Stanford

Chirag Patel, MD, PhD

Bio

ACADEMIC APPOINTMENTS

- Member, Cardiovascular Institute
- Member, Stanford Cancer Institute
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Director of Resident Education, Division of Adult Neuro-Oncology, Stanford University School of Medicine Department of Neurology and Neurological Sciences, (2020- present)
- Diversity, Inclusion, Belonging, Equity, and Justice (DIBEJ) Committee, Stanford University Wu Tsai Neurosciences Institute, (2020- present)
- Fellowship Program Director, Division of Adult Neuro-Oncology, Stanford University School of Medicine Department of Neurology and Neurological Sciences, (2021- present)

HONORS AND AWARDS

- 40 Under 40 in Cancer: Rising Stars and Emerging Leaders, Lynx Group, Upstream Partners, Swim Across America, NCODA
- Dee S. and Patricia Osborne Endowed Scholarship in the Neurosciences, University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences
- Diversity Recognition Award, Johns Hopkins University Diversity Leadership Council
- Excellence in Medicine Leadership Award, American Medical Association Foundation
- Honors Scholar in Medical Education, Stanford University School of Medicine Teaching and Mentoring Academy
- Martin Luther King, Jr. Award for Community Service, Johns Hopkins University
- Palatucci Advocacy Leadership Forum, American Academy of Neurology
- Student Travel Stipend Award, World Molecular Imaging Congress
- Young Investigator Palatucci Research Award, California Neurology Society
- Young Investigators Forum in Neuro-Oncology, Society for Neuro-Oncology (SNO) and WebMD/prIME Oncology

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Network of Digital Health Experts Member, U.S. Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH) (2020 - present)
- Steering Committee Member, Brain Tumor Working Group (BTWG) of the Physical Sciences Oncology Network (PSON) / Cancer Systems Biology Consortium (CSBC) (2019 - present)
- Associate Member Council (AMC), American Association for Cancer Research (AACR) (2018 - 2020)
- Member, American Society of Clinical Oncology (ASCO) (2016 - present)
- Member, American Association for Cancer Research (AACR) (2016 - present)

- Member, Society for Neuro-Oncology (SNO) (2014 - present)
- Member, Sigma Xi (2005 - present)
- Member, American Academy of Neurology (AAN) (2005 - present)
- Member, American Physician Scientists Association (APSA) (2005 - present)

PROFESSIONAL EDUCATION

- Clinical Fellowship, Stanford University School of Medicine Department of Neurology & Neurological Sciences , Neuro-Oncology
- Postdoctoral Fellowship, Stanford University School of Medicine Department of Radiology , Multimodal Molecular Imaging
- Residency, University of California at Los Angeles David Geffen School of Medicine Department of Neurology , Adult Neurology
- Internship, East Tennessee State University James H. Quillen College of Medicine Department of Internal Medicine , Internal Medicine
- MD, University of Texas at Houston John P. and Kathrine G. McGovern Medical School , Medicine
- PhD, University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences , Biomedical Sciences
- MSE, Johns Hopkins University , Biomedical Engineering
- BS, Johns Hopkins University , Biomedical Engineering (concentration in Electrical and Computer Engineering)

COMMUNITY AND INTERNATIONAL WORK

- Stanford Research Experience for Community College (SRECC) Students
- Arbor Free Clinic Specialty Service (Neurology), Menlo Park VA Hospital
- Clinical Neurology Clerkship Bedside Teaching, Stanford Hospital
- Stanford Science Penpals

PATENTS

- Chirag B. Patel, Corinne G. Beinat, Edwin Chang, Sanjiv S. Gambhir, Arutselvan Natarajan. "United States Patent 2021/0199640 A1 (pending) Methods of normalizing aberrant glycolytic metabolism in cancer cells", Leland Stanford Junior University
- Edwin Chang, Chirag B. Patel, Sanjiv S. Gambhir, Tali Voloshin-Sela, Yaara Porat, Moshe Giladi. "United States Patent 2020/0254242 A1 Using Alternating Electric Fields to Increase Cell Membrane Permeability", Novocure GmbH, Leland Stanford Junior University, Aug 31, 2021

LINKS

- Get a Second Opinion: https://stanfordhealthcare.org/second-opinion/overview.html

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My laboratory studies the biology of glioblastoma, the most common and lethal form of primary brain cancer in adults. With the hope of improving outcomes for patients with brain tumors, we investigate new forms of therapy to determine their efficacy in pre-clinical models. We also analyze scans of patients with brain tumors in order to understand imaging features of tumor aggressiveness and response to therapy.

My clinical research focuses on improving delivery of chemotherapy to brain tumors, particularly through the use of alternating electrical fields or tumor treating fields (TTFields).

CLINICAL TRIALS

- Panitumumab-IRDye800 in Diagnosing Participants With Malignant Glioma Undergoing Surgery, Recruiting
- [18F]DASA-23 and PET Scan in Evaluating Pyruvate Kinase M2 Expression in Patients With Intracranial Tumors or Recurrent Glioblastoma and Healthy Volunteers, Not Recruiting
- BPM31510 in Treating Patients With Recurrent High-Grade Glioma Previously Treated With Bevacizumab, Not Recruiting

- Exablate Blood-Brain Barrier Disruption for the Treatment of rGBM in Subjects Undergoing Carboplatin Monotherapy, Not Recruiting
- Hyperpolarized Carbon C 13 Pyruvate Magnetic Resonance Spectroscopic Imaging in Detecting Lactate and Bicarbonate in Participants With Central Nervous System Tumors, Not Recruiting
- INO-5401 and INO-9012 Delivered by Electroporation (EP) in Combination With Cemiplimab (REGN2810) in Newly-Diagnosed Glioblastoma (GBM), Not Recruiting
- ONC201 in Adults With Recurrent H3 K27M-mutant Glioma, Not Recruiting
- Pivotal, Randomized, Open-label Study of Optune® (Tumor Treating Fields) Concomitant With RT & TMZ for the Treatment of Newly Diagnosed GBM, Not Recruiting
- Study of PBI-200 in Subjects With NTRK-Fusion-Positive Solid Tumors, Not Recruiting
- Study of Tumor Treating Fields With Hypofractionated Chemoradiotherapy in Newly Diagnosed Glioblastoma, Not Recruiting
- Study of Vorasidenib (AG-881) in Participants With Residual or Recurrent Grade 2 Glioma With an IDH1 or IDH2 Mutation (INDIGO), Not Recruiting
- TTAC-0001 Phase II Trial With Recurrent Glioblastoma Progressed on Bevacizumab, Not Recruiting
- Whole Brain Radiation Therapy With Standard Temozolomide Chemo-Radiotherapy and Plerixafor in Treating Patients With Glioblastoma, Not Recruiting

Teaching

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Oncology (Fellowship Program)

Publications

PUBLICATIONS

- **Permeabilizing Cell Membranes with Electric Fields** *CANCERS*
  Aguilar, A. A., Ho, M. C., Chang, E., Carlson, K. W., Natarajan, A., Marciano, T., Bomzon, Z., Patel, C. B.
  2021; 13 (9)
- **PTEN mutations predict benefit from tumor treating fields (TTFields) therapy in patients with recurrent glioblastoma.** *Journal of neuro-oncology*
  Dono, A., Mitra, S., Shah, M., Takayasu, T., Zhu, J. J., Tandon, N., Patel, C. B., Esquenazi, Y., Ballester, L. Y.
  2021
- **Tumor treating fields (TTFields) impairs aberrant glycolysis in glioblastoma as evaluated by [18F]DASA-23, a non-invasive probe of pyruvate kinase M2 (PKM2) expression** *Neoplasia*
  Patel, C. B., Beinat, C., Xie, Y., Chang, E., Gambhir, S. S.
  2021; 23 (1): 58-67
- **EGFR-targeted intraoperative fluorescence imaging detects high-grade glioma with panitumumab-IRDye800 in a phase 1 clinical trial** *Theranostics*
  Zhou, Q., van den Berg, N. S., Rosenthal, E. L., Iv, M., Zhang, M., Vega Leonel, J. C., Walters, S., Nishio, N., Granucci, M., Raymundo, R., Yi, G., Vogel, H., Cayrol, et al
  2021; 11 (15): 7130-7143
- **Palliative Care Service Utilization and Advance Care Planning for Adult Glioblastoma Patients: A Systematic Review** *Cancers*
  Wu, A., Ruiz Colón, G., Aslakson, R., Pollom, E., Patel, C. B.
  2021
- **A Clinical PET Imaging Tracer ([18F]DASA-23) to Monitor Pyruvate Kinase M2 Induced Glycolytic Reprogramming in Glioblastoma** *Clinical Cancer Research*
  Beinat, C., Patel, C. B., Haywood, T., Murty, S., Naya, L., Castillo, J., Reyes, S., Phillips, M., Buccino, P., Shen, B., Park, J., Koran, M., Alam, et al
  2021
- **Increasing Diversity in Radiology and Molecular Imaging: Current Challenges.** *Molecular imaging and biology*
  Fite, B. Z., Hinostroza, V. n., States, L. n., Hicks-Nelson, A. n., Baratto, L. n., Kallianos, K. n., Codari, M. n., Yu, B. n., Jha, P. n., Shams, M. n., Stoyanova, T. n., Chapelin, F. F., Liu, et al

2021

- **Recurrent Status Epilepticus in the Setting of Chimeric Antigen Receptor (CAR)-T Cell Therapy** *The Neurohospitalist*
  Reveron-Thornton, R., Scott, B. J., Post, D., Finley Caulfield, A., Werbaneth, K., Hovsepian, D. A., Spiegel, J., Miklos, D., Thomas, R. P., Patel, C. B.
  2021

- **Electrophysiological Characterization of Glioma using a Biomimetic Spheroid Model** *Proceedings of the 10th International IEEE EMBS Conference on Neural Engineering*
  Kim, K. M., Tercan, S., Baday, M., Mahaney, K. B., Recht, L. D., Rajadas, J., Patel, C. B.
  2021

- **High levels of ubidecarenone (oxidized CoQ10) delivered using a drug-lipid conjugate nanodispersion (BPM31510) differentially affect redox status and growth in malignant glioma versus non-tumor cells.** *Scientific reports*
  Sun, J., Patel, C. B., Jang, T., Merchant, M., Chen, C., Kazerounian, S., Diers, A. R., Kiebish, M. A., Vishnudas, V. K., Gesta, S., Sarangarajan, R., Narain, N. R., Nagpal, et al
  2020; 10 (1): 13899

- **Intravital imaging reveals synergistic effect of CAR T-cells and radiation therapy in a preclinical immunocompetent glioblastoma model** *Oncoimmunology*
  Murty, S., Haile, S. T., Beinat, C., Aalipour, A., Alam, I. S., Murty, T., Shaffer, T. M., Patel, C. B., Graves, E. E., Mackall, C. L., Gambhir, S. S.
  2020; 9 (1)

- **Human biodistribution and radiation dosimetry of [18F]DASA-23, a PET probe targeting pyruvate kinase M2.** *European journal of nuclear medicine and molecular imaging*
  Beinat, C. n., Patel, C. B., Haywood, T. n., Shen, B. n., Naya, L. n., Gandhi, H. n., Holley, D. n., Khalighi, M. n., Iagaru, A. n., Davidzon, G. n., Gambhir, S. S.
  2020

- **Visualization of diagnostic and therapeutic targets in glioma with molecular imaging** *Frontiers in Immunology*
  Li, D., Patel, C. B., Xu, G., Iagaru, A., Zhu, Z., Zhang, L., Cheng, Z.
  2020

- **Evaluation of Glycolytic Response to Multiple Classes of Anti-glioblastoma Drugs by Noninvasive Measurement of Pyruvate Kinase M2 Using [18F]DASA-23.** *Molecular imaging and biology : MIB : the official publication of the Academy of Molecular Imaging*
  Beinat, C., Patel, C. B., Xie, Y., Gambhir, S. S.
  2019

- **Nanomedicine for Spontaneous Brain Tumors: A Companion Clinical Trial.** *ACS nano*
  Arami, H., Patel, C. B., Madsen, S. J., Dickinson, P. J., Davis, R. M., Zeng, Y., Sturges, B. K., Woolard, K. D., Habte, F. G., Akin, D., Sinclair, R., Gambhir, S. S.
  2019

- **Positron emission tomography reporter gene strategy for use in the central nervous system** *PNAS*
  Haywood, T., Beinat, C., Gowrishankar, G., Patel, C. B., Alam, I. S., Murty, S., Gambhir, S. S.
  2019

- **Engineered immune cells as highly sensitive cancer diagnostics.** *Nature biotechnology*
  Aalipour, A. n., Chuang, H. Y., Murty, S. n., D'Souza, A. L., Park, S. M., Gulati, G. S., Patel, C. B., Beinat, C. n., Simonetta, F. n., Martinić, I. n., Gowrishankar, G. n., Robinson, E. R., Aalipour, et al
  2019

- **The characterization of 18F-hGTS13 for molecular imaging of xC- transporter activity with positron emission tomography.** *Journal of nuclear medicine : official publication, Society of Nuclear Medicine*
  Beinat, C. n., Gowrishankar, G. n., Shen, B. n., Alam, I. S., Robinson, E. n., Haywood, T. n., Patel, C. B., Azevedo, E. C., Castillo, J. n., Ilovich, O. n., Koglin, N. n., Schmitt-Willich, H. n., Berndt, et al
  2019

- **18F-FDOPA PET and MRI characteristics correlate with degree of malignancy and predict survival in treatment-naïve gliomas: a cross-sectional study.** *Journal of neuro-oncology*
  Patel, C. B., Fazzari, E., Chakhoyan, A., Yao, J., Raymond, C., Nguyen, H., Manoukian, J., Nguyen, N., Pope, W., Cloughesy, T. F., Nghiemphu, P. L., Czernin, J., Lai, et al
  2018

- **Dosimetry Prediction for Clinical Translation of 64Cu-Pembrolizumab ImmunoPET Targeting Human PD-1 Expression.** *Scientific reports*
  Natarajan, A., Patel, C. B., Habte, F., Gambhir, S. S.
  2018; 8 (1): 633

- **The Utility of [18F]DASA-23 for Molecular Imaging of Prostate Cancer with Positron Emission Tomography.** *Molecular imaging and biology : MIB : the official publication of the Academy of Molecular Imaging*
  Beinat, C. n., Haywood, T. n., Chen, Y. S., Patel, C. B., Alam, I. S., Murty, S. n., Gambhir, S. S.
  2018

- **A Novel Engineered Small Protein for Positron Emission Tomography Imaging of Human Programmed Death Ligand-1 : Validation in Mouse Models and Human Cancer Tissues** *Clinical Cancer Res*
  Natarajan, A., Patel, C. B., Ramakrishnan, S., Panesar, P. S., Long, S. R., Gambhir, S. S.
  2018

- **Tumor Treating Fields Increases Membrane Permeability in Glioblastoma Cells** *Cell Death Discovery*
  Chang, E., Patel, C. B., Pohling, C., Young, C., Song, J., Flores, T., Zeng, Y., Joubert, L. M., Arami, H., Natarajan, A., Sinclair, R., Gambhir, S. S.
  2018; 4

- **Southern California neuroinvasive West Nile virus case series.** *Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology*
  Patel, C. B., Trikamji, B. V., Mathisen, G. E., Mishra, S. K.
  2017

- **Movements Here Today, Gone Tomorrow: Images in Clinical Neurology Case of Hyperglycemic Hemichorea.** *The Neurohospitalist*
  Chang, T. S., Patel, C. B., Keener, A. M., Keselman, I., Jamal, N. I.
  2017; 7 (3): 150

- **A single demyelinating attack is enough to limit brain growth in children.** *Neurology*
  Hacohen, Y., Patel, C. B., Hintzen, R.
  2017

- **Synergistic inhibition of glioma cell proliferation by Withaferin A and tumor treating fields.** *Journal of neuro-oncology*
  Chang, E. n., Pohling, C. n., Beygui, N. n., Patel, C. B., Rosenberg, J. n., Ha, D. H., Gambhir, S. S.
  2017

- **Multiple calcifying pseudoneoplasms of the neuraxis (MCAPNON): Distinct entity, CAPNON variant, or old neurocysticercosis?** *Neuropathology : official journal of the Japanese Society of Neuropathology*
  Abdaljaleel, M., Mazumder, R., Patel, C. B., Im, K., Pope, W., Liau, L. M., Vinters, H. V., Yong, W. H.
  2016

- **Natural Language Processing-Enabled and Conventional Data Capture Methods for Input to Electronic Health Records: A Comparative Usability Study.** *JMIR medical informatics*
  Kaufman, D. R., Sheehan, B., Stetson, P., Bhatt, A. R., Field, A. I., Patel, C., Maisel, J. M.
  2016; 4 (4)

- **MRI Ventral Nerve Root Enhancement in Five Patients Presenting With Extremity Weakness Secondary to Neuroinvasive West Nile Virus.** *Journal of clinical neuromuscular disease*
  Patel, C. B., Trikamji, B., Mathisen, G., Yim, C., Zipser, B., Mishra, S.
  2016; 18 (1): 41-43

- **The effects of anesthesia on the morphoproteomic expression of head and neck squamous cell carcinoma: a pilot study** *TRANSLATIONAL RESEARCH*
  Ferrell, J. K., Cattano, D., Brown, R. E., Patel, C. B., Karni, R. J.
  2015; 166 (6): 674-682

- **Challenges and opportunities for reinvigorating the physician-scientist pipeline** *JOURNAL OF CLINICAL INVESTIGATION*
  Daye, D., Patel, C. B., Ahn, J., Nguyen, F. T.
  2015; 125 (3): 883-887

- **Predictive Analytics: The Fifth Clinical Element** *SOUTHERN MEDICAL JOURNAL*
  Peiris, A. N., Patel, C. B.

2013; 106 (4): 290-291

- **Diffuse large B-cell lymphoma: A metabolic disorder?** *The American journal of case reports*
  Tanios, G., Aranguren, I. M., Goldstein, J. S., Patel, C. B.
  2013; 14: 518-525
- **Efficacy of 3% saline vs. conivaptan in achieving hyponatremia treatment goals.** *Methodist DeBakey cardiovascular journal*
  Dominguez, M., Perez, J. A., Patel, C. B.
  2013; 9 (1): 49-53
- **Toward a Better Understanding of the Retention of Physician-Scientists in the Career Pipeline** *ACADEMIC MEDICINE*
  Patel, C. B., Schauberger, E. M., Nguyen, F. T.
  2012; 87 (4): 390-391
- **Intraoperative conversion to open technique: is informed consent implied?** *journal of clinical ethics*
  Patel, C. B., Cattano, D.
  2012; 23 (1): 60-67
- **Xenon exposure in the neonatal rat brain: effects on genes that regulate apoptosis** *MINERVA ANESTESIOLOGICA*
  Cattano, D., Valleggi, S., Cavazzana, A. O., Patel, C. B., Ma, D., Maze, M., Giunta, F.
  2011; 77 (6): 571-578
- **Diagnostic nuclear medicine in the ED** *AMERICAN JOURNAL OF EMERGENCY MEDICINE*
  Amini, B., Patel, C. B., Lewin, M. R., Kim, T., Fisher, R. E.
  2011; 29 (1): 91-101
- **Management of extensive squamous cell carcinoma on the site of radiation-induced dermatitis with severe fibrosis: a case report** *J Radiother Pract*
  Patel, C. B., Rashid, R. M., Nguyen, T. H.
  2010; 9 (2): 125-8
- **Consider using diffusion tensor imaging in Geron phase I trial.** *AJNR. American journal of neuroradiology*
  Patel, C. B.
  2009; 30 (7): E97-?
- **Letter by Patel Regarding Article, "A Primer in Longitudinal Data Analysis"** *CIRCULATION*
  Patel, C. B.
  2009; 120 (4): E25-E25
- **Effect of VEGF Treatment on the Blood-Spinal Cord Barrier Permeability in Experimental Spinal Cord Injury: Dynamic Contrast-Enhanced Magnetic Resonance Imaging** *JOURNAL OF NEUROTRAUMA*
  Patel, C. B., Cohen, D. M., Ahobila-Vajjula, P., Sundberg, L. M., Chacko, T., Narayana, P. A.
  2009; 26 (7): 1005-1016
- **Blood-spinal cord barrier permeability in experimental spinal cord injury: dynamic contrast-enhanced MRI** *NMR IN BIOMEDICINE*
  Cohen, D. M., Patel, C. B., Ahobila-Vajjula, P., Sundberg, L. M., Chacko, T., Liu, S., Narayana, P. A.
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- **The effect of dental artifacts, contrast media, and experience on Interobserver contouring variations in head and neck anatomy** *47th Annual Meeting of the American-Society-for-Therapeutic-Radiology-and-Oncology*
  O'Daniel, J. C., Rosenthal, D. I., Garden, A. S., Barker, J. L., Ahamad, A., Ang, K. K., Asper, J. A., Blanco, A. I., De Crevoisier, R., Holsinger, C., Patel, C. B., Schwartz, D. L., Wang, et al
  LIPPINCOTT WILLIAMS & WILKINS.2007: 191–98
- **Cultural humility in medicine: beyond the K-20 pipeline.** *Texas medicine*
  Patel, C. B.
  2006; 102 (4): 7-?
- **Sinusoidal modeling of ictal activity along a thalamus-to-cortex seizure pathway I: New coherence approaches** *ANNALS OF BIOMEDICAL ENGINEERING*
  Sherman, D. L., Patel, C. B., Zhang, N., Rossell, L. A., Tsai, Y. C., Thakor, N. V., Mirski, M. A.

2004; 32 (9): 1252-1264

- **Prediction of PTZ-induced seizures using wavelet-based residual entropy of cortical and subcortical field potentials** *IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING*
  Paul, J. S., Patel, C. B., Al-Nashash, H., Zhang, N., Ziai, W. C., Mirski, M. A., Sherman, D. L.
  2003; 50 (5): 640-648

- **Residual entropy reveals effects of deep brain stimulation on neural activity in PTZ-induced epilepsy**
  Patel, C. B., Sherman, D. L., Paul, J. S., Zhang, N., Mirski, M. A.
  2003: 2281–84

- **Wilms' tumor suppressor gene (WT1) is expressed in primary breast tumors despite tumor-specific promoter methylation** *CANCER RESEARCH*
  Loeb, D. M., Evron, E., Patel, C. B., Sharma, P. M., Niranjan, B., Buluwela, L., Weitzman, S. A., Korz, D., Sukumar, S.
  2001; 61 (3): 921-925