



HARVARD FACULTY OF MEDICINE CURRICULUM VITAE

OCTOBER 1, 2024

Bob S Carter MD PhD FAANS

WILLIAM AND ELIZABETH SWEET PROFESSOR IN NEUROSCIENCE
HARVARD MEDICAL SCHOOL

CHAIR, DEPARTMENT OF NEUROSURGERY
MASS GENERAL BRIGHAM

CO-CHAIR, MASS GENERAL NEUROSCIENCE
MASSACHUSETTS GENERAL HOSPITAL

MEMBER, NATIONAL ACADEMY OF MEDICINE

OFFICE ADDRESS

Massachusetts General Hospital
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Areas of clinical specialization

Neuro-Oncologic Surgery • Skull Base Surgery
Neurocritical Care and Acute Care Neurosurgery

Education

- 5/86 BA with UNIVERSITY HONORS in Chemistry, Brigham Young University, Provo
5/92 PHD PHI BETA KAPPA in Genetic Epidemiology, Johns Hopkins University School of Public Health, Baltimore
5/92 MD ALPHA OMEGA ALPHA, Johns Hopkins School of Medicine, Baltimore
10/17 MA (HON), Harvard University, Cambridge, MA

Post-doctoral Training

- 7/92-6/93 Surgical Intern, Massachusetts General Hospital
7/93-1/99 Resident in Neurosurgery, Massachusetts General Hospital
7/95-6/96 Post-Doctoral Fellow in Gene Therapy, Richard Mulligan Laboratory, Massachusetts Institute of Technology & Children's Hospital, Boston
2/08-12/09 Healthcare Administrative Leadership Program, Massachusetts General Hospital, Boston, MA

Faculty Appointments held

- 1/99-6/01 Instructor of Surgery (Neurosurgery), Harvard Medical School
7/01-6/06 Assistant Professor of Surgery (Neurosurgery), Harvard Medical School
6/06-2/10 Associate Professor of Surgery (Neurosurgery), Harvard Medical School
2/10-2/17 Professor of Surgery (Neurosurgery), University of California, San Diego
2/17-9/17 Visiting Professor of Neurosurgery, Harvard Medical School
9/17- Professor of Neurosurgery, Harvard Medical School
9/17- William and Elizabeth Sweet Endowed Professor in Neuroscience
Harvard Medical School

Appointments at Hospitals and Affiliated Institutions

- 7/95-6/96 Graduate Assistant in Emergency Medicine, Massachusetts General Hospital
9/98-6/99 Chief Resident, North Neurosurgical Service, Massachusetts General Hospital
9/98-6/99 Graduate Assistant in Neurosurgery, Massachusetts General Hospital
7/99-6/06 Assistant Visiting Neurosurgeon, Massachusetts General Hospital
1/00-6/03 Staff Scientist, Molecular Medicine, Boston Children's Hospital
6/06-2/10 Associate Visiting Neurosurgeon, Massachusetts General Hospital
2/10-2/17 Attending Neurosurgeon, University of California, San Diego
2/17- Attending Neurosurgeon, Massachusetts General Hospital

Major Administrative Leadership Activities

- 1/00-2/10 Course Director, MGH Neurosurgical Grand Rounds, Harvard CME Course
- 6/05-2/10 Director of Education, Department of Neurosurgery, MGH
- 6/06-2/10 Clerkship Director, Harvard Medical School Course SU509M.3a. Senior Clerkship in Neurosurgery
- 2/10-2/17 Division Chief and Department Chair and Chief of Neurosurgery Service, UC San Diego
- 2/10-2/17 Co-Director, Moores Cancer Center Brain Tumor Program
- 1/15-2/17 Member, Board of Governors, UC San Diego Health
- 6/15-2/17 Clinical Director, UC San Diego Neurological Institute
- 9/14-2/17 Chair-Elect, Chair, and Past-Chair of the Faculty, UC San Diego School of Medicine
- 2/17- Department Chair and Chief of Neurosurgery Service, Massachusetts General Hospital
- 2/17- Chief's Council, Massachusetts General Hospital
- 2/17- General Executive Committee, Massachusetts General Hospital
- 2/17- HMS Neurosurgery Executive Committee, Harvard Medical School
- 4/18- Co-Chair and Co-Founder, Mass General Neuroscience
- 4/18- Chief's Representative to MGH Executive Committee on Research
- 6/18- Chair-Elect, Chair, MGH Executive Committee on Education and Training
- 7/21- Executive Board Member, Massachusetts General Hospital Physician Organization
- 7/22- Executive Committee on Hospital Operations

Committee Service - Local

MASSACHUSETTS GENERAL HOSPITAL - HARVARD MEDICAL SCHOOL

- 1/99-1/00 Emergency Ward Census Committee, Massachusetts General Hospital
- 1/99-1/00 MGH Provider Order Entry Implementation Committee
- 1/02-1/03 Search Committee Member, Stem Cell Biologist, Department of Neurosurgery, Massachusetts General Hospital
- 6/03-2/9 Course Planning Committee, Neurovascular Update, Harvard CME Course
- 6/05-6/09 Scientific Review Committee Dana-Farber/Partners HCC
- 1/06-1/07 Responsible Physician Committee, Massachusetts General Hospital
- 1/06-1/07 Chair, Education Committee, Department of Neurosurgery, Massachusetts General Hospital
- 1/07-1/08 Intraoperative MRI Suite Planning Committee, Massachusetts General Hospital
- 6/07-2/10 Co-Faculty Advisor, Cushing Neurosurgical Society, Neurosurgery Student Interest Group, Harvard Medical School
- 2/17- Department of Neurosurgery Executive Committee, Harvard Medical School
- 6/18-6/21 Committee of Promotions, Reappointment and Appointments (P&R) , Harvard

Medical School

- 6/23- Committee on Professors, Harvard Medical School
- 6/23- Subcommittee of Professors (SOP), Harvard Medical School
- 6/23- Chair, Department of Neurosurgery Executive Committee, Harvard Medical School
- 6/23- Council of Executive Department Heads, Harvard Medical School
- 11/23- Co-Lead, CNS Working Group, Mass General Brigham Cancer Center

UNIVERSITY OF CALIFORNIA, SAN DIEGO

- 1/10-2/17 Neurosurgery Quality Officer, UCSD Health System
- 1/10-2/17 Department of Surgery Executive Committee
- 1/10-2/17 Perioperative Services Committee
- 1/10-1/11 UCSD Medical Group Finance Committee
- 1/10-1/11 Jacobs Medical Center Intraoperative MRI Planning Committee
- 1/10-6/11 Trauma Multidisciplinary Committee
- 1/11-1/12 UCSD Health System 5 year Strategic Planning Committee
- 1/11-2/17 Center for the Future of Surgery Executive Board
- 1/12-1/13 Board of Governors Professional Standards Committee
- 6/12 CTRI Tissue Repository Committee, UCSD School of Medicine
- 1/13-2/17 Co-Chair, UCSD Neurological Institute Council
- 7/13 Chair of 5 year review, Department of Anesthesiology
- 1/14-2/17 Advisory Board Member for the UC San Diego Health Physicians Network
- 1/14-1/16 Health Sciences Leadership Academy Steering Committee
- 6/14-8/15 Vice Chair, UCSD Health Sciences Faculty Council
- 1/15-1/16 Health System Support Workstream Leader
- 1/15-2/17 Member, Critical Care Council
- 1/15-2/17 Patient Advocacy (PARS) Messenger

Committee Service - Regional

NEW ENGLAND NEUROSURGICAL SOCIETY

- 1/04-2/10 Board of Directors, New England Neurosurgical Society
- 1/08-6/09 Annual Meeting Co-Chairman, Chatham, MA
- 1/09-2/10 Secretary, New England Neurosurgical Society

SAN DIEGO ACADEMY OF NEUROSURGERY

- 1/12- President
- 12/13

CALIFORNIA ASSOCIATION OF NEUROLOGICAL SURGEONS

1/13-8/15 Regional Board of Directors

Committee Service - National

AMERICAN ASSOCIATION OF NEUROLOGICAL SURGEONS

6/98-6/08 Outcomes Committee AANS/CNS
4/02-4/04 Elected by peers to National Young Neurosurgeons Committee, American Association of Neurological Surgeons.
1/03-1/08 American Association of Neurological Surgeons Web Site Committee
1/04-1/11 American Association of Neurological Surgeons Digital Technology Committee

CONGRESS OF NEUROLOGICAL SURGEONS

1/07- Congress of Neurological Surgeons Abstract Grading Committee
1/08-1/09 Neurosurgical Quarterly Publication Committee
9/16 Local Host, Congress of Neurological Surgeons San Diego Annual Meeting

JOINT CEREBROVASCULAR SECTION

1/04- Executive Committee, Joint Cerebrovascular Section of the American Association of Neurologic Surgeons/Congress of Neurologic Surgeons
6/08 3C Meeting Abstract Grading Committee
1/05-1/12 Joint Cerebrovascular Section AANS/CNS Abstract Grading Committee
1/06-1/11 Chair, Website Committee
1/08-1/11 Editor, Cerebrovascular Section Newsletter
4/12-4/13 Vice Chair, Joint Section
4/13-4/14 Chair, Clinical Trials Advisory Group

AMERICAN ACADEMY OF NEUROLOGICAL SURGERY (BY ELECTION)

6/12-6/13 Local Host Chairperson, Annual meeting, Newport Beach
6/16-1/18 Future Sites Committee
4/19- Bylaws Committee and Executive Committee Member
9/22- Vice Chairman

AMERICAN BOARD OF NEUROLOGICAL SURGERY

5/12-5/21 Oral Board Examiner

SOCIETY OF NEUROLOGICAL SURGEONS (BY ELECTION)

- 3/13- UCSD Host Site Chair, SNS Intermediate Resident Course
- 6/14- Annual Meeting Site Selection Committee

NATIONAL INSTITUTES OF HEALTH

- 1/10-1/15 Chair, Data Safety Monitoring Board, Clear III Trial
- 1/13- see also Grant Review Section
- 1/13- exRNA Consortium Steering Committee Member
- 1/14- National Neurosurgery K12 Advisory Committee

AMERICAN HEART ASSOCIATION

- 1/99-1/00 Boston Operation Stroke, Medical Subcommittee
- 1/00-1/01 American Heart Association, Boston Awards Luncheon Committee
- 1/10-1/13 Program Committee, International Stroke Conference (3 year term)
- 1/12 Member, Guidelines Writing Group, "Hemicraniectomy for Stroke"

AMERICAN ASSOCIATION FOR CANCER RESEARCH

- 4/07 Program Chairperson, Minisymposium on Translational therapies, Annual Meeting of the American Association for Cancer Research, Los Angeles, CA

UNIVERSITY OF ILLINOIS, CHICAGO

- 7/13 External Reviewer, UIC Department of Neurosurgery

STANFORD UNIVERSITY

- 5/19 External Reviewer, Stanford Department of Neurosurgery

WASHINGTON UNIVERSITY

- 5/24 External Reviewer, Wash U Department of Neurosurgery

NATIONAL SPECIAL SYMPOSIA ORGANIZED

- 5/05 Chair and Organizer, 5th Annual Frye-Halloran Symposium on “Stem Cells and Brain Tumors” with national/international faculty of 12 speakers and 150 registrants.
- 8/06-8/07 Co-Organizer, Joint Section on Tumors/ Aspen Symposium on Neuro-Oncologic Immunology with Dr. Kevin Lillehei, University of Colorado.
- 5/09 Co-Organizer, 9th Annual Frye-Halloran Symposium on “Biomarkers and Genetic Alterations in Brain Tumors and Other Cancers” with international faculty of 15 speakers and 150 registrants.
- 10/13 Co-Organizer, Preuss Symposium, San Diego CA “Brain Tumor Collaborative” with regional faculty of 15 speakers and 50 participants.

Grant Review Activities

NATIONAL INSTITUTES OF HEALTH

- 1/13-5/16 Ad hoc NIH CNCB Study Section Reviewer
- 6/16-6/22 Charter Member NIH CNCB Study Section

OTHER RESEARCH ORGANIZATIONS

- 1/10- Brain Aneurysm Foundation Grant Reviewer
- 1/16- Neurosurgery Research and Education Foundation Review

Professional Societies

- 1/90-6/92 American Association for Cancer Research, Associate Member
- 1/90-6/92 Society for Epidemiologic Research
- 1/93- American Association of Neurological Surgeons, Fellow
- 1/93- Congress of Neurological Surgeons, Member
- 1/98- Joint Section on Cerebrovascular Surgery AANS/CNS
- 1/99- Joint Section on Tumors AANS/CNS
- 1/02-2/10 New England Neurosurgical Society
- 1/02-1/03 American Society for Gene Therapy
- 2/10- California Association of Neurological Surgery
- 2/10- San Diego Academy of Neurosurgery

- 2/11- International Society of Extracellular Vesicles
- 2/11-8/14 Western Neurosurgical Society (by election)
- 6/11- The Society of Neurological Surgeons (by election)
- 6/11- American Academy of Neurological Surgery (by election)

Editorial Activities

EDITOR ROLES

- 1/05-1/10 Editor, American Association of Neurological Surgeons Online Case Studies
- 1/10-1/14 General Neurosurgery Section Editor, *Neurosurgery*
- 1/14-4/20 Editorial Board Member and Co-Chair of Editorial Board
- 4/19-4/20 *Journal of Neurosurgery*

AD HOC REVIEWER

Neurosurgery, Neuro-Oncology, Journal of Neuro-Oncology, Cancer Research, Human Gene Therapy, Stroke, Journal of Neurology Neurosurgery and Psychiatry, Nature Communications

Honors & Prizes

- 9/81-7/82 Barrett Scholar, Brigham Young University, (Full tuition)
- 9/84-5/86 Hinckley Scholar, Brigham Young University, (Full tuition)
- 3/85 Pi Delta Phi French Honorary Society, Phi Kappa Phi (Inducted as Junior)
- 5/86 Graduated with University Honors (One of eight of 4873 graduates), BYU
- 5/86 Student Commencement Speaker, Brigham Young University
- 6/87-8/87 Summer Research Fellowship, National Institutes of Health, Bethesda, MD
- 1/88-1/90 PreDoctoral Cancer Training Fellowship, National Cancer Institute
- 5/90 First Prize, Society for Basic Urologic Research Essay Contest
- 5/91 JHU Department of Epidemiology, Doctoral Research Grant
- 5/92 Alpha Omega Alpha, Johns Hopkins School of Medicine
- 5/92 Phi Beta Kappa, Johns Hopkins School of Medicine
- 5/92 Phi Beta Kappa, Johns Hopkins School of Public Health
- 5/92 Upjohn Travel Award, Am. Assoc. for Cancer Research
- 5/92 Academy of Academic Surgeons Student Research Award-First Prize
- 5/92 Ehrlich Award for Clinical Investigation, Johns Hopkins School of Medicine
- 5/92 Delta Omega (National Public Health Honor Society)
- 7/95-6/96 Upjohn Fellowship in Cerebrovascular Disease. AANS/CNS Joint Section of Cerebrovascular Surgery

4/98 Preuss Resident Cancer Research Award Joint Section on Neuro-oncology, AANS/CNS
1/00 Partners in Excellence Award, Massachusetts General Hospital.
3/2018 Partners Healthcare “Journal of Neuro-Oncology Award”, AANS Meeting. New
Orleans, MA
9/2020 Honored Guest of the Congress of Neurologic Surgeons, CNS Meeting. Miami, FL
05/2022 Distinguished Medical Alumnus Award, Johns Hopkins University School of Medicine
10/2024 Member, National Academy of Medicine

Report of Funded Research Projects

FUNDING INFORMATION

PAST FUNDING

- 7/95-6/96 AANS Joint Section on Cerebrovascular Surgery: *Retroviral Targeting of the Cerebrovascular Endothelium via the VEGF/Flk-1 receptor ligand interaction.* \$10,000. role: Principal Investigator, Description: Genetic Engineering of Retroviral Envelope for Targeted Infection of Endothelial Cells
- 7/96-6/97 The Brain Tumor Society: *Genetically Engineered Anti-Angiogenic Anti-Tumor Cytotoxic Lymphocytes: A Novel Immunotherapeutic Strategy for Malignant Glioma.* role: Co-Investigator with Richard Mulligan, Ph.D., Zoher Ghogawala M.D. \$100,000. Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on tumor neovasculature.
- 6/97-6/98 CaP Cure Foundation: *Genetically Engineered Anti-Tumor Anti-Angiogenic Cytotoxic Lymphocyte Therapy for Prostate Cancer.* role: Co-investigator with Richard Mulligan, Ph.D. \$100,000. Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on prostate cancer cells.
- 6/00-7/00 Bayer Research Fellowship *An Investigation Into Gene and Stem Cell Based Therapies for Stroke.* \$25,000. role: Principal Investigator, Description: Analysis of Bone Marrow Derived Stem Cells in acute Cerebrovascular infarction.
- 6/00-6/06 NIH Ko8 Career Research Award. 5Ko8CA082773 National Cancer Institute *Genetically Engineered Anti-Angiogenic Anti-Glioma CTL's.* \$1,250,000. role: Principal Investigator, Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on human glioma cancer cells.
- 7/01-6/02 Genethon *Cooperative Investigation of SNV vector transduction in the central nervous system.* \$50,000. role: Principal Investigator, Description: Analysis of retroviral transduction of rodent brain using SNV vs lentiviral vectors.

- 7/01-6/03 The Brain Tumor Society. *Genetically Engineered Anti-EGFRvIII CTL's for Glioma*. \$100,000. role: Principal Investigator, Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on human glioma cancer cells.
- 7/02-6/06 Goldhirsh Foundation *Human Anti-EGFRvIII CTL's for treatment of Glioblastoma*. \$600,000. role: Principal Investigator, Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on human glioma cancer cells.
- 7/02-6/06 Rappaport Foundation *Genetic Therapies for CNS Disorders*. \$30,000. role: Principal Investigator, Description: Convection enhanced delivery of AAV serotypes to non-human primate brain.
- 7/03-6/05 NIH Dana Farber/Harvard Cancer Center Nodal Award. *Convection Enhanced Delivery of Adeno- Associated Viral vectors encoding Anti-Angiogenic Proteins* with co-Investigator, Dr. Cheryl Baker at Children's Hospital. \$175,000. role: Principal Investigator, Description: Use of AAV vectors as a gene therapy delivery agent for novel anti-angiogenic protein moieties.
- 7/04-6/05 IVAX Laboratories *Phase II Clinical Study of Recombinant Chimeric Protein Composed of Transforming Growth Factor and a Mutated Form for the Treatment of Malignant Brain Tumors* \$70,000. role: Site Principal Investigator, Description: Convection enhanced delivery of the EGFR specific TP38 immunotoxin for glioma.
- 7/05-6/07 HiQ Foundation, *Convection Enhanced Delivery of Adeno- Associated Viral Vectors to Primate Striatum* \$125,000. role: Co-Investigator with Dr. Richard Mulligan Description: Convection enhanced delivery of AAV serotypes to non-human primate brain. Comparison of transduction volume and cell type specificity.
- 7/05-6/06 Harvard Center for Human Cell Therapy Grant. *Human Chimeric T-cell Receptors for Glioblastoma Therapy* \$50,000. role: Principal Investigator, Description: GMP grade production of an artificial anti-EGFRvIII T-cell receptor positive cytotoxic T-cell.

- 7/05-6/07 Pappas Grant, MGH Brain Tumor Center *Developing Chimeric T-cell receptor therapy for Human Glioblastoma*. \$100,000. role: Principal Investigator, Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on human glioma cancer cells.
- 7/06-6/11 National Cancer Institute Program Project: 5P01CA069246-11 Subaward to B. Carter *Chimeric T-cell Receptor Therapy*. \$350,000. role: Principal Investigator, Description: Design and engineering of an artificial T-cell receptor permitting cytotoxic T-cell attack on human glioma cancer cells.
- 7/08-2/10 Adnexus Therapeutics Unrestricted Grant. *Combination Anti-Angiogenic, Radiation, and Chemotherapy Regimens for Human Glioblastoma*. \$60,000. role: Principal Investigator, Description: Pre-clinical studies of combination multi-modality therapy for glioma.
- 7/09-2/10 Harvard Catalyst Program. *Exosome based analysis of Glioma Specific Mutations* \$50,000. role: Principal Investigator, Description: Longitudinal Analysis of Serum Exosomes for Glioma Specific Mutations.
- 7/10-6/11 Brain Tumor Funders Collaborative. *Exosome based Gene Expression Array Analysis*. \$100,000. role: Principal Investigator, Description: Longitudinal Analysis of Serum Exosomes for Glioma Specific Mutations.
- 7/12-6/13 Chimeric T-cell Therapy for Glioma Moores Cancer Center \$50000 1/1/12-12/31/12 role: Principal Investigator, Co-Principal Investigator-Dr. Seogkyoung Kong, 50%. Description: The study involves the development of multiple chimeric CARs to simultaneously target glioma cell surface oncoproteins.
- 6/30/12 ABC2 Foundation *Consortium Study of EGFRvIII in Glioma Exosomes*, role:
-5/31/15 Principal Investigator(\$225,000), Description: Pilot Study of Serum Exosomes for Glioma Specific Mutations.
- 6/30/14 California Office of Statewide Planning and Development. *Spinal Fusion in
-5/31/16 California*, role: Principal Investigator(\$320,000). Description: This study is designed to analyze longitudinal outcomes of spinal fusion in the State of California. The study is based on the OSHPD database, which captures

every inpatient admission over the study period.

7/1/15
-12/31/16

Neurosurgical Quality Improvement Project
University of California Office of the President
Site-Principal Investigator(\$100,000)
This study is to implement and evaluate across the 5 UC medical schools standardization of the inpatient neurosurgical experience in the domains of preoperative patient education, post-operative debriefing, and standard Epic EMR note templating.

1/1/16-
2/17

MISTIE-Trial “Endoscopic Evacuation of Intracerebral Hematoma”
NIH 5U01NS080824-02/03
UCSD role: site Principal Investigator
Describe: MISTIE III (Minimally Invasive Surgery Plus rt-PA for Intracerebral Hemorrhage Evacuation) is an international, Phase III, 500-patient clinical trial with the primary goal of defining a successful treatment for ICH via the use of TPA for clot lysis and minimally invasive surgery.

3/1/14
-3/1/17

Temozolamide Embedded Hydrogels In the Treatment of Malignant Glioma
NanoPacific
Principal Investigator (\$220,000)
Description: The major goal of this study is to evaluate the efficacy of extended drug release embedded in a deformable hydrogel in a post tumor resection cavity.

7/1/15
-6/30/17

Immunosignatures in Medulloblastoma
ABC2 Foundation
Co-Principal Investigator(\$150,000)
The major goal of this study is to analyze immunosignatures in the blood of patients with medulloblastoma. 5 pediatric neurosurgical centers contribute to this study.

3/1/14
-3/1/17
NCE

miRNA Analysis of CSF Glioma Exosomes
ABC2 Foundation
Principal Investigator(\$150,000)
The major goal of this study is to develop miRNA signatures in the CSF of patients with glioma.

- 7/1/13
-6/30/19
- exRNA Biomarkers in Glioma
NIH UH2/UH3-UH3TR000931
Principal Investigator (\$4,000,000)
The major role of this study is to develop extracellular RNA biomarkers for glioma including miRNA and mutational signatures of glioma detected in CSF and blood. 15 participating neurosurgical centers contribute to this study.
- 5/2012
-4/2022
- Experimental Therapeutics and Biomonitoring of Glioma-Biorepository Core
NIH P01 CA069246-19
Principal Investigator(\$160,426 annual direct costs)
The major role of this study is to develop extracellular RNA biomarkers for novel immunotherapy and viral lytic therapies for glioma.

CURRENT NIH FUNDING

- 8/20-8/25
- NIH/NCI 1R01 CA237500
Contact PI/Project Leader: Bob Carter
Title: Standardized Molecular Analysis of EVs.
Awardee Organization: Massachusetts General Hospital \$649,034 annual direct costs
- 3/20-3/25
- NIH/NCI 1R01CA239078-01A1
Contact PI / Project Leader: Bob Carter
Title: Imaging and Liquid Biopsy for Glioma Diagnosis and Treatment Monitoring.
Awardee Organization:
Massachusetts General Hospital \$660,849 annual direct costs
- 8/18-7/25
- Liquid Biopsy for Treatment Stratification of IDH1 and EGFRVIII mutant glioma. NIH U01 CA2306 NCE
Principal Investigator(\$808,800 annual direct costs)

Report of Local Teaching and Training

TEACHING OF STUDENTS IN COURSES

- 2/10-2/17 UC San Diego School of Medicine. Subinternship in Neurosurgery. One hour monthly teaching session on neurocritical care with each subintern group.
- 2/10-2/17 UC San Diego School of Medicine. 3rd Year Core Surgery Clerkship. One hour monthly teaching session on neurosurgical emergencies with each subintern group.
- 2/10-2/17 UC San Diego School of Medicine. Independent Study Program (ISP) mentoring ; Individual Project Mentoring for Medical Students. 1-2 students per year.
- 7/99-2/10, Harvard Medical School. Subinternship in Neurosurgery. One hour monthly teaching session on neurosurgical emergencies with each subintern group. Clerkship Director 6/06-2/10
2/17-

FORMAL TEACHING OF RESIDENTS, CLINICAL FELLOWS, AND RESEARCH FELLOWS (POST-DOCS)

- 2/10- Case Presentation Monthly Teaching Session-Chief's Rounds.
2/17- Weekly Video Review Teaching Session-Chief's Rounds.
2/17- Weekly Quality Conference-Chief's Rounds.

CLINICAL SUPERVISORY AND TRAINING RESPONSIBILITIES

- 7/99- Operating Room Supervision and Teaching of Neurosurgery Residents. Operating room teaching of intern, junior, senior, and chief residents. Typically two full days per week.
- 2/10-2/17 Member Clinical Competency Committee UC San Diego Neurosurgery Residency Program. Twice annual reviews of each resident in training program.
- 2/17- Mentored Practice Supervision Four month rotation experience with PGY-7 resident for outpatient and inpatient practice.

LABORATORY SUPERVISORY AND TRAINING RESPONSIBILITIES

- 7/00- Post-Doctoral Fellow Supervision. Have continuously sponsored post-doctoral fellows in the laboratory environment with direct supervisory and teaching responsibility for laboratory techniques with specific focus on research investigation, and written and oral presentation of research reports. Supervision involves both weekly individual meetings and weekly group meeting.
- 7/11- National K-12 Mentorship Program. K-08 Mentor. Serve on steering committee for the Neurosurgical National K12 program. Active K-08 award mentor for Ganesh Shankar MD PhD 2020-, Pamela Jones MD, Bryan Choi MD PhD, K-08 applicant Theresa Williamson MD
- 6/12-2/17 Big Data Outcomes Group. Created a weekly 'big data' outcomes group for medical students, residents, and faculty. Supervise coding in R, STATA for large data abstraction. This activity has generated 5-10 direct manuscripts per year with mentee co-authors.
- 2/17- Summer Research Training Program. Sponsor Underrepresented in Medicine Students for a Full Scholarship Laboratory Experience with exposure to MGH and techniques in CNS molecular biology.

MENTORED TRAINEES AND FACULTY

Chief Residents and Senior Residents in Neurosurgery

1. Myron Rolle, M.D. Chief Resident in Neurosurgery, Pediatric Neurosurgery 2024
2. Mo Hadzipasic, M.D. Ph.D, Chief Resident in Neurosurgery, Spine Neurosurgery 2024
3. Pratik Talati, M.D. PhD, Chief Resident in Neurosurgery, Functional Neurosurgery 2024
4. Arjun Khanna, M.D. Chief Resident in Neurosurgery, Neuro-Oncologic Neurosurgery 2023
5. Amy Baohan, M.D. Ph.D, Chief Resident in Neurosurgery, Functional Neurosurgery 2023
6. Victoria Clark, M.D. PhD, Chief Resident in Neurosurgery, Fellow, MD Anderson

7. Christine Lee MD PhD, Assistant Professor Brown University, Chief Resident 2022
8. Ather Malik MD PhD, Assistant Professor Brown University, Chief Resident 2022
9. Cameron Sadegh MD PhD, Assistant Professor UC Davis, Chief Resident 2022
10. Bryan Choi, M.D., Ph.D., Chief Resident in Neurosurgery, Neuro-Oncologic Neurosurgery 2021
11. Jimmy Yang, M.D., Chief Resident in Neurosurgery, Functional Neurosurgery 2021
12. Ben Grannan, M.D., Chief Resident in Neurosurgery, Assistant Professor, U Washington 2021
13. Christopher Alvarez-Breckenridge, M.D., Chief Resident in Neurosurgery, Tumor Neurosurgery 2020
14. Robert Koffie, M.D. Ph.D., Chief Resident in Neurosurgery, Spine Neurosurgery 2020
15. Matt Koch, M.D., Chief Resident in Neurosurgery, Vascular Neurosurgery 2020
16. Marcus Zachariah, M.D.,Ph.D. Chief Resident in Neurosurgery, Skull Base Neurosurgery 2019
17. Vijay Yanamadala, M.D. Chief Resident in Neurosurgery, Spinal Neurosurgery 2019
18. Sarah Bick, M.D. Chief Resident in Neurosurgery, Functional Neurosurgery 2019
19. Chris Stapleton, M.D. Chief Resident in Neurosurgery, Vascular Neurosurgery 2018
20. Andrew Venteicher, M.D. Ph.D. Chief Resident in Neurosurgery, Skull Base Neurosurgery 2018
21. Matt Mian, M.D. Chief Resident in Neurosurgery, Functional Neurosurgery 2017
22. PK Agarawalla, M.D. Chief Resident in Neurosurgery, Skull Base Neurosurgery 2017

23. David Santiago-Dieppa, M.D. Resident in Neurosurgery, Vascular Neurosurgery 2013-2016
24. Jeff Steinberg, M.D. Resident in Neurosurgery, Vascular Neurosurgery 2013-2016
25. Robert Rennert, M.D. Resident in Neurosurgery, Vascular Neurosurgery 2014-2016
26. Joel Martin, M.D. Resident in Neurosurgery, Neurosurgery 2014-2016
27. Mihir Gupta, M.D. Resident in Neurosurgery, Neurosurgery 2015-2016
28. Dan Cleary, M.D. Resident in Neurosurgery, Neurosurgery 2015-2016
29. Matthew MacDougall, M.D. Chief Resident in Neurosurgery, Functional Neurosurgery Fellow Stanford 2010-2016
30. Jayson Sack, M.D., 2010-2016, Neurosurgeon, Skull Base Surgery Fellow, University of South Florida
31. David Weingarten, M.D., 2012-15, Neurosurgeon, Guam Regional Medical City
32. David Gonda, M.D., 2010-14, Assistant Professor of Neurosurgery, UC San Diego
33. Chiazoo Amene, M.D., 2010-14, Mercy Clinic Neurosurgery, Springfield, Missouri
34. J. Dawn Waters, M.D., 2010-13, Chief Neurosurgical Officer, Aetna, Fellowship Stanford Med School
35. Jayant Menon, M.D., 2010-13, Functional Neurosurgeon, Fellowship Stanford Med School
36. Ben Newman, M.D., 2010-12, Endovascular Neurosurgeon, Dallas, Tx
37. Sassan Keshavarzi, M.D., 2010-12, Spine Neurosurgeon, Bakersfield CA
38. Lissa Baird, M.D., 2010-11, Associate Professor of Neurosurgery, Boston Children's Hospital
39. Andrew Nguyen, M.D., 2010, Associate Professor of Neurosurgery, University of California, San Diego
40. Gavin Dunn, M.D.PhD, 2006-2010, Associate Professor, Massachusetts General Hospital

41. David Jho, M.D.PhD, 2005-2010, Allegheny General Hospital
42. Sameer Sheth, M.D.PhD, 2005-2010, Associate Professor, Columbia University
43. Brian Nahed, M.D., 2004-2010, Associate Professor, Massachusetts General Hospital, Harvard Medical School
44. Rollin Hu, M.D.PhD, 2004-2010, Assistant Professor, Kaiser Health System, Los Angeles, CA
45. Jason Gerrard, M.D.PhD, 2003-2010, Assistant Professor, Yale University
46. Wael Asaad, M.D.PhD, 2003-2010, Assistant Professor, Brown University
47. Travis Tierney, M.D., 2003-2010, Assistant Professor, Brigham and Women's Hospital
48. Chistopher Farrell, M.D., 2005-2009, Associate Professor, Jefferson Medical Center
49. Manuel Ferreira, M.D., Ph.D., 2002-2009, Professor of Neurosurgery, University of Washington
50. Daniel Cahill, M.D., Ph.D., 2001-2008, Professor of Neurosurgery, Massachusetts General Hospital
51. Clark Chen, M.D., Ph.D., 2001-2008, Professor and Chair, University of Minnesota
52. Manish Aghi, M.D., 2000-2007, Professor of Neurosurgery, UC San Francisco
53. Ramin Amirnovin, M.D., 2000-2007, Private Neurosurgical Practice, Los Angeles CA
54. Ziv Williams, M.D., 1999-2006, Associate Professor of Neurosurgery, MGH
55. Khalid Abbed , M.D., 1999-2006, Professor of Neurosurgery, Yale Medical School
56. Brian Hoh, M.D. , 1999-2005, Professor and Chair of Neurosurgery, University of Florida
57. Ekkehard Kasper, M.D., 1999-2005, Chair and Professor of Neurosurgery, Steward Health, Boston Harvard Medical School
58. Joseph Neimat, M.D., 1999-2004, Professor and Chair Department of Neurosurgery, University of Louisville

59. William T. Curry, M.D., 1999-2004, Professor of Neurosurgery, Chief Medical Officer, MGH, Harvard Medical School
60. Steven Kalkanis, M.D., 1998-2003, Professor and Chairman, Neurosurgery, Henry Ford Hospital
61. Edward R. Smith, M.D., 1999-2003, Associate Professor of Neurosurgery, Children's Hospital, Harvard Medical School
62. Yogish Kamath, M.D., 1999-2002, Private Practice Neurosurgery
63. Jonathan Brisman, M.D., 1999-2002, Private Practice Neurosurgery, Long Island, NY
64. Sepi Amin-Hanjani, M.D., 1999-2001, Professor of Neurosurgery, University of Illinois-Chicago
65. Albert S. Lee, M.D., 1999-2001, Private Practice Neurosurgery, Florida
66. Richard Chung, M.D. Ph.D, 1999- 2000, Private Practice Neurosurgery, Santa Barbara, CA
67. Emad Eskandar, M.D., 1999-2000, Chair of Neurosurgery, Albert Einstein, Montefiore

Research Laboratory Trainees

1. Abimanyu Thakur, 2023- Post-doctoral Fellow
2. Juliana Tapia, 2023 SRTP Student. Columbia University Undergraduate
3. Tiffaney Hsia, BS 2020-2024 Research Associate, MD PhD Acceptance U Mass Chan [co-authored publications-8]
4. Maheen Batool, MD 2020-2024 Research Associate, [co-authored publications-8]
5. Koushik Muralidharan, BA 2019-2021 Research Associate [co-authored publications-7]
6. Keiko Kang, MD Candidate 2019-2020 UC San Diego Medical Student [co-authored publications-3]
7. Andrew Sykes, BA MD Candidate Georgetown 2019 Brigham Young University
8. Julia Small, MD 2017-2019 Candidate Tufts University [co-authored publications-2]

9. Anudeep Yekula MD, 2018-2020 Post-doctoral fellow [co-authored publications-4]
10. Javier Figueroa, MD PhD, 2016 Laboratory Post Doctoral Fellow “Exosomes in Glioma” [co-authored publications-2]
11. Brian Hirshman, 2014-2016 MD PhD Candidate, “Big Data Informatics in Neurosurgery” [co-authored publications-3]
12. Dustin Hatefi 2015 Laboratory Post-Doctoral Fellow “Immunosignatures in Glioma” [co-authored publications-1]
13. Jie Li 2012-15 Laboratory Post-Doctoral Fellow “Molecular Studies of Glioma Pathophysiology” [co-authored publications-3]
14. Tyler Steed 2012-15 Laboratory Ph.D. Graduate Student “Novel Imaging Applications in Glioma” [co-authored publications-4]
15. Valya Ramakrishnan 2012-15 Laboratory Post-doctoral Fellow “miRNA studies in Glioma” [co-authored publications-4]
16. Johnny Akers PhD. 2012-13 Laboratory Post-doctoral Fellow “exRNA Biomarkers for Glioma” [co-authored publications - 10]
17. Abraham Noorkbasch M.D. 2012-13 UCSD Medical Student Mentorship [co-authored publications-5]
18. Brandon McCutcheon MD 2012-15 UCSD Medical Student Mentorship, ISP Committee Chair [co-authored publications-8]
19. Logan Marcus, M.D. 2012-15 UCSD Medical Student Mentorship, ISP Committee Member, Current: UCLA Neurosurgery Resident [co-authored publications-7]
20. David Gonda, M.D. 2011 Postdoctoral Fellow studying glioma genomics in exosomal RNA, Current: Assistant Professor of Neurosurgery, UC San Diego [co-authored publications-19]
21. Dawn Waters, M.D. 2011 Postdoctoral Fellow studying anti-angiogenic multimodality therapy for glioma, [co-authored publications-1]
22. Justin Scherer 2011 UCSD Medical Student Summer Mentor, “Glioma Biomarkers” [co-authored publications-1]
23. Amit Goyal 2010 UCSD Medical Student Summer Mentor “Exosomes as Biomarkers in CSF” [co-authored publications-3]

24. Afshin Salehi 2010 UCSD Medical Student Summer Mentor “Use of Exosomes as Biomarkers in Brain Tumors”, Current: Neurosurgery Resident, Washington University [co-authored publications-2]
25. Tsinsue Chen, M.D. “Role of Magnesium in Vasospasm” University of California, San Diego, Resident in Neurosurgery Barrow Neurological Institute [co-authored publications-1]
26. Aygun Sahin, Ph.D. Post-doctoral Fellow 2006-2009. 2008 American Brain Tumor Association Awardee. “3rd Generation Chimeric T-cell Receptors for Glioma” [co-authored publications-4]
27. Elizabeth Baratta 2005-2007. M.D. Ph.D. Candidate University of Massachusetts School of Medicine [co-authored publications-1]
28. Carlos Sanchez, M.D. Post-doctoral Fellow 2005-2010. National Cancer Institute Awardee. “Surgical Oncology Training Program” Resident in Neurosurgery, University of New Mexico [co-authored publications-4]
29. Ning Lin, M.D. Harvard/MIT one year student fellow 2004-2005. Assistant Professor, Weill Cornell Medical College [co-authored publications-3]
30. Kwan-Sung Lee, M.D. Post-doctoral Fellow 2003-2005, Cerebrovascular Neurosurgeon, Seoul, Korea [co-authored publications-1]
31. Sunil Sheth, M.D. Harvard Undergraduate Summer Research Project—HST student; Vascular Neurologist UCLA [co-authored publications-2]
32. Jared Connelly Undergraduate Summer Research Rotation. Current: Partners Emergency Medicine Resident
33. Manish Sethi, M.D. 2002 Summer student, Current: Orthopedic Trauma Surgeon, Vanderbilt University [co-authored publications-2]
34. Ilya Liviz, D.M.D. 2002- Summer research student, Harvard Dental School
35. Szofia Bullain, M.D. Post-Doctoral Fellow 2002-2007, Present position: Assistant Professor of Neurology, UC Irvine [co-authored publications-3]
36. Oscar Szentirmai, M.D. Post-Doctoral Fellow, 2000-2005, Present position: Assistant Professor Neurosurgery, University of South Florida (USF) [co-authored publications-7]
37. Yorell Manon-Matos, M.D. Summer Rotation Student. Dartmouth Medical Student 2001

38. Martin Ollenu, M.D. Summer Rotation Student, Karolinska Institute, Sweden 2000.
39. Jenny Wang, M.D. MIT Undergraduate UROP program. M.D. Candidate Northwestern University 1997.

Mentorship of Faculty In Early Career Faculty Positions

1. Andrew Nguyen MD PhD 2010 UC San Diego. Associate Professor UC San Diego
2. Alex Khalessi MD 2012 UC San Diego, Current Position: Chair, Department of Neurosurgery UC San Diego
3. Clark Chen MD PhD 2011, Assistant Professor UC San Diego, Current Position Chair University of Minnesota
4. J. Scott Pannell MD. Current Position: Associate Professor of Neurological Surgery and Radiology Director of Neurointerventional Surgery Neuroendovascular Surgery Fellowship Director
5. Justin Brown MD, Assistant Professor UC San Diego, Current Position: Associate Professor Harvard Medical School
6. Sharona Ben-Haim MD, Current Position: Associate Residency Program Director Surgical Director of Epilepsy Associate Professor of Clinical Neurological Surgery Equity, Diversity and Inclusion Officer
7. Pamela Jones MD Assistant Professor UCSD K12 Mentee MD Current Position: Director of Pituitary Surgery Mass General
8. Jeff Schweitzer MD Current Position: Assistant Professor MGH
9. Ganesh Shankar MD PhD, Assistant Professor MGH, Ko8 Mentee
10. Theresa Williamson MD, Current Position: Assistant Professor MGH
11. Chris Stapleton MD, Current Position: Assistant Professor MGH
12. Mark Richardson MD, Associate Professor MGH, Current Position: Director of Functional Neurosurgery MGH
13. Bryan Choi MD PhD, Current Position: Assistant Professor MGH, K12 Mentee
14. Kris Kahle MD PhD, Current Position: Associate Professor MGH, Director of Pediatric Neurosurgery MGH

FORMAL TEACHING OF PEERS-CONTINUING MEDICAL EDUCATION

No presentations below were sponsored by outside entities.

- 3/1990 Lecturer, Cancer Epidemiology Course, Johns Hopkins University School of Hygiene and Public Health Lecture
- 4/1992 Invited lecturer, “Familial Studies of Prostate Cancer”, 19th Annual Johns Hopkins Oncology Center Postgraduate course on neoplastic disease
- 9/1995 Lecturer, “Decompressive Surgery for Stroke” Harvard Medical School Continuing Education Course: “Stroke and Subarachnoid Hemorrhage”
- 9/1995 Invited Lecturer, “Long term outcome after SAH” Harvard Medical School Continuing Education Course: “Stroke and Subarachnoid Hemorrhage”
- 10/1996 Invited Lecturer, “Emergent Surgical Therapy for Stroke” Harvard Medical School Continuing Education Course, “Minutes Count: Emergency Management of Cerebrovascular Ischemia”
- 3/1998 Invited Lecturer. “Cerebral Perfusion Pressure Management” Harvard Medical School Continuing Education Course. “Minutes Count: Intracranial Hemorrhage and Stroke Diagnosis, Treatment and Recovery”
- 5/1999 Harvard Medical School Continuing Education Course. Neurovascular Update 1999 and Beyond. “Acute Surgery for Stroke”
- 9/1999 Harvard Medical School Continuing Education Course. Brain Attack: Minutes Count “Surgical Therapy for Acute Stroke”
- 5/2001 Harvard Medical School Continuing Education Course. “Neurovascular Update: Cavernous Malformations”
- 5/2001 Harvard Medical School Continuing Education Course: “Neurovascular Update: Surgery for Intracranial Aneurysms”
- 5/2002 Harvard Medical School Continuing Education Course: “Neurovascular Update” Lecturer “Hemicraniectomy for Stroke”
- 5/2003 Harvard Medical School Continuing Education Course: “Neurovascular Update” Lecturer “Surgery for Stroke”
- 5/2003 Harvard Medical School Continuing Education Course: “Neurovascular Update” Lecturer “Surgery for Intracerebral Hemorrhage”
- 6/2004 Harvard Medical School Continuing Education Course: “Neurovascular Update” Lecturer “Genetics of Cerebral Aneurysms” Course Co-Director
- 11/2005 Invited Speaker “Comprehensive Update on Vascular Disease – Intracerebral Hemorrhage” MGH Vascular Center
- 11/2005 Invited Speaker “Skull Base Tumors” Harvard CME Course on Brain Tumors
- 2006-09 Invited Speaker-Harvard CME Course-MGH Neurovascular Update-“Carotid Surgery”

- 1/2011 Trends in Neuro-Oncology. CME Offering UCSD School of Medicine
- 4/2011 “Carotid Surgery and Stenting” UCSD Stroke Conference CME
- 4/2012 “Carotid Surgery and Stenting” UCSD Stroke Conference CME
- 4/2013 “Extracranial-Intracranial Bypass Surgery: Techniques and Implications” UCSD Stroke Conference CME
- 4/2014 “EC-IC Bypass” UCSD Stroke Conference CME
- 4/2015 “Surgery for Intracerebral Hemorrhage” UCSD Stroke Conference CME
- 5/2021 “The Practical Neurological Toolkit” Mass General Neuroscience CME

LOCAL INVITED PRESENTATIONS

- 5/1990 “The Familial Aggregation of Prostate Cancer”, Oncology Grand Rounds, The Johns Hopkins Oncology Center.
- 2/1997 Invited Lecturer. “Genetic Strategies Against Glioma” Johns Hopkins Oncology Center
- 4/1998 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “The Cavernous Sinus”
- 6/1998 Combined Neurosurgical Service Research Retreat Harvard Medical School. Novel “Glioma Therapies: Designer T-cells and Anti-angiogenic Gene Therapy”.
- 6/1998 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “The Role of Radiation Therapy in the Treatment of Benign Meningioma”
- 7/1998 Massachusetts General Hospital Department of Neurosurgery Grand Rounds. Genetic Strategies Against Angiogenesis
- 6/1999 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. North Neurosurgical Service Report
- 9/1999 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “Amyloid Associated Lumbar Arthropathy”
- 2/2000 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “Outcome after Subarachnoid Hemorrhage”
- 3/2000 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “Hemicraniectomy: Indications and Outcomes”
- 5/2000 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “Intracranial and Carotid Stenting”
- 6/2000 Massachusetts General Hospital. Department of Neurosurgery Grand Rounds. “Outcome after Aneurysm Management in the Elderly”

- 12/2000 Massachusetts General Hospital. Department of Medicine Grand Rounds. "Diagnosis and Treatment of Cervical Atheromatous Disease"
- 9/2001 MGH Neurology Residents Course "Neurosurgical Emergencies"
- 11/2001 MGH Neurology Grand Rounds. Hemicraniectomy for Malignant Brain Edema
- 2/2002 Massachusetts General Hospital. Neurosurgery Grand Rounds. "Unruptured Intracranial Aneurysms"
- 10/2005 "Convection Enhanced Delivery of TGF-alpha-Pseudomonas Exotoxin Conjugates" Neuro-oncology Rounds, Massachusetts General Hospital
- 9/2006 Immunotherapy for Brain Tumors. MGH Neurosurgical Service Grand Rounds
- 5/2008 Cerebral Vasospasm Update. MGH Neurosurgical Service Grand Rounds
- 6/2008 Professionalism in Neurosurgery, MGH Neurosurgical Service Grand Rounds
- 1/2010 Lessons from the MGH Neurosurgical Service, MGH Neurosurgery Grand Rounds
- 2/2010 Trends in Neurosurgical Practice, UCSD Dept. of Surgery Grand Rounds
- 6/2010 "Strategies for Complex Cerebrovascular Reconstruction", UCSD Dept. of Surgery Grand Rounds
- 8/2010 Surgery Clerkship Teaching Session UCSD School of Medicine "Neurosurgical Emergencies"
- 3/2011 Neurosurgery Interest Group Teaching Session "Intracranial Aneurysm Surgery", UCSD School of Medicine
- 1/2012 "Surgical Advances in Brain Tumor Surgery" UCSD Brain Tumor Conference
- 4/2012 "Carotid Surgery and Carotid Stenting" UCSD CME Stroke Conference
- 8/2012 "Endoscopic Techniques in Brain Surgery" UCSD CME Operating Room Nurses Didactic Course
- 8/2012 "Neurosurgery Update" Department of Medicine Grand Rounds UCSD
- 9/2012 "Grantsmanship", UCSD Resident Teaching Didactic Session
- 9/2013 "Minimally Invasive Neurosurgery for Facial Pain" Facial Pain Conference, San Diego, CA
- 11/2013 "Big Data Analytics in Neurosurgery" San Diego, CA UC San Diego Department of Surgery Grand Rounds
- 04/2014 "exRNA Biomarkers for Glioma" Forbeck Meeting Focus Group San Diego CA
- 01/2015 "Optimizing Exosome Purification from CSF" NIH CSF Consortium, San Diego CA
- 11/2015 "Research Update in Neuro-Oncology" San Diego, CA UC San Diego School of Medicine, Moores Cancer Center Comer Commons Seminar
- 1/2016 "The Future on Neuro-Oncology Care" San Diego, CA UC San Diego School of Medicine, Moores Cancer Center

- 1/2016 “Finding Your Voice in Science and Medicine: Inaugural Anne Baldock Memorial Lecture ” San Diego, CA UC San Diego School of Medicine
- 2/2017 “Lessons from the MGH in Neurosurgical Discovery: The Road Ahead” MGH Neurosurgery Grand Rounds, Boston, MA
- 2/2017 “Liquid Biopsy in Glioma” MGH Neuro-Oncology Research Seminar, Boston, MA
- 1/2021 “State of the Department: Innovating for Success” MGH Neurosurgery Grand Rounds , Boston, MA
- 1/2021 “iPSC Cell Therapy for Parkinson’s” MGH Symposium ‘Innovative Molecular, Physiological, and Therapeutic Approaches to Neurodegenerative Disease’, Boston, MA

Report of Regional, National, and International Invited Teaching Presentations

No presentations below were sponsored by outside entities.

REGIONAL

- 3/1996 Invited Lecturer. The Role of Growth Factors in Brain Angiogenesis. Society of Neurochemistry Annual Meeting, Philadelphia, PA
- 6/2001 Invited Presentation on “Stem Cell Based Therapy for Stroke” to Bayer Fellowship Committee, Amelia Island Plantation Florida
- 8/2002 MGH Neurology Summer Course. “Cerebral Trauma”
- 12/2002 New England Journal of Medicine Clinicopathological Case Conference Presentation “Hemicraniectomy for Stroke”
- 4/2002 Invited Faculty. Connecticut Neurological Society Annual Meeting “Hemicraniectomy for Stroke” Hartford, CT
- 7/2003 Neurology MGH Summerstock Resident Education Series “Carotid Endarterectomy”
- 5/2004 Visiting Professor. University of Illinois at Chicago. Presentation. “Hemicraniectomy for Cerebrovascular Disease”
- 5/2004 Invited Lecturer. “Boston Stroke Society”, “Hemicraniectomy for Stroke”
- 5/2004 Invited Speaker. Goldhirsh Foundation Annual Meeting. Boston, MA “Anti-EGFRvIII Lymphocytes”
- 11/2004 Invited Lecturer. New England Medical Center Grand Rounds “Hemicraniectomy for Stroke”
- 3/2005 Invited Lecturer. Grand Rounds-Salem Hospital/North Shore Medical Center-“Hemicraniectomy for Stroke”
- 6/2005 Invited Speaker, “Stroke in Young People” Spaulding Rehab Hospital
- 10/2007 Invited Faculty. BRAIN 2007. International Symposium on Neoplasia, Moderator of Session on Immunotherapy Boston, MA
- 10/2007 Invited Lecturer. Collegium Aesculapium Society “Update on Brain Tumor Immunotherapy” Burlington, MA
- 6/2006 “An Online Case Repository: The AANS Case Studies Project” The New England Neurosurgical Society Annual Meeting. Concord, MA
- 3/2010 “Educating the Next Generation of Neurosurgeons” San Diego Academy of Neurosurgery
- 3/2011 Preuss Symposium “Exosomes and Brain Tumors” San Diego CA

- 9/2012 “Biomonitoring of Glioma” Halsted Society Annual Meeting, San Diego, CA
- 10/2012 “Next Generation Neurosurgery”, Visiting Professor Stanford Department of Neurosurgery
- 4/2013 TriState Neurovascular Summit. “Big Data and Cerebrovascular Outcomes” New York, New York.
- 4/2013 Frye Halloran Symposium. Massachusetts General Hospital. “Macromolecular Analysis in Extracellular Vesicles”
- 9/2013 “Training Next Generation Neurosurgeons” Visiting Professor, UC Irvine
- 10/2014 “Lessons from the MGH” 75th Anniversary Celebration MGH Neurosurgery, Boston, MA
- 03/2015 “On Field Diagnosis of Concussion” 10th Annual Scripps Concussion Conference, San Diego CA
- 10/2015 “Becoming a Surgeon Scientist” UC Irvine MSTP Retreat, Lake Arrowhead, CA
- 03/2016 “On Field Diagnosis of Concussion” 11th Annual Scripps Concussion Conference, San Diego CA

NATIONAL

- 9/1998 Preuss Cancer Research Award Presentation. A Novel Secreted form of the Angiogenesis Inhibitor Endostatin Inhibits the Growth of Human Glioma Xenografts. Joint Section of Neuro-oncology, Congress of Neurologic Surgeons, Seattle WA
- 2/2000 Invited Lecturer. Joint Section of Cerebrovascular Disease American Association of Neurologic Surgeons, New Orleans, LA. “Cavernous Malformations”
- 2/2001 Instructor Joint Section on Cerebrovascular Surgery American Association of Neurologic Surgeons. Critical Care Management Course. Kona, HI.
- 4/2001 Instructor. American Association of Neurologic Surgeons. Critical Care Management Course, Toronto, CA
- 9/2001 Invited Faculty. “Carotid Disease” Congress of Neurologic Surgeons
- 9/2001 Invited Faculty. “Neurosurgical Critical Care” Congress of Neurologic Surgeons
- 9/2001 Moderator. Scientific Open Program. Congress of Neurologic Surgeons Meeting. an Antonio, TX
- 2/2002 Invited Faculty. “Neurovascular Critical Care” Joint Section on Cerebrovascular Surgery. Dallas, TX
- 4/2002 Invited Faculty. “Neurocritical care” American Association of Neurologic Surgeons Meeting. Critical Care course. Chicago, IL.
- 4/2003 Invited Faculty. “Neurocritical Care” American Association of Neurologic Surgeons Meeting. Critical Care course. San Diego, CA.

- 11/2003 Invited Faculty. Houston, TX. American Association of Neurologic Surgeons Board Preparation Course
- 2/2004 Invited Faculty. "Unruptured Aneurysms" Joint Section on Cerebrovascular Surgery American Association of Neurologic Surgeons, San Diego, CA
- 4/2004 Invited Faculty. "Rat Vessel Anastomosis Course" Joint Section on Cerebrovascular Surgery American Association of Neurologic Surgeons, San Diego, CA
- 4/2004 Invited Plenary Session commentary on Unruptured intracranial aneurysms. American Association of Neurologic Surgeons Annual meeting.
- 5/2004 Invited Faculty. New Orleans, LA American Association of Neurologic Surgeons Oral Boards Review Course. "Vascular Disease"
- 1/2005 Invited Speaker. MD Anderson Cancer Center-"Engineering an Anti Angiogenic Anti-Glioma Lymphocyte"
- 2/2005 Invited Speaker. Joint Section on Cerebrovascular Surgery-"Practical Aspects of Cerebral Aneurysm Management"
- 8/2005 Invited Speaker. Joint Section Symposium on Immunotherapy-"Chimeric T-cell Receptors for glioma" University of Colorado. Denver Colorado
- 2/2006 Invited Faculty. "Strategies for Ruptured Aneurysms" Joint section on Cerebrovascular Disease, Orlando, FL.
- 5/2006 Invited Speaker. Goldhirsh Foundation Annual Meeting. Boston, MA "Anti-EGFRvIII Lymphocytes"
- 10/2006 Invited Faculty. "Strategies for Unruptured Aneurysms" Congress of Neurologic Surgeons, Chicago, FL
- 10/2006 Invited Faculty. "Flow Assessment in Cerebral Aneurysms" University of Illinois at Chicago.
- 1/2007 Visiting Professor. University of Colorado Presentation. "Genetically Engineered T-cells for Glioma"
- 10/2007 Visiting Professor. University of Chicago Presentation. "Gene and Cell Based Therapeutics for Central Nervous System Disorders"
- 2/2008 Invited Speaker. Annual Joint Cerebrovascular Section Meeting, New Orleans, Louisiana. "Cerebral Vasospasm: Overview and Medical Management"
- 8/2008 Visiting Professor, University of Minnesota, "Gene and Cell Based Therapy for Glioma"
- 2/2009 Invited Moderator. International Stroke Conference, San Diego 2009, "Unruptured Aneurysms"
- 2/2009 Invited Faculty. 3rd Annual Flow Symposium, Stanford University, Feb 2009, "Giant Cerebral Aneurysm"

- 5/2009 Invited Speaker, Cedars-Sinai Symposium on Stem Cells and Immunotherapy for Glioma.
- 2/2011 Symposium Chair and Moderator, “Cerebral Vasospasm”, Los Angeles, CA International Stroke Conference
- 9/2012 Invited Speaker, 11th Annual Update in Neuro-Oncology, Johns Hopkins University, “Targeted Therapy and Biomonitoring of Glioma”
- 10/2012 ABC2 Foundation. San Francisco CA. “Exosomes in Brain Tumors”
- 2/2013 10th Annual Molecular Diagnostics Conference. “Exosomes in Molecular Diagnostics” San Francisco, CA
- 2/2013 Preuss Foundation Seminar “Glioma Exosomes miRNA profiling” San Francisco, CA
- 2/2013 Moderator. “Cerebral Bypass” Joint Section on Cerebrovascular Disease, Honolulu, HI
- 4/2013 American Association of Neurological Surgeons Annual Meeting. “Neurosurgery in the Patient with Coagulation Disorders” New Orleans Louisiana
- 5/2013 Society for Neurological Surgeons Boot Camp Course “Neurosurgery Leadership” Center for the Future of Surgery, San Diego, CA
- 10/2013 “Endoscopic Microvascular Decompression” Trigeminal Neuralgia Association National Meeting, San Diego, CA
- 09/2014 “Exosomes” Forbeck Foundation Annual Meeting, Lake Geneva, WI
- 04/2015 “CSF Exosomes” Annual NIH exRNA Communication Consortium Meeting, Washington DC
- 04/2015 “exRNA Biomarkers for Glioma” Annual NIH exRNA Communication Consortium Meeting, Washington DC
- 05/2015 “Neurosurgery in the Factor Deficient Patient” American Association of Neurologic Surgeons Meeting, Washington DC
- 05/2015 “Stems Cells and Exosomes” American Association of Neurologic Surgeons Meeting, Washington DC
- 11/2015 “Exosomes: Nanovesicular Studies” Preuss Symposium, San Diego, CA
- 12/2015 “Exosomes: Future Science Directions” San Diego, CA American Society of Cell Biology
- 2/2016 “The Future of Neurologic Care” CannonDesign Executive Education: Future of Neuroscience Presentation, Los Angeles, CA
- 2/2016 “The Difference Between Zero and One: Exosomes and Glioma” Baltimore, MD, Johns Hopkins School of Medicine

- 3/2016 “Exosomes and Glioma” Select Biosciences Circulating Biomarkers World Congress 2016, Boston, MA
- 05/2016 “Neurosurgery in the Factor Deficient Patient” American Association of Neurologic Surgeons Meeting, Chicago, IL
- 05/2016 “Stems Cells and Exosomes” American Association of Neurologic Surgeons Meeting, Chicago, IL
- 05/2016 Invited Faculty “National K12 Career Preparation” American Association of Neurologic Surgeons Meeting, Chicago, IL
- 9/2016 “Leadership Preparation for Neurosurgeons” American Academy of Neurological Surgeons, Jackson Hole, WY
- 10/2016 “Preparing for a Career in Tumor Neurosurgery” Congress of Neurological Surgeons, San Diego, CA
- 1/2017 “Investigating Extracellular Vesicles in Glioma” Schwartz Annual Lecturer Keynote Address. Washington University, St. Louis, MO
- 3/2017 “Henderson Lecture: Lessons for the Surgeon Scientist: Extracellular Vesicles” Keynote Address. University of Maryland, Baltimore, MD
- 4/2017 “Lessons for Leadership in Neurosurgery” CSNS Young Neurosurgeon Reception. 1st Annual Invited Lecturer. Los Angeles, CA
- 9/2017 “The Road to Leading a Department” Academy Scholars Program. Santa Barbara, CA
- 10/2017 “Atypical Meningiomas” Congress of Neurological Surgeons. Boston, MA
- 10/2017 “Biomarkers in Glioma” Congress of Neurological Surgeons. Boston, MA
- 12/2017 “Glioma and Exosomes” Yale University, New Haven, CT
- 12/2017 “Glioma and Exosomes” Mt Sinai Hospital, New York City, New York
- 3/2018 “Exosomes” Select Bio 2018, Boston, MA
- 3/2018 “Development of the Surgeon Scientist” Columbia University Grand Rounds.
- 4/2018 “Exosomes as Glioma Biomarkers” ERCC Update. NIH Common Fund Meeting, Bethesda, MA
- 4/2018 “R and P series NIH Grants” Early Career Investigator Workshop. AANS Meeting.
- 4/2018 “Journal of Neuro-Oncology Award Presentation-Use of Vocimagen Amiretrorepvec in the Treatment of Recurrent Glioma. AANS Meeting. New Orleans, LA
- 6/2019 Extracellular Vesicles and Neuro-Oncology. Grand Rounds. Northwestern Univ. Department of Neurosurgery
- 12/2019 Liquid Biopsy Consortium. UCLA. Plasma Based Liquid Biopsy for Glioma.
- 9/2020 Cell Therapy for Parkinson’s. Mayo Clinic Jacksonville

- 4/2021 Cell Therapy for Parkinson's. Barrow Neurological Institute, Phoenix AZ
- 10/2021 Honored Guest Presentation. Congress of Neurological Surgeons Annual Meeting. "Gene and Cell Therapy in Neurosurgery". Austin, Texas
- 9/2022 Gene and Cell Therapy in Neurosurgery. Rosenblum Lecturer, Henry Ford Hospital
- 9/2022 Advances in Molecular Therapeutics and Diagnostics in Brain Tumors, Henry Ford Hospital
- 9/2022 The Difference Between Zero and One, Advancing a Career in Academic Neurosurgery, Henry Ford Hospital
- 9/2022 Rosenblum Lecture, "Cell Therapy for Parkinson's" Henry Ford Medical Center
- 9/2022 Grand Rounds, 'Personalized Therapeutics in Glioma' Henry Ford Medical Center
- 8/2023 IGNITE Gene and Cell Therapy Conference. "Considerations in Cell Therapy in the CNS" Solana Beach, CA
- 10/2023 Rockefeller Neuroscience Institute Grand Rounds. "Cell Therapy in the CNS" Morgantown, WVA
- 6/2024 Alksne Lecture. UC San Diego "Cell Therapy in the CNS" La Jolla, CA

INTERNATIONAL

- 6/2000 Invited Lecturer. 6th International Cerebrovascular Workshop. Seoul, Korea. "Outcome after Subarachnoid Hemorrhage" and "Management of Fusiform Aneurysms"
- 3/2008 Invited Lecturer, "Evidence Based Decision Making in Cerebrovascular Disease" Seoul National University, Korea
- 10/2008 Invited Guest, "Evidence Based Decision Making in Cerebrovascular Surgery" 67th Annual Meeting of the Japan Neurosurgical Society.
- 9/2009 Invited Lecturer, "Surgical Intervention for Acute Stroke" World Federation of Neurologic Surgeons Annual Meeting
- 11/2009 Invited Lecturer, "Strategies for Complicated Aneurysms" 9th International Cerebrovascular Surgery Symposium, Nagoya, Japan
- 11/2009 Invited Lecturer, "Minimally Invasive Treatment of Cerebral Aneurysms" 9th International Cerebrovascular Surgery Symposium, Nagoya, Japan
- 11/2009 Invited Lecturer, "Video Seminar: Nuances of Intracranial Aneurysm Surgery" 9th International Cerebrovascular Surgery Symposium, Nagoya, Japan
- 11/2012 Toyko Women's Hospital. Invited Lecturer. Exosomal Analysis in Human Glioma.
- 4/2013 ISEV (International Society for Extracellular Vesicles) Annual Meeting. "Consortium for Blood, CSF Exosome Analysis in Brain Tumor Patients"

- 4/2013 ISEV (International Society for Extracellular Vesicles) Annual Meeting. “EGFRvIII Analysis in CSF Exosomes”
- 10/2013 “Training Next Generation Neurosurgeons” Peking Union Medical College, Beijing, China
- 10/2013 “Minimally Invasive Endoscopic Neurosurgery”, Peking Union Medical College, Beijing China
- 10/2013 “exRNA Biomarkers for Glioma” Peking Union Medical College, Beijing China
- 03/2014 “exRNA Biomarkers for Glioma” Navy PLA Hospital, Beijing, China
- 09/2015 “Exosomes in Glioma” Barretos Cancer Symposium, Barretos, Brazil
- 10/2017 “Liquid Biopsy for Glioma” MGH-Heidelberg Conference. Heidelberg, Germany
- 11/2017 “Meningiomas” Beijing. Beijing, China
- 11/2017 “Excellence in Spinal Surgery” MGH-PUTH Conference. Beijing. Beijing, China
- 11/2017 “Brain Tumor Update” West China Hospital. Chengdu, China
- 2018-2023 Executive Sponsor, Quarterly Virtual Grand Rounds. Mass General and Huashan Hospital, Shanghai, China
- 9/2021 World Congress Society for Brain Mapping and Therapeutics. ‘A Novel Plasma Based Liquid Biopsy for Brain Tumors’ Los Angeles, CA
- 3/2022 World Congress Society for Brain Mapping and Therapeutics. ‘Monitoring Brain Tumors Via Liquid Biopsy: A Neurosurgeon’s Perspective’ Los Angeles, CA
- 3/2022 Huashan Conference on Neurological Disorders. ‘Cell Therapy for Parkinson’s Disease’ Shanghai, China
- 2/2023 Novel Approaches to Brain Cell Therapy. Jamaican Annual Caribbean Neurosurgery Conference. Half Moon Bay, Jamaica.
- 7/2023 Seoul National, Korea University, and UMN Conference. ‘iPSC derived Cell Therapy for Parkinson’s Disease’ Seoul National University, Seoul Korea
- 11/2023 Huashan Conference on Neurological Disorders. ‘iPSC derived Cell Therapy for Parkinson’s Disease’ Kyorin University School of Medicine, Tokyo, Japan
- 12/2023 Taiwan Neurosurgical Society. ‘iPSC derived Cell Therapy for Parkinson’s Disease’ Tapei, Taiwan

Report of Teaching and Education Innovations

Innovation	Description
Co-Founding Faculty Advisor HMS Neurosurgery Student Interest Group	Served as co-founding faculty advisor to Cushing Neurosurgery Interest group at Harvard Medical School to provide exposure of incoming 1st and 2nd year medical students to field of Neurosurgery. Faculty Liaison to undergraduate medical student group, Mission:Brain, to improve to global neurosurgical access.
Big Data Teaching Group for UC San Diego Medical Students	Founded a 'big data' group for incoming first year medical students and residents in neurosurgery. Students are introduced to the group and progress through 4 years of analytics and introduction to programming in R and STATA with independent projects.
Center for the Future of Surgery Surgical Skills Laboratory	Served as a founding member of the executive committee to design state of the art surgical skills laboratory at UC San Diego School of Medicine. Raised capital donations to facilitate resident and faculty procedural education. Recognized as one of the top procedural education facilities in the United States with over 400 courses taught annually.
Society of Neurological Surgeons Resident Site Co-Director	Mobilized faculty leadership to create a Society for Neurological Surgeons training course, held annually. One of three sites nationally, which trains >100 neurosurgery residents annually in advanced surgical techniques and OR leadership.
American Academy of Neurological Surgery/K12 Leadership Training	Served on steering committee of K12 program and implemented semi-annual leadership training course for early career physician-scientists.
Residency Teaching Innovations	Establishment of 'Video Rounds', an after-surgery technical review focused on video analysis of operative interventions.
Multi-Teaching Case Conference	Resident, APP, Faculty Interprofessional Conference incorporating case and topical review.

Report of Technological and Other Scientific Innovations: Patents

Patent Title	Description
Vegf-binding protein for blockage of Angiogenesis	<p><i>Publication number:</i> 20140302025 <i>Filed:</i> August 17, 2012 <i>Publication date:</i> October 9, 2014 <i>Applicants:</i> Childrens Medical Center Corporation, The General Hospital Corporation, President and Fellows of Harvard College. <i>Inventors:</i> Bob Carter, Jeng-Shin Lee, Szofia S. Bullain, Richard C. Mulligan.</p> <p><i>Description:</i> Chimeric VEGF-binding proteins were designed and created and tested in pre-clinical models for anti-tumor activity. These novel proteins show a high degree of interference of VEGF/VEGFR binding at low molecular weight. The technology has been licensed by Kadmon Pharmaceuticals for clinical development.</p>
Chimeric T-cell Receptors and T-cells targeting EGFRVIII on tumors	<p><i>Publication number:</i> 20100105136. <i>Filed:</i> October 9, 2007, <i>Publication date:</i> April 29, 2010 <i>Applicants:</i> The General Hospital Corporation, Children’s Medical Center Corporation <i>Inventors:</i> Bob Carter, Richard C. Mulligan, Szofia Bullain.</p> <p><i>Description:</i> Chimeric T-cell receptors targeting EGFRvIII, a prominent oncoprotein on human glioma were created and demonstrated anti-glioma activity in pre-clinical trials. This approach is currently being evaluated in Phase 1 clinical trials; next generation anti-EGFRvIII CAR T-cells currently under development.</p>
Use of Microvesicles in Analyzing Nucleic Acid Profiles	<p><i>Publication number:</i> 20160002736 <i>Filed:</i> July 6, 2015 <i>Publication date:</i> January 7, 2016 <i>Applicants:</i> The General Hospital Corporation <i>Inventors:</i> Mikkel Noerholm, Johan Karl Olov Skog, Xandra O. Breakefield, Bob Carter</p> <p><i>Description:</i> The invention concerns gene signatures obtained from microvesicles and a method of applying these gene signatures in the diagnosis, prognosis, and therapy treatment selection for diseases such as glioma or cancer more generally.</p>
Modified T lymphocytes and uses thereof	<p><i>Publication number:</i> 20060269529 <i>Filed:</i> May 7, 2003 <i>Publication date:</i> November 30, 2006 <i>Inventors:</i> Thomas Niederman, Zoher Ghogawala, Bob Carter, Richard Mulligan <i>Applicants:</i> The General Hospital Corporation, Children’s Medical Center Corporation</p> <p><i>Description:</i> Modified T lymphocytes that express a chimeric T cell receptor (CAR T-cells) reactive with two or more different cell surface antigenic markers were created and shown to have anti-tumor activity.</p>
Plasma Based Detection of TERT Promoter Mutations	<p><i>Publication number:</i> 20230027906-A1 <i>Filed:</i> October, 2019 <i>Publication date:</i> January 26, 2023 <i>Inventors:</i> Leonora Balaj, Koushik Mulhaldin, Bob Carter, <i>Applicants:</i> The General Hospital Corporation</p> <p><i>Description:</i> Plasma Based Detection of TERT Promoter mutations in glioma.</p>

Focused Contributions to Medical Science-Highlighted Publications

1. Characterization of peripheral blood-derived exosomes as biomarkers for brain tumor. In 2008, we published in *Nature Cell Biology*, the characterization of RNA containing extracellular vesicles released from glioblastoma tumor cells. This was a landmark contribution (cited more than 5,500 times in the literature) of how glioma cells release small microvesicles that contain mRNA and miRNA. We have followed that initial observation with numerous publications concerning exosome-based detection in RNA as referenced below.
 - (a) Skog J., Wurdinger T, vanRijn S, Meijerl D, Sena-Esteves M., Curry W., Carter BS, Krichevsky A, Breakefield X. Glioblastoma microvesicles transport RNA and protein that promote tumor growth and provide diagnostic biomarkers *Nat Cell Biol.* 2008 Dec;10(12):1470-6. Epub 2008 Nov 16.
 - (b) BEAMing and Droplet Digital PCR Analysis of Mutant IDH1 mRNA in Glioma Patient Serum and Cerebrospinal Fluid Extracellular Vesicles. Chen WW, Balaj L, Liau LM, Samuels ML, Kotsopoulos SK, Maguire CA, Loguidice L, Soto H, Garrett M, Zhu LD, Sivaraman S, Chen C, Wong ET, Carter BS, Hochberg FH, Breakefield XO, Skog J. *Mol Ther Nucleic Acids.* 2013 Jul 23;2:e109. doi: 10.1038/mtna.2013.28.
 - (c) RNA expression patterns in serum microvesicles from patients with glioblastoma multiforme and controls. Noerholm M, Balaj L, Limperg T, Salehi A, Zhu LD, Hochberg FH, Breakefield XO, Carter BS, Skog J. *BMC Cancer.* 2012 Jan 17;12:22. doi: 10.1186/1471-2407-12-22.
 - (d) Chip-based analysis of drug resistance of glioblastoma using exosomes. Shao H, Chung J, Lee K, Balaj L, Min C, Carter BS, Hochberg F, Breakefield X, Lee H, Weissleder R. *Nature Communications,* 6999, 2015
 - (e) TERT Promoter Mutation Analysis for Blood-Based Diagnosis and Monitoring of Gliomas. Muralidharan K, Yekula A, Small JL, Rosh ZS, Kang KM, Wang L, Lau S, Zhang H, Lee H, Bettegowda C, Chicoine MR, Kalkanis SN, Shankar GM, Nahed BV, Curry WT, Jones PS, Cahill DP, Balaj L, Carter BS. *Clin Cancer Res.* 2021 Jan 1;27(1):169-178. doi: 10.1158/1078-0432.CCR-20-3083. Epub 2020 Oct 13.
 - (f) Highly Sensitive EGFRvIII Detection in Circulating Extracellular Vesicle RNA of Glioma Patients. Batool SM, Muralidharan K, Hsia T, Falotico S, Gambin AS, Rosenfeld YB, Khanna SK, Balaj L, Carter BS. *Clin Cancer Res.* 2022 Sep 15;28(18):4070-4082.
2. A second major area of work has been the utilization of gene and cell therapy approaches for the central nervous system. This has led to the development of novel insights into the utility gene and cell transfer for the treatment of central nervous system cancers and other disorders.
 - (a) Kuo CJ, Farnebo F, Yu EY, Christofferson R, Swearingen RA, Carter BS, von Recum HA, Yuan J, Kamihara J, Flynn E, D'Amato R, Folkman J and Mulligan RC. Comparative evaluation of the antitumor activity of antiangiogenic proteins delivered by gene transfer. *Proc Natl. Acad. Sci.*98:4605, 2001. Research Article
 - (b) Recombinant adeno-associated virus type 2 pseudotypes: comparing safety, specificity, and transduction efficiency in the primate striatum. Laboratory investigation. Sanchez

- CE, Tierney TS, Gale JT, Alavian KN, Sahin A, Lee JS, Mulligan RC, Carter BS. *J Neurosurg.* 2011 Mar;114(3): 672-80. Research Article.
- (c) Pluripotent stem cell-based therapy for Parkinson's disease: Current status and future prospects. Sonntag KC, Song B, Lee N, Jung JH, Cha Y, Leblanc P, Neff C, Kong SW, Carter BS, Schweitzer J, Kim KS. *Prog Neurobiol.* 2018 Sep;168:1-20. doi: 10.1016/j.pneurobio.2018.04.005. Epub 2018 Apr 11. Review.
- (d) Personalized iPSC-Derived Dopamine Progenitor Cells for Parkinson's Disease. Schweitzer JS, Song B, Herrington TM, Park TY, Lee N, Ko S, Jeon J, Cha Y, Kim K, Li Q, Henchcliffe C, Kaplitt M, Neff C, Rapalino O, Seo H, Lee IH, Kim J, Kim T, Petsko GA, Ritz J, Cohen BM, Kong SW, Leblanc P, Carter BS, Kim KS. *N Engl J Med.* 2020 May 14;382(20):1926-1932. doi: 10.1056/NEJMoa1915872.
- (e) Co-transplantation of autologous Treg cells in a cell therapy for Parkinson's disease. Park TY, Jeon J, Lee N, Kim J, Song B, Kim JH, Lee SK, Liu D, Cha Y, Kim M, Leblanc P, Herrington TM, Carter BS, Schweitzer JS, Kim KS. *Nature.* 2023 Jul;619(7970):606-615. doi: 10.1038/s41586-023-06300-4. Epub 2023 Jul 12. PMID: 37438521
PMID: 29653250
3. A third area of work has been the use of CAR-T for glioma therapy. We published pre-clinical model for anti-EGFRvIII CAR-T therapy and have followed this with novel modifications for local secretion of BiTEs at the time of CAR-T engagement, now launched into a new clinical trial of this approach, with a recent NEJM publication highlighting early results.
- (a) Genetically engineered T cells to target EGFRvIII expressing glioblastoma. Bullain SS, Sahin A, Szentirmai O, Sanchez C, Lin N, Baratta E, Waterman P, Weissleder R, Mulligan RC, Carter BS. *J Neurooncol.* 2009 Sep;94(3):373-82. Epub 2009 Apr 23. Research Article.
- (b) Suppression of human glioma xenografts with second-generation IL13R-specific chimeric antigen receptor-modified T cells. Kong S, Sengupta S, Tyler B, Bais AJ, Ma Q, Doucette S, Zhou J, Sahin A, Carter BS, Brem H, Junghans RP, Sampath P. *Clin Cancer Res.* 2012 Nov 1;18(21):5949-60. doi: 10.1158/1078-0432.CCR-12-0319. Epub 2012 Sep 10
- (c) Development of third generation anti-EGFRvIII chimeric T cells and EGFRvIII-expressing artificial antigen presenting cells for adoptive cell therapy for glioma. Sahin A, Sanchez C, Bullain S, Waterman P, Weissleder R, Carter BS. *PLoS One.* 2018 Jul 5;13(7):e0199414. doi: 10.1371/journal.pone.0199414. eCollection 2018. PMID: 29975720
- (d) CAR-T cells secreting BiTEs circumvent antigen escape without detectable toxicity. Choi BD, Yu X, Castano AP, Bouffard AA, Schmidts A, Larson RC, Bailey SR, Boroughs AC, Frigault MJ, Leick MB, Scarfò I, Cetrulo CL, Demehri S, Nahed BV, Cahill DP, Wakimoto H, Curry WT, Carter BS, Maus MV. *Nat Biotechnol.* 2019 Jul 22. doi: 10.1038/s41587-019-0192-1.
- (e) Intraventricular CARv3-TEAM-E T Cells in Recurrent Glioblastoma. Choi BD, Gerstner ER, Frigault MJ, Leick MB, Mount CW, Balaj L, Nikiforow S, Carter BS, Curry WT, Gallagher K, Maus MV. *N Engl J Med.* 2024 Mar 13.

Report of Education of Patients and Service to the Community

No presentations below were sponsored by outside entities

2000-16	Medical Advisory Board, National Brain Aneurysm Foundation
2003	Video Production “Endovascular Therapy for Cerebral Aneurysms” Brain Aneurysm Foundation
3/2006	Invited Lecturer. Brain Tumor Society, Patient Education Day. Boston MA “Glioma”
2008	Contributing author. “Color Me Hope” Brain Tumor Society Patient Information Book.
11/2010	Community Update on Brain Tumors, Encinitas Public Library, Encinitas, CA
1/11-	San Diego Magazine/Castle-Connolly, “Top Doctors”
4/2011	Speaker, “Brain Tumors” San Diego Brain Tumor Foundation Patient and Caregiver Workshop
5/2011	City of San Diego, Commendation for Establishment of Brain Tumor Center at UC San Diego
4/2012	Speaker, “Update in Neurosurgical Techniques” Vi Retirement Community, La Jolla, CA
2013-2015	Participant Fundraiser, Accelerate Brain Cancer Cure, “Over the Edge” San Diego CA
2/18-	Boston Magazine “Top Doctors”
2013-2022	National Football League, Sideline Unaffiliated Neurosurgical Consultant Program
2023	Board of Directors, The Neurosurgical Atlas

MEDIA EDUCATION

11/2010	KPBS on Dr. Bob Carter “Awake Craniotomy”: http://bit.ly/1QRckMH
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- 11/2010 UCSD TV Dr. Bill Mobley Interview of Dr. Bob Carter on “Brain Tumor Treatments”:
<https://www.youtube.com/watch?v=edou847hfDA>
- 6/12 The New Standard for Intraoperative Imaging Environments:
<http://www.healthcaredesignmagazine.com/article/new-standard-intraoperative-imaging-environments->PDF>
- 08/2014 San Diego Union Tribute Article by Paul Sisson, citing Dr. Bob Carter on the “Mobile EMR”: <http://bit.ly/1mo48c5> (Aug. 19, 2014)
- 07/2015 San Diego Union Tribute Article by Hieu Tran Phan, citing Dr. Bob Carter’s work, Hope Amid Dire Brain Tumor Diagnosis: <http://bit.ly/1Sy7aEc> (July 17, 2015)
- 01/2018 NY Times, citing Dr. Carter’s evaluation of exoscopes in neurosurgery. [NY Times](#)
- 04/2020 People Magazine, citing Dr. Carter’s role in cell therapy for Parkinson’s. [People Magazine](#)
- 05/2024 People Magazine, citing Dr. Carter’s care of a BU undergraduate student. [People Magazine](#)

Report of Scholarship

PEER REVIEWED SCHOLARSHIP

RESEARCH INVESTIGATIONS

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2. **Carter BS**, Epstein JI, and Isaacs WB ras Gene Mutations in Human Prostate Cancer *Cancer Res*. 1990 Nov 1;50(21):6830-2.
3. Steinberg GD, **Carter BS**, Beaty TH, Childs B, and Walsh PC. Family History and the Risk of Prostate Cancer. *Prostate* 1990;17:337-347.
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8. **Carter BS**, Beaty TH, Steinberg GD, Childs B and Walsh PC. Mendelian Inheritance of Early Onset Familial Prostate Cancer. *Proc Natl Acad Sci (USA)* 1992;89: 3367-3371.
9. Umbas R, Schalken JA, Aalders TW, **Carter BS**, Karthaus HF, Schaafsma HE, Debryne FM, and Isaacs WB. Decreased expression of e-cadherin in high grade prostatic carcinomas. *Cancer Research* 1992;52:5104-9.
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16. **Carter BS** and Ogilvy CS. Surgical Management of Middle Cerebral Artery Aneurysms. *Contemporary Neurosurgery*: 1998;20:1-9.
17. **Carter BS**, Zervas NT, Chiocca EA. Neurogenetic Surgery: Current Limitations and Future Promise of Gene and Cell Based Therapies. *Clinical Neurosurgery* 1999;45:226-246.
18. Ogilvy CS and **Carter BS**. A proposed comprehensive grading system to predict outcome for surgical management of intracranial aneurysms. *Neurosurgery*. 1998;42:959-968.
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PROFESSIONAL EDUCATIONAL MATERIALS OR REPORTS

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CLINICAL GUIDELINES AND REPORTS

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DOCTORAL THESIS

The Molecular Genetics and Genetic Epidemiology of Human Prostate Cancer. **Carter BS**. Johns Hopkins University School of Public Health, 1992.

CITATION IMPACT

Total citations in the literature: 42,508 (accessioned June 2024)

H-index: 96

i10-index (# of papers with at least 10 citations): 251

Papers with NIH iCite citation ranking >90%ile: 54

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PHILANTHROPIC EFFORTS IN SUPPORT OF ACADEMIC AND CLINICAL PROGRAMS

Focus Area	Description
Endowed Chair Support for Faculty	<ul style="list-style-type: none"> • Robert L. Martuza - Endowed Professorship at Harvard Medical School. \$4 million • Marshall Family - Endowed Chair at UC San Diego. Raised 1st Endowed Chair commitment in Neurosurgery at UC San Diego. \$2 million • Kingdon-Saylor Family - Endowed Chair in Spine Surgery Massachusetts General Hospital. Raised funds to support establishment of first chair in Spine Surgery at MGH. \$2 million • George Lopez Endowed Chair in Cell Therapy Massachusetts General Hospital. Raised funds to support establishment of first chair in neurological cell therapy at MGH. \$2 million • Barracos Endowed Chair in Spine Surgery Education Massachusetts General Hospital. Raised funds to support establishment of first chair specifically focused on spine surgery education. \$2 million • Napthal Endowed Chair in Neurosurgery at Massachusetts General Hospital. Raised funds to support establishment of first chair focused on women leaders in neurosurgery. \$4 million • Migliaro Endowed Scholar in Neurosurgery at Massachusetts General Hospital. Funds in support of residency program director at MGH. \$1 million • Tagliente Endowed Scholar in Neurosurgery at Massachusetts General Hospital. Funds in support of residency program director at MGH. \$1 million • Glazer Endowed Chair and Endowed Scholar in Neurosurgery at Massachusetts General Hospital. Funds in support of low grade glioma research. \$3 million • Robins Endowed Scholar in Neurosurgery at Massachusetts General Hospital. Funds in support of NF2 research and care. \$2 million • Hahn Family Endowed Chair in Neurosurgery at Massachusetts General Hospital. Funds in support of Brain Neurorestoration. \$2 million • Gund Family Endowed Transformative Scholar in Neurosurgery at Massachusetts General Hospital. Funds in support of CSF Research. \$1.5 million
Capital and Programmatic Support	<ul style="list-style-type: none"> • Completed \$500K fund raise to support installation of first iMRI in So. California • Completed \$20 million dollar fund raise to support launch of Phase 1 clinical trial in Cell Therapy for Parkinson's, including build out of state of the art GMP facility on MGH campus. • Completed \$5 million dollar fund raise to support build out of state of the art GMP facility on MGH campus for CNS Cell Therapy. • Completed \$2 million dollar fund raise to support establishment of new Scientific director of Lopez laboratory.
Endowed Support of Mass General Neuroscience	<ul style="list-style-type: none"> • Deployed with MGN Leadership a \$15 million Gamble Estate philanthropic gift to establish three endowed directorships and administrative support of Mass General Neuroscience.
Center for Glioma of Young Adults	<ul style="list-style-type: none"> • Secured \$10 million dollar commitment for new Center for Glioma of Young Adults including two research scholars and endowed chair support.

Narrative Report of Scientific Research Contributions

Research Contributions

My academic research career has been dedicated to advancing molecular diagnostics and gene and cell therapy in human health. Major scientific themes in the literature (contributed in 220 original research publications, 91 reviews, H-index of 94) include:

Characterization of Genetic Underpinnings of Prostate Cancer

1. My early career research at Johns Hopkins was pivotal in defining hereditary prostate cancer. I led a series of investigations that resulted in a seminal *Proceedings of the National Academy of Sciences* publication. This body of work, cited more than 7000 times, established the first genetic model for hereditary prostate cancer in early-onset cases and developed criteria for its identification. This comprehensive series of studies also involved molecular genetic analysis of spontaneous tumors, which significantly contributed to understanding prostate tumorigenesis.

CAR-T Therapy in Neurological Cancers and iPSC Based Cell Therapy for CNS Disorders

1. At Massachusetts General Hospital, I pioneered gene therapy approaches in the CNS by developing and publishing the first ex vivo manipulated CAR-T cells targeting EGFRvIII and VEGF receptors in human glioblastoma. This innovative work was published in the *Proceedings of the National Academy of Sciences* and laid the groundwork for subsequent clinical trials and continues to be a key research area in our Department with active clinical trials and a newly published (March 2024) NEJM article describing our early Phase 1 results.
2. Our team authored the first description of the use of dopaminergic neurons derived from iPSC in Parkinson's disease treatment, published in *New England Journal of Medicine* (2020). This research has now led to the first FDA-approved clinical trial for autologous cell therapy in Parkinson's disease.

Extracellular Vesicles in Neurological Disorders and Liquid Biopsy Applications

1. Our first report on extracellular vesicles in human glioblastoma, published in *Nature Communications* in 2008 and cited over 5400 times, was the first to identify the release of nano-sized RNA containing vesicles from glial tumors. My lab's extensive work, including more than 50 key publications, has been instrumental in the NIH extracellular RNA communication consortium and the National Cancer Institute's liquid biopsy consortium.
2. Our group later went on to develop the first CSF and plasma-based tests for high-grade glioblastoma genetic mutations, such as EGFRvIII and TERT promoter mutations, detailed in *Clinical Cancer Research* (2021,2022). Co-leading the NCI's Liquid Biopsy consortium, we have continued to advance the effort of CSF and plasma-based diagnostics for human glioma.

comment

Leadership Narrative

A cornerstone of my leadership philosophy is a belief in the boundless potential of collaboration, that we can achieve much more by working synergistically. My tenure as Department Chair and System Leader in two different academic health systems, the University of California, San Diego, and Mass General Brigham (MGB)/Harvard Medical School, has been marked by cross-disciplinary initiatives, forging positive inflection points in achieving strategic goals, and advancing institutional missions in clinical care and community service, teaching, and research.

The essence of collaboration is most pronounced in multidisciplinary system initiatives. I have held pivotal roles in major committees and boards, overseeing operational, financial, and strategic governance across hospitals, medical schools, and health systems. My service on Chief's councils, Boards of Governors, and Executive Committees at both UC San Diego and MGB exemplifies my commitment to stewardship and governance, including a major leadership role in the integration of the Mass General and Brigham & Women's neuroscience service lines.

For instance, collaborating with the chairs of Neurology, Psychiatry, and Radiology at MGH, we co-founded *Mass General Neuroscience*. This initiative laid the foundation for an interdisciplinary collaboration involving over 2,000 dedicated professionals, advancing interdisciplinary neurological care across twelve inpatient hospitals in the Mass General Brigham Health System. It has evolved into a pivotal nexus for cross-disciplinary neuroscience initiatives throughout the institution.

In my multifaceted roles as a neurosurgical oncologist, researcher, and educator, I find immense gratification in nurturing the next generation of medical leaders. Whether recruiting new faculty and mentoring K-awardees at UC San Diego's Neurological Institute and MGB's Brain Tumor Center, or developing faculty leaders, my focus has been on creating high-value professional development and career opportunities for students and faculty.

Research and education are the linchpins that set academic medical centers apart. With practical experience leading NIH funded research programs and a national perspective as Co-Chair of an NCI consortium, I have actively sought cross-institutional collaborations locally and nationally to foster strategic scientific innovation. These activities have been recognized by my election to the National Academy of Medicine.

In fund-raising, the power of collaboration has been a guiding principle. Beyond securing \$75 million in philanthropic support, I have spearheaded large system initiatives, developing thematic gifts in neuroscience, education, and capital projects. One example is in my role as Chair of ECOTE at MGH, overseeing all facets of medical education, wherein we are deploying a new \$50 million gift to establish the *Peter L. Slavin, MD Academy for Applied Learning in Health Care*, laying the groundwork for a new vision of lifelong learning in the hospital.

I ardently believe that investments in community building are essential both within and outside

our academic community. My leadership efforts have championed approaches to foster inclusion and belonging, specifically in the domains of recruitment, faculty wellness and support, and leadership advancement.

Leading collaborative teams at UC San Diego and Mass General Brigham has been a source of immense satisfaction. Together, we have delivered on the promise of new therapies, innovative research, and exemplary clinical care, always upholding community and collaboration as key drivers of success.