygi SP, Sorger PK, Rabinowitz JD, Sharpe AH, Haigis MC. *Obesity Shapes Metabolism in the Tumor Microenvironment to Suppress Anti-Tumor Immunity.* **Cell.** 2020 Dec 23;183(7):1848-1866.e26. doi: 10.1016/j.cell.2020.11.009. Epub 2020 Dec 9. PubMed PMID: 33301708; PubMed Central PMCID: PMC8064125.

Gerosa L, Chidley C, Fröhlich F, Sanchez G, Lim SK, Muhlich J, Chen JY, Vallabhaneni S, **Baker GJ**, Schapiro D, Atanasova MI, Chylek LA, Shi T, Yi L, Nicora CD, Claas A, Ng TSC, Kohler RH, Lauffenburger DA, Weissleder R, Miller MA, Qian WJ, Wiley HS, Sorger PK. *Receptor-Driven ERK Pulses Reconfigure MAPK Signaling and Enable Persistence of Drug-Adapted BRAF-Mutant Melanoma Cells.* **Cell Syst.** 2020 Nov 18;11(5):478-494.e9. doi: 10.1016/j.cels.2020.10.002. Epub 2020 Oct 27. PubMed PMID: 33113355; PubMed Central PMCID: PMC8009031.

Baker GJ, Muhlich JL, Palaniappan SK, Moore JK, Davis SH, Santagata S, Sorger PK. *SYLARAS: A Platform for the Statistical Analysis and Visual Display of Systemic Immunoprofiling Data and Its Application to Glioblastoma.* **Cell Syst.** 2020 Sep 23;11(3):272-285.e9. doi: 10.1016/j.cels.2020.08.001. Epub 2020 Sep 7. PubMed PMID: 32898474; PubMed Central PMCID: PMC7565356.

2019 Nalle SC, Zuo L, Ong MLDM, Singh G, Worthylake AM, Choi W, Manresa MC, Southworth AP, Edelblum KL, **Baker GJ**, Joseph NE, Savage PA, Turner JR. *Graft-versus-host disease propagation depends on increased intestinal epithelial tight junction permeability.* **J Clin Invest.** 2019 Feb 1;129(2):902-914. doi: 10.1172/JCI98554. Epub 2019 Jan 22. PubMed PMID: 30667372; PubMed Central PMCID: PMC6355225.

2017 Fallahi-Sichani M, Becker V, Izar B, **Baker GJ**, Lin JR, Boswell SA, Shah P, Rotem A, Garraway LA, Sorger PK. *Adaptive resistance of melanoma cells to RAF inhibition via reversible induction of a slowly dividing de-differentiated state.* **Mol Syst Biol.** 2017 Jan 9;13(1):905. doi: 10.15252/msb.20166796. PubMed PMID: 28069687; PubMed Central PMCID: PMC5248573.

2016 Yadav VN, Zamler D, **Baker GJ**, Kadiyala P, Erdreich-Epstein A, DeCarvalho AC, Mikkelsen T, Castro MG, Lowenstein PR. *CXCR4 increases in-vivo glioma perivascular invasion, and reduces radiation I nduced apoptosis: A genetic knockdown study.* **Oncotarget.** 2016 Dec 13;7(50):83701-83719. doi: 10.18632/oncotarget.13295. PubMed PMID: 27863376; PubMed Central PMCID: PMC5341257.

Baker GJ, Chockley P, Zamler D, Castro MG, Lowenstein PR. *Natural killer cells require monocytic Gr-1(+)/CD11b(+) myeloid cells to eradicate orthotopically engrafted glioma cells.* **Oncoimmunology.** 2016 Jun;5(6):e1163461. doi: 10.1080/2162402X.2016.1163461. eCollection 2016 Jun. PubMed PMID: 27471637; PubMed Central PMCID: PMC4938363.

Kamran N, Candolfi M, **Baker GJ**, Ayala MM, Dzaman M, Lowenstein PR, Castro MG. *Gene Therapy for the Treatment of Neurological Disorders: Central Nervous System Neoplasms.* **Methods Mol Biol.** 2016;1382:467-82. doi: 10.1007/978-1-4939-3271-9_31. PubMed PMID: 26611605; PubMed Central PMCID: PMC4677484.

2015 **Baker GJ**, Castro MG, Lowenstein PR. *Isolation and Flow Cytometric Analysis of Glioma-infiltrating Peripheral Blood Mononuclear Cells.* **J Vis Exp.** 2015 Nov 28;(105). doi: 10.3791/53676. PubMed PMID: 26650233; PubMed Central PMCID: PMC4692754.

Calinescu AA, Kamran N, **Baker GJ**, Mineharu Y, Lowenstein PR, Castro MG. *Overview of current I mmunotherapeutic strategies for glioma.* **Immunotherapy.** 2015;7(10):1073-104. doi: 10.2217/imt.15.75. Review. PubMed PMID: 26598957; PubMed Central PMCID: PMC4681396.

2014 Lowenstein PR, **Baker GJ**, Castro MG. *Cracking the glioma-NK inhibitory code: toward successful innate immunotherapy.* **Oncoimmunology.** 2014 Nov;3(11):e965573. doi:

10.4161/21624011.2014.965573. eCollection 2014 Nov. PubMed PMID: 25941594; PubMed Central PMCID: PMC4292565.

Castro MG, **Baker GJ**, Lowenstein PR. *Blocking immunosuppressive checkpoints for glioma therapy: the more the Merrier!* **Clin Cancer Res.** 2014 Oct 15;20(20):5147-9. doi: 10.1158/1078-0432.CCR-14-0820. Epub 2014 May 30. PubMed PMID: 24879798; PubMed Central PMCID: PMC4330468.

Baker GJ, Chockley P, Yadav VN, Doherty R, Ritt M, Sivaramakrishnan S, Castro MG, Lowenstein PR. *Natural killer cells eradicate galectin-1-deficient glioma in the absence of adaptive immunity.* **Cancer Res.** 2014 Sep 15;74(18):5079-90. doi: 10.1158/0008-5472.CAN-14-1203. Epub 2014 Jul 18. PubMed PMID: 25038230; PubMed Central PMCID: PMC4184887.

Lynes J, Wibowo M, Koschmann C, **Baker GJ**, Saxena V, Muhammad AK, Bondale N, Klein J, Assi H, Lieberman AP, Castro MG, Lowenstein PR. *Lentiviral-induced high-grade gliomas in rats: the effects of PDGFB, HRAS-G12V, AKT, and IDH1-R132H.* **Neurotherapeutics.** 2014 Jul;11(3):623-35. doi: 10.1007/s13311-014-0269-y. PubMed PMID: 24752661; PubMed Central PMCID: PMC4121445.

Baker GJ, Yadav VN, Motsch S, Koschmann C, Calinescu AA, Mineharu Y, Camelo-Piragua SI, Orringer D, Bannykh S, Nichols WS, deCarvalho AC, Mikkelsen T, Castro MG, Lowenstein PR. *Mechanisms of glioma formation: iterative perivascular glioma growth and invasion leads to tumor progression, VEGF-independent vascularization, and resistance to antiangiogenic therapy.* **Neoplasia.** 2014 Jul;16(7):543-61. doi: 10.1016/j.neo.2014.06.003. PubMed PMID: 25117977; PubMed Central PMCID: PMC4198934.

2012 Assi H, Candolfi M, **Baker GJ**, Mineharu Y, Lowenstein PR, Castro MG. *Gene therapy for brain tumors: basic developments and clinical implementation.* **Neurosci Lett.** 2012 Oct 11;527(2):71-7. doi: 10.1016/j.neulet.2012.08.003. Epub 2012 Aug 10. Review. PubMed PMID: 22906921; PubMed Central PMCID: PMC3462660.

2011 Candolfi M, Kroeger KM, Xiong W, Liu C, Puntel M, Yagiz K, Muhammad AG, Mineharu Y, Foulad D, Wibowo M, Assi H, **Baker GJ**, Lowenstein PR, Castro MG. *Targeted toxins for glioblastoma multiforme: pre-clinical studies and clinical implementation.* **Anticancer Agents Med Chem.** 2011 Oct;11(8):729-38. doi: 10.2174/187152011797378689. Review. PubMed PMID: 21707497; PubMed Central PMCID: PMC3364590.

2010 Kroeger KM, Muhammad AK, **Baker GJ**, Assi H, Wibowo MK, Xiong W, Yagiz K, Candolfi M, Lowenstein PR, Castro MG. *Gene therapy and virotherapy: novel therapeutic approaches for brain tumors.* **Discov Med.** 2010 Oct;10(53):293-304. Review. PubMed PMID: 21034670; PubMed Central PMCID: PMC3059086.

Muhammad AK, Puntel M, Candolfi M, Salem A, Yagiz K, Farrokhi C, Kroeger KM, Xiong W, Curtin JF, Liu C, Lawrence K, Bondale NS, Lerner J, **Baker GJ**, Foulad D, Pechnick RN, Palmer D, Ng P, Lowenstein PR, Castro MG. *Study of the efficacy, biodistribution, and safety profile of therapeutic gutless adenovirus vectors as a prelude to a phase I clinical trial for glioblastoma.* **Clin Pharmacol Ther.** 2010 Aug;88(2):204-13. doi: 10.1038/clpt.2009.260. Epub 2010 Feb 17. PubMed PMID: 20164833; PubMed Central PMCID: PMC2908190.

2006 Meneni SR, D'Mello R, Norigian G, **Baker GJ**, Gao L, Chiarelli MP, Cho BP. *Sequence effects of aminofluorene-modified DNA duplexes: thermodynamic and circular dichroism properties.* **Nucleic Acids Res.** 2006;34(2):755-63. doi: 10.1093/nar/gkj480. Print 2006. PubMed PMID: 16449208; PubMed Central PMCID: PMC1356535.

BOOK CHAPTERS

2016 Kamran N, Candolfi M, **Baker GJ**, Ayala MM, Dzaman M, Lowenstein PR, Castro MG. *Gene Therapy for the Treatment of Neurological Disorders: Central Nervous System Neoplasms.* **Methods Mol Biol.** 2016;1382:467-82.

MANUSCRIPTS IN REVISION

Notarangelo G, Spinelli JB, Perez EM, Kurmi K, Elia I, **Baker GJ**, Baquer G, Stopka SA, Lin JR, Golby AJ, Joshi S, Baron HF, Drijvers, JM, Georgiev P, Ringel AE, Zaganjor E, McBrayer SK, Sorger PK, Sharpe AH, Wucherpfennig KW, Santagata S, Agar NY, Suvà ML, Haigis MC. *Oncometabolite D-2HG Inhibits Lactate Dehydrogenase to Impair $CD8^+$ T Cell Function.* **In revision at Science AAAS**

Coy S, Wang S, Stopka SA, Lin JR, Yapp C, **Baker GJ**, Baquer G, Ritch CC, Rashid R, Salhi L, Khadka P, Regan M, Hwang J, Wen PY, Bandopadhayay P, Ligon KL, Agar NY, Sorger PK, Touat M, and Santagata S. *Single Cell Spatial Analysis Reveals the Topology of Immunomodulatory Purinergic Signaling in Glioblastoma.* **In revision at Nature Communications**

MANUSCRIPTS IN PREPARATION

Baker GJ, Vallius T, Davis JA, Lin JR, Mittendorf EA, Santagata S, Guerriero JL, Sorger PK. *CyLinter: An Interactive Segmentation Filter for Multiplex Microscopy.*

Baker GJ, Guerriero JL, Lin JR, Chen YA, Pastorello R, Vallius T, Davis J, Yapp C, Church SE, Miller E, Färkkilä A, Vinayak S, Telli ML, Fulci G, D'Andrea A, Shapiro GI, Tolaney SM, Santagata S, Sorger PK, and Mittendorf EA. *High-dimensional, Single-cell Analysis and Transcriptional Profiling Reveal Novel Correlatives of Response to PARP Inhibition plus PD-1 Blockade in Triple-negative Breast Cancer.*

Baker GJ, Novikov E, Yapp C, Hug C, Nariya M, Magid S, and Sokolov A. *Pixel-level Cell State Calling in Multiplex Immunofluorescence Images of Human Tissue using Variational Autoencoders and Instance Segmentation Models.*

Iorgulescu JB, Ruthen N, Ahn R, Neagu M, Speranza M, Gokhale P, **Baker GJ**, Yates K, Datta M, Rajan S, Perez L, Suva M, Sorger P, Jain R, Chiocca EA, White F, Anderson A, Freeman G, Sharpe A, Wu C, and Reardon D. *Antigen Presentation Machinery Deficiency Leads to Immunotherapeutic Resistance in Syngeneic Murine Glioma Models.*

SELECTED CONFERENCE PROCEEDINGS

11/2021 **Baker GJ**, Vallius T, Davis JA, Lin JR, Guerriero JL, Mittendorf EA, Sorger PK. *CyLinter: An Interactive Segmentation Filter for Multiplex Microscopy,* **Human Tumor Atlas Network (HTAN) Fall F2F** (virtual)

07/2021 Invited speaker, **2nd International Conference on Cell and Experimental Biology (CEB)**, *Experimental and Computational Tools for Acquiring and Analyzing Fluidics and Microscopy-based Single-cell Data*, Houston, TX (virtual)

11/2019 **Baker GJ**, Muhlich JL, Palaniappan SK, Moore JK, Davis SH, Sorger PK. *Systemic Immune Response Profiling with SYLARAS Implicates a Role for CD45R/B220^{+} CD8^{+} T Cells in Glioblastoma Immunology,* **AACR Tumor Immunology and Immunotherapy**, Boston, MA

02/2017 Invited speaker, **Quantitative Systems Pharmacology—Systems Biology (QSP-SB) Industry and Academia Symposium**, *Systems Biology Approaches to the Study Glioblastoma-induced Immune Suppression*, Boston, MA

02/2014 Invited Speaker, **Department of Pediatrics Immuno-Hematology Symposium**, *Glioma-derived Galectin-1 is a Potent Suppressor of NK Immunosurveillance*, University of Michigan, Ann Arbor, MI

11/2014 **Baker GJ**, Yadav VN, Motsch S, Koschmann CJ, Calinescu A, Mineharu Y, Camelo-Piragua S, Orringer D, Bannykh SI, Nichols WS, deCarvalho AC, Mikkelsen T, Castro MG, Lowenstein PR. *Mechanisms of Glioma Formation: Perivascular Glioma Invasion is a VEGF-independent Mechanism of Tumor Vascularization,* **19th Annual Scientific Meeting of the Society for Neuro-Oncology (SNO),** Miami, FL

05/2014 **Baker GJ**, Yadav VN, Motsch S, Koschmann CJ, Calinescu A, Mineharu Y, Camelo-Piragua S, Orringer D, Bannykh SI, Nichols WS, deCarvalho AC, Mikkelsen T, Castro MG, Lowenstein PR. *Investigating the neoangiogenic consequences of the perivascular growth pattern in malignant brain tumors,* **50th Annual Meeting of the American Society of Clinical Oncology (ASCO)**, Chicago, IL

11/2015 **Baker GJ**, Chockley P, Zamler D, Castro MG, Lowenstein PR. *Gr-1^{+}/CD11b^{+} Myeloid Cells are Required for Natural Killer Cell-mediated Eradication of Galectin-1- deficient Glioma,* **20th Annual Scientific Meeting of the Society for Neuro-Oncology (SNO)**, San Antonio, TX

04/2014 **Baker GJ**, Chockley P, Yadav VW, Doherty R, Ritt M, Sivaramakrishnan S, Castro MG, Lowenstein PR. *Natural Killer Cells Eradicate Galectin-1 Deficient Glioma in the Absence of Adaptive Immunity,* **American Association for Cancer Research (AACR) Annual Meeting**, San Diego, CA

ACADEMIC PARTICIPATION / TEACHING EXPERIENCE

02/2022 **Cancer Systems Biology Consortium (CSBC)/Physical Sciences in Oncology (PS-ON) Image Analysis Hackathon**
3-day image analysis hackathon centered on solving problems in multiplex imaging of human cancer tissue using techniques in machine learning and computer vision (virtual)

11/2021 **Data Viz + Cancer Innovation Lab 2021: Visualizing Data in Context for Novel Insights**
Participant in a National Cancer Institute (NCI)-sponsored, 5-day innovation lab to generate creative data visualization strategies for cancer research (virtual)

10/2019 **Python Training Workshop**
Instructor for an Intensive, 5-day Python programming course sponsored by the Harvard Program in Therapeutics Science (HiTS), Boston, MA

2014 **Graduate Student Mentor**
Graduate Program in Immunology, University of Michigan, Ann Arbor, MI

2013 **Graduate Student Mentor**

Program in Biomedical Sciences, University of Michigan, Ann Arbor, MI

2006 **Undergraduate Tutor**
Clinical Pharmacology, University of Rhode Island, Kingston, RI

HONORS

2020-Present	Peer review service: Clinical Cancer Research
2014-Present	Peer review service: PLoS ONE
2022	Grand prize winner, CSBC/PS-ON Image Analysis Hackathon
2017-2020	American Cancer Society (ACS) Postdoctoral Fellow
2021	Best abstract, CSBC/PS-ON/BD-STEP Junior Investigator (JI) Meeting
2017	Best abstract, Harvard Program in Therapeutic Sciences Symposium, Cambridge, MA
2014	Guest lecturer, Immuno-Hematology Symposium, Dept. of Pediatrics, U of M
2014	Poster session winner, Annual Meeting of the Society for Neuro-Oncology, Miami, FL
2014	Summa cum laude honors, Dept. of Molecular and Medical Pharmacology, UCLA
2012	Graduate Student Travel Award, Dept. of Molecular and Medical Pharmacology, UCLA
2007	Summa cum laude honors (second in class), College of Pharmacy, URI
2007	Recipient of "*Outstanding Achievement in Biomedical Sciences Research*" award, College of Pharmacy, URI

PROFESSIONAL AFFILIATIONS AND SERVICE

2015-Present	Trainee, Ludwig Center, Harvard Medical School
2013-Present	Associate Member, American Association for Cancer Research (AACR)
2012-2014	Associate Member, American Society of Gene and Cell Therapy (ASGCT)
2005-2006	Executive Board Treasure, Rho Chi Society, Beta Pi Chapter, URI
2004-2009	Member, American Pharmacists Association (APhA)
2004-2007	Member, Academy of Student Pharmacists (ASP)
2007-2009	Rhode Island Pharmacists Association (RIPA)
2003-2007	Member, National Society of Collegiate Scholars
2003-2007	Member, Honor Society of Phi Kappa Phi

PATENTS

- "*Ligand Binding Stabilization Method for Drug Target Identification*", U.S. Patent No. 8,703,438, date of patent: April 22, 2014

- "*A Novel Cell Target for Cancer Immunotherapy*", provisional patent: January 18, 2019

LICENSURE

- Registered Pharmacist (RPH), state of Rhode Island (active status)

- Registered Pharmacist (RPH), state of California (active status)