

Harvard Medical School Curriculum Vitae

Date Prepared: December 7, 2022
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Place of Birth: Murray, UT

Education

1999	B.S. (Magna Cum Laude)	Physics	Brigham Young University
2006	Ph.D.	Physics	Washington University in St. Louis
2006	M.D.	Medicine	Washington University School of Medicine

Postdoctoral Training

09/04-01/05	Research Associate	Neurology	Alzheimer's Disease Research Center, Washington University School of Medicine, St. Louis, Missouri
07/06-06/07	Intern	Medicine	Barnes Jewish Hospital, Washington University School of Medicine, St. Louis, MO
07/07-06/10	Resident	Neurology	Partners (BWH & MGH)
07/10-06/12	Fellow	Epilepsy and Clinical Neurophysiology	MGH
07/10-06/12	Research Fellow	Neurology	MGH

Faculty Academic Appointments

07/12-05/14	Instructor	Neurology	Harvard Medical School
05/14-05/18	Assistant Professor	Neurology	Harvard Medical School
05/18-10/22	Associate Professor	Neurology	Harvard Medical School
10/22-	Professor	Neurology	Harvard Medical School
11/22	Emily Fisher Landau Professor of Neurology	Neurology	Harvard Medical School

Appointments at Hospitals/Affiliated Institutions

07/12-05/18	Assistant Neurologist	Neurology	Massachusetts General Hospital
05/18-10/22	Associate Neurologist	Neurology	Massachusetts General Hospital
10/22-	Professor of Neurology	Neurology	Beth Israel Deaconess Medical Center

Other Professional Positions

2015-2016	Scientific Advisor	Roche	1 day per year
2016	Scientific Advisor	Lundbeck LLC	2 days
2016	Scientific Advisor	Marinus Pharmaceuticals Inc	2 days
2016-2018	Scientific Advisor	UCB Inc	5 days per year
2018	Scientific Consultant	Celgene Corporation	1 day
2019	Scientific Consultant	Advise Connect Inspire, LLC	2 days
2019-2020	Scientific Advisor	Pear Therapeutics	1 day per year
2019-2020	Scientific Advisor	Praxis Precision Medicines, Inc	5 days per year
2020-	Scientific Advisory Board	Beacon Biosignals, LLC	1 day per week
2021-	Member	Department of Health and Human Services, Acute Neural Injury and Epilepsy Study Section, Center for Scientific Review	6 days per year

Major Administrative Leadership Positions

Local

2003-2004	Organizer, Dynamical Systems Reading Group	Washington University in St. Louis
2004-2006	Organizer, Machine Learning Reading Group	Washington University in St. Louis
2010-2012	Organizer, Neurophysiology Teaching Conference	Massachusetts General Hospital, Brigham and Women's Hospital
2012-	Director, Critical Care EEG Monitoring Service	Massachusetts General Hospital
2012-	Course director, Medical Decision Analysis and Diagnostic Test Interpretation (HST 192.0)	Harvard Medical School, HST Program
2018-2019	President, Greater Boston Epilepsy Society	Greater Boston Epilepsy Society, membership composed of epilepsy faculty from hospitals throughout New England
2020-	Director of Data Science	McCance Center for Brain Health

National

2013	Organizer, New Directions in Quantitative EEG for Neurocritical Care	Miami, FL, Feb 9, 2013 American Clinical Neurophysiology Society Annual meeting.
2013	Co-Organizer, Workshop: Emerging Applications in Systems and Control Theory for Neuroscience and Neural Medicine	Washington, DC, June 16, 2013 American Control Conference, Washington, DC, USA
2013-2015	ACNS Website Committee Chair	American Clinical Neurophysiology Society
2014	Organizer, Symposium: Ischemia Monitoring in Critical Care: EEG Trend	Atlanta, GA, Feb 7, 2014, American Clinical Neurophysiology Society Annual meeting.

2015	Analysis to Detect Development of and Recovery from Cerebral Ischemia Co-Organizer, Symposium: Background Matters: Beyond Seizure Detection	Houston, TX, Feb 5, 2015, American Clinical Neurophysiology Society Annual meeting.
2016	Course Director, Intensive Care Unit EEG Monitoring (ICU EEG); Co-Director: Tammy Tsuchida, MD, PhD	Nashville, Tennessee, Sept 24-25, 2016, American Clinical Neurophysiology Fall Course.
2017	Organizer, Symposium: "Advances in Prognostication and Management of Coma Following Cardiac Arrest"	Phoenix, AZ, Feb 11, 2017. American Neurophysiology Society Annual Meeting.
2017	Course Director, Intensive Care Unit EEG Monitoring (ICU EEG); Co-Director: Tammy Tsuchida, MD, PhD	Chicago, Illinois, Oct 14-15, 2017, American Clinical Neurophysiology Fall Course.
2018	Course Director, Intensive Care Unit EEG Monitoring (ICU EEG); Co-Director: Tammy Tsuchida, MD, PhD	Boston, MA, Oct 20-21, 2018, American Clinical Neurophysiology Fall Course.
2019	Organizer, Symposium: "Artificial Intelligence in Clinical Neurophysiology"	Las Vegas, NV, Feb 8, 2019, American Clinical Neurophysiology Society Annual meeting.

International

2015-2017	Member at Large	Critical Care EEG Monitoring Research Consortium (CCEMRC)
2016	Co-Chair	The 7th International Conference on Extreme Learning Machines (ELM2016). Singapore, December 13-15, 2016.
2017-2019	Vice-Chair	Critical Care EEG Monitoring Research Consortium (CCEMRC)
2017	Co-Chair	The 8th International Conference on Extreme Learning Machines (ELM2017). Yantai, China, October 4-7, 2017.
2019-	Chair	Critical Care EEG Monitoring Research Consortium (CCEMRC)

Committee Service

Local

2011-2017	Critical Care Informatics Committee	Massachusetts General Hospital
2011-	Neurocritical Care Clinical Review Committee	Massachusetts General Hospital
2011-	Co-director, MGH Neuromonitoring Committee	Massachusetts General Hospital
2010-2016	Member, MGH EEG Reporting System Redesign Committee	Massachusetts General Hospital
2013-2017	MGH Infusion Pump Committee	Massachusetts General Hospital
2014-	MGH Cooling Committee	Massachusetts General Hospital

2015-2018	Member, PhD Thesis Committee (Candidate: Mohammad Ghassemi)	Massachusetts Institute of Technology
2015-2019	Member, PhD Thesis Committee (Candidate: Jing Zhi An)	Massachusetts Institute of Technology
2017-2019	Chair, Data Safety Monitoring Board (DSMB) for R01 (PI: Ken Solt)	Massachusetts General Hospital
2018-2020	Member, Data Safety Monitoring Board (DSMB) for R01 (PI: Alvaro Pascual Leone)	Beth Israel Deaconess Medical Center, Harvard Medical School

National

2011-2014	TRENdS (Treatment of Recurrent Nonconvulsive Seizures) Clinical Trial Investigators Committee	Duke University / Duke Clinical Research Institute (DCRI)
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Professional Societies

2007-	American Academy of Neurology	Member
2010-	American Epilepsy Society	Member
2011-	American Heart Association	Member
2012-	Greater Boston Epilepsy Society	
	2012-	Member
	2018-2019	President
2012-	Critical Care EEG Monitoring Research Consortium (CCEMRC)	
	2015-2017	Member at Large
	2017-2019	Vice-Chair
	2019-	Chair
2012-	American Clinical Neurophysiology Society	
	2012-	Member
	2013-2015	Chair Social Media Committee
	2013-	Member, Research Committee
	2016-	Member, Course Committee
	2018-	Member, Program Committee
2013-	Institute of Electrical and Electronics Engineers (IEEE)	Member
2018-	American Neurological Association	Member
2018-	American Academy of Sleep Medicine	
	2018-	Co-chair, AASM Artificial Intelligence (AI) in Sleep Medicine Subcommittee

Grant Review Activities

2018-2020	Acute Neural Injury & Epilepsy (ANIE)	Ad Hoc Member
2021-	Acute Neural Injury & Epilepsy (ANIE)	Permanent Member

Editorial Activities

Ad hoc reviewer:

Neurology
 JAMA Neurology (formerly Archives of Neurology)
 Philosophical Psychiatry
 Journal of Clinical Epidemiology
 BMJ Case Reports
 IEEE Transactions on Information Theory
 IEEE Transactions on Signal Processing
 Journal of Medical Engineering
 Journal of Clinical Neurophysiology
 Journal of Neuroscience
 European Journal of Neurology
 Critical Care Medicine
 Annals of Clinical and Translational Neurology
 Journal of Neural Engineering
 Journal of Cerebral Blood Flow & Metabolism
 Computers in Biology and Medicine
 Proceedings of the National Academy of Sciences (PNAS)
 Neurology
 Brain
 Epilepsy Research
 American Journal of Respiratory and Critical Care Medicine

Other Editorial Roles:

2010 Editor	Editor	Pocket Neurology; Lippincott Williams & Wilkins
2016	Editor	Pocket Neurology, 2nd Edition; Wolters Kluwer
2019-	Editorial Board Member	<i>Journal of Clinical Neurophysiology</i>

Honors and Prizes

2011	Best Paper Award	Statistical Literacy (www.statlit.org)	Statistical Education
2012	Best Paper Award	Association for Computing Machinery: Special Interest Group on Knowledge Discovery and Data Mining (SIGKDD)	Basic Research
2014	Rappaport Fellowship	Massachusetts General Hospital	Nominated award, \$60K
2018	#1 Most Disruptive AI Innovator	Partners Healthcare	Partners World Innovation Forum
2018	Innovation Discovery Grant	Partners Innovation Office	Artificial Intelligence Research / Development
2018	MGH-MIT Grand Challenge Winner	ECOR	Artificial Intelligence Research
2018	Best Neurology Clinical Research Abstract	MGH Neurology Department	Clinical Research
2018	Best Paper Award	CyberWorlds 2018, Singapore	Computer Science

2019	Disruptive Dozen AI Innovator	Massachusetts General Hospital Partners Healthcare	World Innovation Forum
2019	Innovation Discovery Award (IDG)	Partners Healthcare	World Innovation Forum
2019	Innovative Applications in Analytics Award (IAAA)	INFORMS Conference on Business Analytics & Operations Research	For achievements featuring novel combinations of descriptive, predictive and prescriptive analytics.
2019	Best Oral Abstract: Translational	American Delirium Society (ADS)	ADS annual meeting
2019	Derek Denny-Brown Young Neurological Scholar Award	American Neurological Association	ANA's Highest award. For outstanding scientific advances toward the prevention, diagnosis, treatment, and cure of neurological diseases

Report of Funded and Unfunded Projects

Funding Information

Past

1997-2006	Medical Scientist Training Program, Washington U. School Med, Saint Louis, Missouri MD and PhD student (Tuition plus \$15-25K / year) Provided funding for medical and graduate school training
2004-2004	Alzheimer's Disease Research Center, Washington U. School of Med., Saint Louis, MO PI (\$20K salary) Goal: Develop automated method for quantifying amyloid plaques in autopsy slides.
2010-2012	Neurophysiology of Human Cortical Epilepsy NIH – NINDS, R01-NS062092, (04/01/10 – 03/31/15, PI: Sydney Cash, MD, PhD). Postdoctoral Investigator Goal: To better understand focal seizures by employing specialized microelectrodes to record microscale neuronal activity in patients with intractable focal epilepsy.
2012- 2014	Treatment of Recurrent Electrographic Nonconvulsive Seizures (TRENdS) Study. Site-PI Goal: Evaluate the efficacy and tolerability of fosphenytoin and lacosamide in patients having nonconvulsive seizures. My site (MGH) was the leading enroller for this study.
2012-2013	Inter-rater Agreement Assessment of ACNS ICU EEG Terminology Co-PI; Collaboration with Dr. Nicolas Gaspard (Yale). Goal: Assess inter-rater agreement in usage of new American Clinical Neurophysiology Society standard terminology for ICU EEG patterns, across 11 core concepts.

- 2012-14 Early Detection of Delayed Cerebral Ischemia After Subarachnoid Hemorrhage Using Context-Sensitive Computational EEG.
American Brain Foundation Clinical Research Training Fellowship Grant
PI (\$65K / year for 2 years)
Goal: Develop automated methods for predicting and detecting ischemic stroke in patients with aneurysmal subarachnoid hemorrhage (aSAH).
- 2014-15 Rappaport Fellowship, nominated fellowship
PI (\$60K)
- 2012-17 Transcranial Magnetic Stimulation (TMS) as a Novel Therapy for Vasospasm, Periodic Electrical Discharges, or Cortical Spreading Depression Associated with Neurologic Decline Following Subarachnoid Hemorrhage
Andrew David Heitman Neuroendovascular Research Fund.
co-PI (with other co-PIs: Drs. Eric S. Rosenthal and Mouhsin M. Shafi; \$750K).
Goal: Develop advanced monitoring technology for predicting stroke after aneurysmal subarachnoid hemorrhage, to investigate the mechanisms underlying delayed ischemia (DCI) in aSAH, and to investigate novel interventions for DCI
- 2016-2018 Clinical Data Animation Center (CDAC)
Neurology Departmental Funds
PI (\$625K over 2 years)
Mission: To catalyze neurology research and advance neurological patient care through big data management, analytics and research.
- 2014-19 Quantitative Neurophysiological Monitoring and Control of Sedation-Analgesia in the ICU Environment.
NIH-NINDS (1K23NS090900)
PI (\$794K over 5 years)
Goal: Developing technology for monitoring and maintaining sedation-analgesia within a clinically acceptable range.
- 2018-2019 Artificial Intelligence Based Seizure Detection and Classification
Partners Healthcare Innovation
PI (\$50K)
The goal of this project is to develop deep-learning algorithms to detect seizure and seizure-like events as accurately as human experts, and to use semi-supervised deep-learning methods to categorize seizures into distinct types.
- 2018-2019 Big Data and Deep Learning for the Interictal-Ictal-Injury Continuum
MGH-MIT Grand Challenge
PI (\$100K over 1 year)
Goal: Use the Big Data in the MGH EEG archive and deep learning to improve care for patients suffering from IIICA, by developing algorithms to detect IIICA brain states and to quantify the impact of IIICA states on neurologic outcomes.
- 2017-2019 Automated Detection of Seizure-Spectrum Patterns and Quantitative Neurological Outcome Prediction
SAGE Therapeutics (Academic-industrial partnership; investigator-initiated project)
PI (\$700K over 2 years)

Goal: Develop algorithms that can automatically detect and classify seizure-spectrum EEG patterns, extract their key characteristics and measure their persistence, (c) make quantitative statements about the potential for harm, and (d), provide an estimate of the probabilities across the spectrum of potential neurological outcomes.

- 2018-2019 Predicting In-Hospital Cardiac Arrest Using Machine Learning and Massive Streaming Electronic Patient Data.
American Heart Association – Uncovering New Patterns Grant
Co-I (\$150K over 1 years; PI: Aaron Aguirre)
Goal: Develop machine learning algorithms to predict cardiac arrest in the hospital.
- 2017-2019 Reduced-Channel EEG for Detecting Epileptiform Abnormalities in the ICU This trial
Ceribell, Inc
PI (\$26K)
Goal: Evaluate how well (sensitivity and time to detection) EEG data displayed using a reduced number of recording electrodes can allow identification of epileptiform abnormalities compared to EEG recorded with the standard 10-20 system.
- 2018-2019 Does Use of a Rapid Response EEG Impact Clinical Decision Making (DECIDE)
Ceribell, Inc
PI (\$100K)
This trial evaluates the impact of a new rapid-set-up EEG on clinician decision making regarding antiepileptic drug management in acutely hospitalized patients at risk for seizures.
- 2018-2021 Electroencephalogram-Based Brain Age and Its Relationship with Cognitive Function and Sleep Quality
Glenn Foundation for Medical Research, Glenn BIG Award
PI (\$300K)
The goals of this project are to introduce and validate an EEG-based biomarker of brain age by evaluating the relationship between the brain age index and general cognitive ability, and to evaluate the association between sleep quality and the brain age index.
- 2019-2020 Multicenter Observational Study and FDA Clearance of DeepAISE-on-FHIR for Early Prediction of Sepsis
BARDA-DRIVE (BAA-18-100-SOL-00018)
Site PI (\$172K; PI: Shamim Nemati)
The goal of this project is to use deep learning in the development of an analytic platform useful in the early prediction of sepsis.
- 2019-2022 Redefining Sleep: Data Driven Biomarkers of Sleep Quality
AASM Foundation 2019 Strategic Research Award (Category I).
PI (\$249,726.00 over 3 years)
The goal of this project is over 20K polysomnograms and deep learning methods to develop *data driven sleep quality (DDSQ) biomarkers*, i.e. measures of sleep quality that reflect cognitive and cardiovascular risks of disrupted sleep.

Current

- 2018-2023 Investigation of Sleep in the Intensive Care Unit
NIH-NINDS (1R01NS102190)
PI (\$4.2M over 5 years).
Goal: To determine whether dexmedetomidine reduces delirium by improving sleep, and to determine the relationship of sleep quality to long-term cognitive outcomes after discharge from the ICU.
- 2018-2023 Multimodal Network Connectivity Architecture (MOCA) of the Brain and its Role in the Recovery of Consciousness in Comatose Cardiac Arrest Patients.
NIH-NINDS (1R01NS102574)
Co-I (\$2.4M over 5 years; PI: Ona Wu)
Goal: To investigate the neuroanatomical and neurophysiological basis underlying brain injury and recovery in cardiac arrest patients who remain comatose >24h after resuscitation, patients for whom accurate methods of long-term neurologic prognostication is currently lacking.
- 2018-2023 Comparing Home Sleep Monitoring Sleep vs Clinical Polysomnography
Apple, Inc
PI (\$1.5M)
The goal of the project is to gather clinical PSG data, synchronized with simultaneously recorded signals from one or more Self-Sleep Monitors (SSM) to further this objective.
- 2019-2022 A New Brain Medical Record for Precision Management of TBI
Department of Defense
Co-I (\$243K / year; PI: Dick Moberg)
Goal: Development of a large database of physiological signals from patients with brain injury, to support clinical trials.
- 2019-2024 Deep Learning for the Ictal-Interictal-Injury Continuum
NIH-NINDS (1R01NS107291)
PI (\$3M over 5 years)
Goal: To develop better-than-human expert detection algorithms for seizures and seizure-like “IIC patterns” based on EEG monitoring data, to clarify which types of seizures and IIC patterns harm the brain and how much harm they cause, and to develop algorithms able to provide recommendations about the optimal intervention for seizures and IIC patterns.
- 2019-2024 Treating hyperexcitability in Alzheimer’s disease with levetiracetam to improve brain function and cognition
NIH-NIA (1R01AG060987)
Co-I (\$12K site Years 4-5; PI: Mouhsin Shafi)
The goals of this project are to investigate the effects of levetiracetam on baseline EEG, TMS, and perfusion abnormalities in participants with Alzheimer's disease, whether levetiracetam improves cognitive performance, and whether the effects of it are related to the presence of baseline epileptiform abnormalities on EEG.
- 2019-2024 Integrated motor activity biomarker for the risk of Alzheimer’s dementia

NIH-NIA (1RF1AG064312)

Co-I (\$70,036 site over 5 years; PI: Kun Hu)

The goal of this project is to develop an integrated biomarker for the risk of AD using motor activity recordings.

- 2021-2026 Establishing a Brain Health Index from the Sleep Electroencephalogram
NIH-NINDS (1R01AG062989-01)
PI (\$4.2M over 5 years)
Goal: Develop a series of brain health indices based on the sleep electroencephalogram that can detect signs of brain structural pathology (e.g. atrophy in specific regions, or presence of neurodegenerative disease), and that are able to predict cognitive impairment.
- 2022-2027 Prospective Validation of Neurophysiologic Outcome Prediction in Acute Brain Injury
NIH-NINDS (R01NS119522)
PI (\$4.2M over 5 years)
Goal: To develop statistical models that predict acute seizures, neurological outcomes, and chronic epilepsy in patients hospitalized because of acute brain injuries.

Training Grants and Mentored Trainee Grants

- 2014-2015 Rhodes Scholarship to Oxford University (2014).
Mentor to Elliott Akama-Garren
- 2015-2016 NIH Advanced Multimodal Neuroimaging Training Program (AMNTP) fellowship award
Mentor to Mohammad Ghassemi
Major goal: Develop EEG-based algorithm to predict neurological outcome in patients with anoxic brain injury.
- 2016-2017 Dynamics and variability of burst suppression in pharmacological coma for refractory status epilepticus
MIT Martha Gray Prize for Excellence in Research
Mentor of Jingzhi An
Major goal: Develop closed-loop anesthesia delivery system for treatment of refractory status epilepticus.
- 2016-2017 Quantitative EEG-based assessment of reactivity in postanoxic coma
Neurocritical Care Society Fellowship
Mentor of Edilberto Amorim
Major goal: Develop quantitative methods to assess EEG reactivity in coma after cardiac arrest
- 2017-2019 Dynamic EEG reactivity signatures underlying recovery trajectories in hypoxic brain injury
American Heart Association Research Fellowship (17POST33330001)
Mentor of Edilberto Amorim
Major goal: Characterize trends in EEG features that predict good vs poor neurologic outcomes
- 2019-2024 Optimizing Anti-Epileptic Drug Treatment in Acute Brain Injury

- K23NS114201, NIH/NINDS
Mentor of Sahar Zafar
Major goal: Identify patterns of anti-seizure drug use in critically ill patients associated with net benefit and net harm.
- 2016-2017 Coordination for the Improvement of Higher Education Personnel Doctoral Sandwich
Abroad Program (from Brazilian Government)
Mentor of Jefferson T. Oliva
Major goal: Develop automated methods for detection of epileptic spikes.
- 2015-2017 Identifying EEG hallmarks for increased seizure risk in SAH: A quantitative EEG analysis
NIH NINDS Research Education Grant Program (R25) for Residents and Fellows in
Neurology, Neurosurgery, Neuropathology and Neuroradiology
Mentor of Jennifer Kim
- 2017-2018 Using Electroencephalography Features to Identify Risk for Delayed Cerebral Ischemia in
Subarachnoid Hemorrhage
Bee Foundation Brain Aneurysm Research Grant
Mentor of Jennifer Kim
Major goal: Develop quantitative EEG methods to identify patients at high risk for delayed
cerebral ischemia following subarachnoid hemorrhage.
- 2018-2019 Defining optimal electroencephalography and ultrasound signatures of delayed cerebral
ischemia
American Heart Association Fellowship Grant
Mentor of Jennifer Kim
Major goal: Develop an algorithm that combines information from EEG and transcranial
doppler ultrasound to predict delayed cerebral ischemia.
- 2019-2020 Investigation of Epileptiform Discharges as a Biomarkers of Post-traumatic Epilepsy Risk
American Brain Foundation Spencer Award Fellowship
Mentor of Jennifer Kim
Major goal: To identify EEG and MRI biomarkers to predict post-traumatic epilepsy.
- 2019-2020 MRI Biomarkers of Post-Traumatic Epilepsy
Swebilius Foundation
Mentor of Jennifer Kim
Major goal: Identify features of MRI in patients with head trauma that increase risk for
epilepsy.
- 2020-2025 EEG and MRI Biomarkers to Predict Post-traumatic Epilepsy
1K23NS112596-01A1 (NIH-NINDS)
Mentor of Jennifer Kim, MD, PhD
Major goal: To develop acute biomarkers of post-traumatic epilepsy risk using EEG and
MRI.
- 2019-2020 Electroencephalogram-Based Brain Age in People Living with HIV
CFAR Developmental Core Award
Mentor of Haoqi Sun
Major goal: To estimate the effect of chronic HIV infection on biological brain age.
- 2022-2027 Non-invasive seizure forecasting system using e-diaries, sleep, and medication adherence
K23 NS124656-01 (NIH-NINDS)
Mentor of Daniel Goldenholz, MD, PhD
Major goal: Develop AI model to predict future risk of seizures based on seizure diaries.

Unfunded Current Projects

- 2011- PI / Closed Loop Control of Burst Suppression
Collaboration with Drs. Emery N. Brown, MD, PhD (MGH), Patrick L. Purdon, PhD (MGH), and ShiNung Ching, PhD (Washington U. in St. Louis). Goal: Develop an automated system for tracking and maintaining tight control of depth EEG burst suppression for treating patients with refractory status epilepticus.
- 2012- PI / General Purpose Automated Epileptic Spike Detection
Collaboration with Drs. Sydney Cash, MD, PhD (MGH), Justin Dauwels, PhD (NTU, Singapore) and Jing Jin (Postdoctoral fellow, MGH). Goal: Develop algorithms for automated detection of epileptic discharges in routine EEGs.

Report of Local Teaching and Training

Teaching of Students in Courses

2001-2002	Computational Neuroscience	Washington U. St. Louis, Dept Anatomy and Neurobiology
2003	Neuroscience & engineering PhD students Detection and Estimation Theory	One 2 hr session per wk for 12 weeks Washington U. St. Louis, Dept of Electrical and Systems Engineering
2004	Electrical Engineering PhD Students Information Theory	One 2 hr session per wk for 12 weeks Washington U. in St. Louis, Dept of Electrical and Systems Engineering
2008-2009	Electrical Engineering PhD students Neuroanatomy Lab	One 2 hr session per wk for 12 weeks Harvard Medical School
2012-	1st year Harvard Medical Students Medical Decision Analysis and Diagnostic Test Interpretation (HST192.0)	Two 3hr sessions per wk for 6 weeks Harvard HST Program
	4th yr HST medical and MIT PhD students	Two 3hr sessions per wk for 3 weeks

Formal Teaching of Residents, Clinical Fellows and Research Fellows (post-docs)

7/2008	"Probability in medical reasoning" Neurology Residents	BWH One-hour lecture
9/2009	"Bayes' Rule for Physicians" Neurology residents and faculty	MGH/BWH-- Partners Neurology One-hour lecture
6/2010	"EEG Alphabet Soup: GCSE, NCSE, PLEDs, BIPLDs, GPEDs, & DEADs" Neurology residents and faculty	MGH/BWH -- Partners Neurology One-hour lecture
8/2011	"Status Epilepticus: Diagnosis and Management" Neurology residents and faculty	MGH/BWH -- Partners Neurology One-hour lecture
9/2012	"Introduction to ICU EEG: Seizures, spikes, PEDs, Ischemia, Coma, and the Infamous SI-LA-LRDA-MfS" Neurology residents and faculty	MGH/BWH -- Partners Neurology One-hour lecture

1/2013- 1/2017	HST192.0: "Medical Decision Analysis and Diagnostic Test Interpretation" (Course Director, Lecturer, and Course Developer 4 HST medical and PhD students	Harvard HST Program
7/2018	"Quantitative Electroencephalography". Neurophysiology & Epilepsy Fellows.	Six 3hr sessions One-hour lecture. MGH Epilepsy Division
7/2019	"Recognizing Seizures and Ischemia in Critical Care EEG Monitoring." Neurophysiology & Epilepsy Fellows.	One-hour lecture. MGH Epilepsy Division.
6/2020	"Emergency Electroencephalography." MGH Emergency Department Residents.	One-hour lecture. MGH
7/2020	"Introduction to Spectrograms in ICU EEG." Neurophysiology & Epilepsy Fellows.	One-hour lecture. MGH Epilepsy Division.

Clinical Supervisory and Training Responsibilities

2012-	MGH Adult Epilepsy Clinic	1 half session per week
2012-	Massachusetts General Hospital inpatient Neurology Service, supervising Neurology residents and Harvard medical students	2-week service block per year
2012-	Massachusetts General Hospital inpatient General Neurology Consult Service, supervising Neurology residents	2-week service block per year
2012-	MGH Critical Care EEG Monitoring Service, supervising Epilepsy & Clinical Neurophysiology Fellows	10 weeks per year
2012-	MGH Epilepsy Monitoring Unit, supervising Epilepsy & Clinical Neurophysiology Fellows	6 weeks per year
2012-	Outpatient EEG Reading Service, supervising Epilepsy & Clinical Neurophysiology Fellows	2 days per month

Research Supervisory and Training Responsibilities

2012-	Supervision of post-doctoral research fellows (average of 5-10 fellows per year)	Massachusetts General Hospital Two one-hour lab meetings per week; 1:1 supervision 1 hour per week per fellow
2012-	Supervision of graduate students	MGH, MIT Two one-hour lab meetings per week; 1:1 supervision 1 hour per week per student

Other Mentored Trainees and Faculty

2010; 2011	Nathaniel Eiseman, Senior undergraduate at Tulane Mentorship for 4 months (2 summers), resulted in 4 scientific publications. Now a senior trader at Voleon Capital.
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- 2011-2012 Sarah Wahlster, MD, Neurology resident. One published manuscript. Currently Assistant Professor of Neurology at University of Washington.
- 2011-2012 Craig Williamson, MD, Neurology resident, Mentorship for 1 year, resulted in 2 published manuscripts. Currently Assistant Professor of Neurology at University of Michigan.
- 2012 Matthew Ferguson, sophomore at Washington University in Saint Louis. Mentorship for 3 months, resulted in 1 published scientific manuscript.
- 2012 Justine Cormier, BS, medical student at Boston University School of Medicine. Mentorship for 6 months. One 1 published scientific manuscript. Currently Neurology Resident at Yale.
- 2013-2014 Lidia Moura, MD, Epilepsy Fellow at MGH. Two abstracts, 1 published scientific manuscript. Currently Assistant Professor at Harvard Medical School.
- 2013-2014 Marcus Ng, MD, Epilepsy Fellow at MGH. One published manuscript, 1 book. Currently Assistant Professor at University of Manitoba, Winnipeg, Canada.
- 2013-2014 Deirdre O'Rourke, MD, Epilepsy Fellow at MGH, mentorship for 1 year, resulted in 1 abstract and 1 published manuscript. Currently Neurologist at Connolly Hospital Blanchardstown/ Beaumont Hospital Dublin.
- 2013-2014 Sandipan Pati, MD, Epilepsy Fellow at MGH. 1 abstract, 2 published scientific manuscripts. Currently Associate Professor of Neurology at UAB Birmingham.
- 2013- Jing Jin, PhD from NTU in Singapore. 16 published manuscripts, 3 in preparation. Postdoctoral fellow at MGH. **Approved for promotion to Instructor at MGH.**
- 2013-2014 Aaron Berkowitz, MD, PhD, neurology resident at BWH/MGH/Partners. 3 publications. Currently Director of Global Health, Professor of Neurology at Kaiser Permanente Bernard J. Tyson School of Medicine.
- 2013-2014 Zhang Rui, PhD, visiting scholar from NTU in Singapore, mentoring for 2 months through present. Project: Developed methods for automated seizure detection in ICU patients. Resulted in 1 published manuscript. Currently Professor of Mathematics at Northwestern University, Xi'an, China.
- 2014-2016 Vincent Alvarez, MD, visiting Research Fellow from Universite de Lausanne (Switzerland). 5 published manuscripts. Currently an Attending Neurologist at Hopital du Valais, Sion, Switzerland.
- 2014-2015 Elliot Akama-Garren, MIT undergraduate, mentorship for 6 months; resulted in 1 publication. Currently an MD-PhD student at Harvard Medical School.
- 2014- Aaron Struck, MD, Epilepsy Fellow at MGH. 2 abstracts, 8 published manuscripts. Currently Assistant Professor of Neurology at University of Wisconsin.
- 2014-2019 Mohammed Ghassemi, MIT PhD candidate (now graduated). 3 published manuscripts. Currently CEO of a startup company, Ghamut.
- 2014-2020 Jingzhi An, PhD candidate at Harvard/MIT HST program. One published manuscript, 4 in preparation.
- 2014- Edilberto Amorim, MD, neurointensive care fellow at MGH. Research on the prognostic value quantification of EEG reactivity in coma in patients with anoxic brain injury. Has accepted a faculty position in UCSF Neurology Department.
- 2014- Jennifer Kim, MD, PhD, neurology resident at MGH/BWH. Project: "Identifying EEG Hallmarks for Increased Seizure Risk in SAH: A Quantitative EEG Analysis." Currently Assistant Professor of Neurology at Yale School of Medicine.
- 2014-2018 Sunil Belur Nagaraj, PhD, electrical engineering postdoctoral fellow. Projects: Inferring sedation levels from heart rate variability and EEG in ICU patients. 4 peer reviewed manuscripts, 3 scientific abstract/poster presentations. Currently an Assistant Professor

- at University of Groningen, Department of Clinical Pharmacology, Groningen, Netherlands.
- 2014-2018 Lauren McClain, PhD. Research Fellow. Project: Investigation of brain activity patterns in patients receiving sedative drugs in the ICU, and the relation of sedative exposure to ICU delirium. Co-author on 7 manuscripts. Currently a PhD student at Fordham University, New York.
- 2014-2017 Katherine O'Connor. Project: Predicting delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage. 5 published manuscripts.
- 2014-2019 Moura, Junior Valdery, MS (computer science), programmer analyst / research assistant at MGH. Project: establishing a database for the *Clinical Data Animation Center* (CDAC). 3 peer-reviewed publications to date, 1 in preparation. Currently Project Manager for Landmark Project #4 at Partners Healthcare.
- 2014-2017 Apeksha Shenoy, MS (electrical engineering), programmer analyst / research assistant. Projects: developing clinical and quantitative/automated methods to detect ischemia preceding delayed cerebral ischemia in patients with subarachnoid hemorrhage; characterizing the dependence of intracranial EEG on blood pressure changes. 1 publication. Currently a Senior Consultant at Boston Strategic Partners.
- 2015-2019 Elham Bagheri, MS (electrical and systems engineering). Nanyang Technical University (NTU), Singapore, PhD candidate, co-supervised with Prof. Justin Dauwels (NTU). Projects: identifying predictors of expert ratings of epileptiform discharges; automated rejection of "background" EEG patterns for automated epileptiform spike detection. 3 peer reviewed publications.
- 2015-2020 John Thomas, MS (electrical and systems engineering). Nanyang Technical University (NTU), Singapore, PhD candidate, co-supervised with Prof. Justin Dauwels (NTU). Projects: developing "universal templates" for automated spike detection; deep and recurrent neural network methods for automated epileptiform discharge detection. 4 peer reviewed publications.
- 2015- Sahar Zafar, MD, neurointensive care fellow at MGH. Research on the impact of pathological brain activity and its treatments on neurological outcome in ICU patients. 9 published manuscripts, 10 scientific abstracts. **SCCM Star Research Achievement Award (2020)**.
- 2015-2016 Siddharth Biswal, MS, computer programmer / research assistant. Multistate survival modeling of risk for delayed cerebral ischemia after subarachnoid hemorrhage, algorithms for mining free-text EEG reports, and automated sleep staging using recurrent neural networks. 14 publications to date. Currently a PhD candidate at Georgia Institute of Technology.
- 2015-2017 Gladia Hotan, PhD candidate at MIT. Mentorship resulted in 2 publications to date.
- 2015-2016 Ellis Wickerling, MS, University of Twente, Netherlands. Research internship in my laboratory for 3 months. 1 peer reviewed publication. Project: automated determination of cerebral reactivity using quantitative EEG and machine learning. Currently working as a computer programmer at Prolira.
- 2015-2017 Carlos Muniz, MD. Epilepsy / Neurophysiology Fellow. Project: Codifying a Clinical Protocol for Ischemia Monitoring in Patients with Aneurysmal Subarachnoid Hemorrhage. 1 published manuscript. Currently a practicing neurologist in Towson, Maryland.
- 2016-2017 Jefferson T. Oliva, PhD candidate in University of Sao Paulo, Brazil, Institute of Mathematics and Computer Sciences.

- 2016-2017 Greta Gadbois, BS (mathematics), research assistant. Projects: machine learning models to predict delirium in hospitalized patients; automatically quantifying severity of delirium from EEG data; characterizing sleep in patients with critical illness. 1 published manuscript.
- 2016-2020 Jord Vink, MS, University of Twente, Netherlands, 3-month research internship with me at MGH, co-mentored with Dr. Mouhsin Shafi (BIDMC). Project: Prediction of TMS response from pre-stimulus functional connectivity measures. 1 manuscript in preparation. Currently working at Brain Science Tools, Netherlands.
- 2016- Manohar Ghanta, MS (computer science). Computer engineer / research assistant. Project: Developing a Big Data Analytics Platform for clinical data at MGH, as part of the Clinical Data Animation Center (CDAC). Co-author on 3 published manuscripts.
- 2016- Yu-Ping Shao, MS (computer science). Computer engineer / data scientist / research assistant. Projects: Automated hospital-wide surveillance for hospital acquired pneumonia; Developing a Big Data Analytics Platform for clinical data at MGH, as part of the Clinical Data Animation Center (CDAC). Co-author on 3 published manuscripts.
- 2016-2016 Eva Postma, MD, University of Twente, Netherlands, visiting scholar for 6 months in my laboratory, co-mentored by Dr. Sahar Zafar, MD. Project: developing outcome prediction models for patients with subarachnoid hemorrhage due to ruptured brain aneurysms. 2 published manuscripts.
- 2016-2018 Sungtae An, MS (computer science). Georgia Tech PhD candidate, co-supervised with Dr. Jimeng Sun. Project: machine learning algorithms for predicting refractory epilepsy using “big” medical claims data. 1 published manuscript, 1 in preparation.
- 2016- Haoqi Sun, MD (computer science). Nanyang Technical University (NTU), Singapore. Began mentoring as PhD candidate, co-supervised with Prof. Guangbin Huang (NTU). Now postdoctoral fellow. Automated sleep staging using EEG data; automated discovery of sleep neurophysiological phenotypes. 8 published manuscripts, 6 in preparation. Accepted for promotion to Instructor at Harvard Medical School, Massachusetts General Hospital. **Sleep Research Society Outstanding Early Investigator Award (2020).**
- 2016-2017 Jia Jian, PhD (mathematics), Northwestern University (NWU), Xian, China. Projects: Algorithms for quantifying apnea from respiratory signals; seizure detection from EEG recordings in patients with epilepsy. 1 published manuscript. Currently an Associate Professor of Mathematics at NWU.
- 2016-2017 Senan Ebrahim, MD, PhD student in the Harvard Medical School HST program; co-supervised with Dr. Sydney Cash. Project: Developing a rapid method for annotating seizures and IICA patterns in large-scale EEG recordings. 1 published manuscript, 1 in preparation.
- 2016-2017 Sophia Bechek, research assistant. Project: Early detection of delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage. 6 published manuscripts. Currently a PhD candidate at Stanford.
- 2016-2018 Balaji Goparaju, MSc. Project: Automation of clinical polysomnogram interpretation. 6 published manuscripts. Currently a Data Scientist at Novartis Institutes for BioMedical Research (NIBR).
- 2016-2020 Jiang Ling Song, MS (mathematics), Northwestern University, Xian, China. Project: Feature engineering for automated seizure detection in patients with epilepsy. 5 published manuscripts.
- 2014-2018 Durga Jonnalagadda, MD, Projects: Diagnosing severity of delirium in hospitalized patients from EEG recordings. 3 published manuscripts.

- 2017-2019 Wade Whitt, undergraduate student at BYU. Projects: Correlation of EEG findings in delirious patients with neurologic outcomes. 1 manuscript published. Accepted to medical school at University of Rochester.
- 2017- Aline Herlopian, MD. Fellow in Clinical Neurophysiology and Epilepsy at Harvard Medical School, MGH. Projects: Characterizing EEG patterns in patients with CAR-T cell encephalopathy and Measuring expert inter-rater agreement for detection of epileptiform discharges in routine EEGs. 6 published manuscripts. Currently Assistant Professor of Neurology at Yale.
- 2017-2020 Hassan Aboul Nour, MD. Project: Estimating the effect of exposure to inadvertent pharmacological burst suppression during critical illness on neurologic outcomes. 1 published manuscript.
- 2017-2019 Mohammad Tabaeizadeh, MD. Research Fellow. Project: Estimating the effect of seizures on neurological outcome in patients with ischemic stroke. 5 published manuscripts. Currently Neurology resident at Baylor College of Medicine, Houston.
- 2017-2018 Dennis Rebergen. Research internship. Masters student in Technical Medicine from U Twente, Netherlands. Project: Developed a method for reducing artifacts in noisy ECG recordings from ICU patients. 1 published manuscript.
- 2017-2020 Emile d'Angremont. Research internship. Masters student in Technical Medicine from U Twente, Netherlands. Project: Developing a rapid method for annotating seizures and IICA patterns in large-scale EEG recordings. 1 published manuscript, 1 in preparation.
- 2017-2018 Erik Bao, MD candidate in the Harvard/MIT Health Sciences & Technology. Project: Antiepileptic drug treatment after an unprovoked first seizure: A decision analysis. 1 published manuscript.
- 2017-2018 Peiyun Ni, MD/PhD candidate at Harvard Medical School / MIT. Project: Antiepileptic drug treatment after an unprovoked first seizure: A decision analysis. 1 published manuscript.
- 2017-2018 Monica (Ling-Ya) Chao, MD candidate in Harvard HST program. Project: Antiepileptic drug treatment after an unprovoked first seizure: A decision analysis. 1 published manuscript.
- 2016-2017 Nishant Sinha, PhD candidate (now graduated) at NTU, Singapore, department of computer science. Co-mentored with Justin Dauwels. Project: Predicting neurosurgical outcomes in focal epilepsy patients using computational modelling. 1 published manuscript.
- 2018- Eyal Kimchi, MD, PhD, Neurology junior faculty member (MGH). Project: Predicting delirium severity and mortality from scalp EEG. 1 published manuscript. "Best Oral Abstract: Translational" award for presentation entitled "Delirium severity and clinical outcomes are both predicted by machine learning analysis of routine EEG".
- 2018- Alek Westover. High school student. Project: Text mining in the medical literature to estimate how often researchers misunderstand / misuse concepts of sensitivity and specificity. 1 published manuscript.
- 2018-2020 Jacob Hogan, undergraduate student at BYU. Project: Estimating the causal effect of burst suppression on neurologic outcomes. 1 manuscript under review.
- 2018-2020 Qiang Li, PhD candidate in Mathematics, Northwestern University, Xi'an, China. Co-mentored with Prof. Zhang Rui. Project: Modeling the relationship between sleep and epileptic brain activity. 1 manuscript in preparation.
- 2018- Kendrick Shaw, MD, PhD. Anesthesia Resident and incoming faculty (Instructor) at Harvard Medical School / MGH. Project: Predicting delirium using electronic health record data. 1 manuscript in preparation.

- 2018-2019 Kicky van Leeuwen. Masters student in Technical Medicine from U. Twente, Netherlands. Project: Deep learning to discriminate normal from abnormal routine EEGs. 2 published manuscripts. Currently a Medical Machine Learning Scientist at Medicx.ai, Utrecht, Netherlands.
- 2018- Michael Leone, MSc. Research assistant. Project: Estimating the average causal effect of chronic HIV infection on brain age. 2 manuscripts under review.
- 2018- Sophia Ryan, MD. Harvard Medical School/CRICO Patient Safety and Quality Fellow at Harvard Medical School. Co-mentored with Dr. Eyal Kimchi, MD< PhD. Project: Estimating the impact of delirium in patients on the inpatient Neurology wards. 1 published manuscript.
- 2019- Eline Oppersma, PhD. Visiting scholar. Project: Predicting CPAP failure and detecting patients with “high loop gain” physiology. 1 manuscript under review. Currently Assistant Professor of Technical Medicine at University of Twente, Netherlands.
- 2019- Wendong Ge, PhD. Postdoctoral fellow. Project: Predicting neurologic outcomes in patients undergoing continuous EEG monitoring, using deep learning methods. 1 manuscript in preparation.
- 2019- Wolfgang Ganglberger, MA. PhD Student. Project: Investigating sleep disturbances in the ICU, using machine learning methods. 2 published manuscripts, 2 in preparation.
- 2019- Weilong Zheng. Postdoctoral fellow. Project: Neurologic prognostication for patients with postanoxic coma. 2 published manuscripts, 2 in preparation.
- 2020- Zi-Wei Fan, MA. Software Engineer. Project: Developing cloud-based research data and code sharing platform.
- 2019- Elissa Ye, MA. Medical Informatics Specialist. Project: Characterizing sleep in neurodegenerative disease. 1 published manuscript, 1 in preparation.
- 2019- Erik-Jan Meulenbrugge, MS. Research internship. Masters student in Technical Medicine from U Twente, Netherlands. Project: Automated detection of deviations from normal brain aging using EEG. 1 manuscript under revision, 1 in preparation.
- 2019- Aayushee Jain, MS. Medical Informatics Specialist. Project: Predicting intravenous immunoglobulin need. 2 manuscripts in preparation.
- 2019- Noor Adra, BS. Research assistant. Project: Optimizing spindle detection parameters to maximize relevance to cognitive function. 1 manuscript in preparation.
- 2019- Ryan Tesh, BS. Research assistant. Project: Inferring delirium severity from visual analysis of the scalp EEG. 2 published manuscripts, 2 in preparation.
- 2019- Abigail Bucklin. Research assistant. Project: Investigating the prevalence and morbidity of undiagnosed sleep apnea in the ICU. 1 manuscript in preparation.
- 2019- Syed Quadri, MD. Research Fellow. Project: Investigating the relationship between sleep and delirium in the ICU. 2 published manuscripts, 3 in preparation.
- 2019- Marta Priscila Bento Fernandes, PhD. Postdoctoral fellow. Project: Detecting seizures in prolonged critical care ICU EEG recordings. 2 manuscripts in preparation.
- 2020- Sijm Noteboom. Research internship. Masters student in Technical Medicine from U Twente, Netherlands. Project: Automated determination of the type of epilepsy from EEG recordings. 1 manuscript in preparation
- 2020- Meike van Sleuwen. Research internship. Masters student in Technical Medicine from U Twente, Netherlands. Project: Automated determination delirium severity from the scalp EEG. 1 manuscript in preparation
- 2019-2020 Mehmet Nergiz, PhD. Visiting scholar. Project: Automated segmentation of ischemic strokes in brain MRI images. 1 manuscript in preparation.

2020- Rajesh Amerineni, PhD. Postdoctoral fellow. Project: Simulating the time course of seizures in the ICU, and analysis of anti-seizure drug effects. 1 manuscript in preparation.

Formal Teaching of Peers

10/2009	" Granger Causality Analysis Techniques for EEG Data "	1.5-hour lecture
	Clinical Neurophysiology Research Group	MGH, Boston
5/2010	"Synchronization Likelihood for Functional Connectivity Analysis of EEG Data "	1.5-hour lecture
	Clinical Neurophysiology Research Group	MGH, Boston
7/2012-present	Director, MGH Critical Care EEG Monitoring Service (Periodic clinical and teaching sessions for fellows and EEG technologists).	MGH, Boston
7/2012-present	MGH Clinical Neurophysiology Conference (Weekly clinical and teaching conference for medical students, residents and fellows and attending staff).	MGH, Boston

Local Invited Presentations

No presentations below were sponsored by outside entities.

2002	"What is monkey cortex layer four for?"	
	Neuroanatomy and Neurobiology Dept, Washington U. School of Med. St. Louis, MO	
2010	"EEG Patterns in the Neurological ICU and Their Management"	
	MGH Neurosciences ICU	
2010	"Should Statins Be Avoided After Intracerebral Hemorrhage? Implications of SPARCL"	
	MGH Stroke Research Center	
2012	"Fundamentals of ICU EEG Monitoring"	
	Nursing Skills Day, MGH Neurosciences ICU	
2012	"Status Epilepticus and the Ictal-Interictal Continuum: Introduction to ICU EEG"	
	MGH Critical Care Center	
2013	"Neurophysiological Monitoring for Prognosis in Anoxic Coma"	
	MGH Critical Care Center	
2013	"Continuous EEG Monitoring in Postanoxic Coma: Prognostic and Management Value"	
	Cardiac ICU Leadership Meeting, MGH	
2013	Grand Rounds: " Monitoring and Closed Loop Control of Burst Suppression"	
	Neurology Department, MGH	
2013	Grand Rounds: "Continuous Brain Monitoring in Critical Care"	
	Department of Anesthesia, Critical Care and Pain Medicine, MGH	
2013	"Neurological Prognostication in Coma After Cardiac Arrest"	
	MGH Critical Care Center	
2014	"Monitoring, Modeling, and Control of Burst Suppression"	
	Massachusetts Institute of Technology (MIT), Dept. Brain and Cognitive Sciences	
2014	"EEG-Related Skin Lesions: Statistical Process Monitoring & Risk Reduction"	
	MGHfC Quality and Safety Operations Lead Team Meeting.	

- 2014 “Fundamentals of Continuous EEG Monitoring in Neurocritical Care”
MGH Neurosciences ICU
- 2014 “Quantitative Clinical Electroencephalography Fundamentals”
MGH/BWH Clinical Neurophysiology Fellows Didactic Conference
- 2015 “Automated Surveillance for Ventilator Associated Pneumonia”
MGH Infection Control Committee
- 2015 “The Role of Continuous EEG in Coma After Cardiac Arrest: Prognostic Value”
MGH Monthly EEG Technologist Training Meeting
- 2016 Grand Rounds: “Why Brains Need Computers.” Neurology Department, MGH.
- 2017 Epilepsy Fellows Training Conference: “Quantitative Electroencephalography.”
Neurology Department, MGH.
- 2018 “CDAC: Bringing Big Clinical Data to Life.” MGH Neurosurgery Faculty Meeting.
- 2018 “Taming the Ictal-Interictal-Injury Continuum Using Big Data”. MGH-MIT Grand
Challenge, MIT.
- 2018 “Landmark Project #4: Clinical Time Series Data”. Partners Healthcare EDMT Meeting.
- 2019 “Validation the Brain Age Index: Modifying Brain Aging Through Exercise”. Jan 9.
McCance Brain Health Center Faculty Meeting.
- 2020 “AI in Clinical Neurophysiology.” MGH Neurology Grand Rounds. Jan 2.
- 2020 “Automating the Diagnosis of Epilepsy.” Keynote Speaker. Harvard Sciences and
Technology Program, HST graduate program recruitment dinner. Feb. 29.
- 2020 Grand Rounds: "Covid-19 Outcome Risk Prediction"
Neurology Department, MGH. April 23.

Report of Regional, National and International Invited Teaching and Presentations

Invited Presentations and Courses

No presentations below were sponsored by outside entities.

Regional

- 2005 “Automatic detection of beta amyloid in digital images using visual texture”
Washington U. School of Med. Alzheimer’s Disease Research Center, St. Louis, MO
- 2012 “Neurophysiological Monitoring in Coma After Cardiac Arrest.”
New England Society of Electrodiagnostic Technologists (Weymouth, MA)
- 2014 “Continuous EEG Monitoring in Neurocritical Care”
Advanced Neuro Intensive Care Course, Harvard Medical School, Boston, MA
- 2015 “Early Detection of Delayed Cerebral Ischemia in Subarachnoid Hemorrhage Using EEG”
Greater Boston Epilepsy Society, Boston, MA
- 2017 “Sleep AI: Automated Sleep Staging and Brain Age from 10,000 PSGs”
Building Boston’s Sleep Data Resource Capacities Conference, Boston, MA. (June 21).
- 2017 “Polysomnographic Signatures of Brain Age.” Massachusetts Sleep Society. Westborough,
MA (October 21).
- 2018 “Automating Clinical Neurophysiology.” UMASS Amherst Data Science Seminar.
University of Massachusetts Amherst Lowell, Lowell, MA (October 17).
- 2019 “Automated Diagnosis of Epilepsy”. World Medical Innovation Forum. Innovation
Discovery Grant Forum. Boston, MA (April 10).
- 2019 “Artificially Intelligent Brain Monitoring”. World Medical Innovation Forum. “Disruptive
Dozen” Forum. Boston, MA (April 10).
- 2020 “Automated Spike Detection.” Invited speaker, Neural Signal Processing Seminar, MIT.
Boston, MA (March 30).

- 2020 "Detecting Spikes and Seizures for Clinical Trials." Invited speaker. Praxis Precision Medicines, Inc. Boston, MA (April 16).
- 2020 "Covid-19 Risk Prediction using Machine Learning." Invited speaker, MGH Infectious Disease Research Forum. (April 16).
- 2022 "Recognizing Epileptiform Discharges." Invited speaker. New England Society of Electrodiagnostic Technologists. (October 29).

National

- 2003 "A new look at cat simple cells"
Vision ScienceS Meeting (VSS03). Sarasota, FL
- 2005 "Pattern Recognition with Budget Constraints"
Center for Imaging Science, Johns Hopkins University, Baltimore, MD
- 2013 "Towards Automated EEG Ischemia Monitoring After Subarachnoid Hemorrhage"
American Clinical Neurophysiology Society (ACNS) Annual Meeting, ICU EEG Monitoring Special Interest Group. Miami, FL
- 2013 "Modeling and Control of Burst Suppression for Management of Medical Coma"
2013 American Control Conference, at Emerging Applications in Systems and Control Theory for Neuroscience and Neural Medicine (workshop). Washington, DC.
- 2013 "Dynamics of Seizure Risk During Critical Care EEG Monitoring"
Yale School of Medicine, Neurology Department, New Haven, CT
- 2014 "Practical Aspects of Ischemia Monitoring in Subarachnoid Hemorrhage" American Clinical Neurophysiology Society (ACNS) Annual Meeting, ICU EEG Monitoring Special Interest Group. Atlanta, GA. Feb 6.
- 2014 "Towards Automation of cEEG Ischemia Detection in Subarachnoid Hemorrhage"
American Clinical Neurophysiology Society (ACNS) Annual Meeting, ICU EEG Monitoring Special Interest Group. Atlanta, GA. Feb 7.
- 2014 "The Future of EEG-Based Subarachnoid Hemorrhage Ischemia Monitoring"
Yale School of Medicine, Neurology Department, New Haven, CT
- 2014 Grand Rounds: "Pharmacologically induced coma: Neurophysiology and closed-loop control." Neurology department, University of Washington. Seattle, WA. Dec 11.
- 2015 "Quantitative Clinical Electroencephalography" American Clinical Neurophysiology Society Meeting (ACNS) Annual Meeting, ICU EEG CME Course. Houston, TX. Feb 5.
- 2015 "Monitoring (over) sedation in the ICU: The Burden of Burst Suppression" American Clinical Neurophysiology Society Meeting (ACNS) Annual Meeting, Symposium: Background Matters: Beyond Seizure Detection. Houston, TX. Feb 5.
- 2015 "Early Detection of Delayed Cerebral Ischemia: Prospective Validation of a Clinical Reporting System." Invited presentation to the Emory University School of Medicine, Department of Neurology. Atlanta, GA. Sept 15.
- 2015 "Multidisciplinary Development of an Automated System for Ventilator Associated Event Detection from Streaming Electronic Health Data". Invited talk given by my student, Siddharth Biswal, at the Excel Medical Streaming Analytics Users' Forum VI. Chicago, IL. Sept 14.
- 2015 "Burst Suppression EEG Patterns: Towards Robust Closed-Loop Control of Anesthesia for Refractory Status Epilepticus." Washington University in St. Louis, Preston M. Green Department of Electrical & Systems Engineering. October 12, 2015. St. Louis, MO.
- 2015 "Closed-loop Delivery of Anesthesia for Medically Induced Coma." FDA Public Workshop on Physiological Closed-Loop Controlled Devices. October 14, 2015. Silver Spring, MD.

- 2015 “Shared Data Platforms: Efficiency, Integrity, Fairness and Utility.” Invited talk at the Translational Research Symposium: Rigor in Translational Research — Issues, experience and Solutions, American Epilepsy Society, Dec 5, 2015, Houston, TX.
- 2016 “EEG Monitoring in SAH for Prediction of Delayed Neurological Deficits: A Prospective Study”. Yale School of Medicine, Neurology Department, New Haven, CT
- 2016 “Why We Need Closed-Loop Control in Neurocritical Care”. 2016 American Control Conference: Modeling, Estimation and Control Across Scales in Neuroscience (workshop). July 5, 2016, Boston, MA.
- 2016 “Why Brains Need Computers”. November 10, 2016. Computational Health Distinguished Lecture Series, Georgia Institute of Technology, Invited talk. Atlanta, GA.
- 2016 “EEG Monitoring to Detect Delayed Cerebral Ischemia”. December 6, 2016. American Epilepsy Society Annual Meeting, Special Interest Group: Quantitative EEG Trends in the Epilepsy Monitoring Unit and Intensive Care Unit. Houston, TX.
- 2017 “Self-Fulfilling Prophecies, Moral Dilemmas, and the Need for Quantitative Knowledge in Predicting Neurologic Outcomes in Patients with Hypoxic Ischemic Encephalopathy.” February 11, 2017. American Neurophysiology Society Annual Meeting, Symposium: “Advances in Prognosis and Management of Postanoxic Coma.” Phoenix, AZ.
- 2017 “Autonomous Drug Delivery Systems for Refractory Status Epilepticus Management.” February 12, 2017. American Neurophysiology Society Annual Meeting, Symposium: “Defining Research Priorities in Refractory Status Epilepticus Management.” Phoenix, AZ.
- 2017 “Determination of Reactivity in Comatose Patients.” February 11, 2017. American Neurophysiology Society Annual Meeting, symposium: “Advances to Improve Accuracy of EEG Interpretation.” Phoenix, AZ.
- 2017 “Quantitative EEG For Ischemia Detection.” February 8, 2017. American Neurophysiology Society Annual Meeting, Course on “Intensive Care Unit EEG Monitoring (ICU EEG)”. Phoenix, AZ.
- 2017 Stanford Neurology Grand Rounds: “Towards Personalized Critical Care Brain Monitoring.” September 15, 2017. Stanford Neurology Department, Palo Alto, CA.
- 2017 “Monitoring Sedation in the ICU: Oversedation and Closed-Loop Control.” American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. Chicago, IL. Oct 15.
- 2017 “Theory of Spectrograms.” American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. Chicago, IL. Oct 15.
- 2017 “Monitoring for Delayed Cerebral Ischemia in Subarachnoid Hemorrhage.” American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. Chicago, IL. Oct 15.
- 2017 “NICU to NICU: Which Adult Multimodal Monitoring Practices Might Benefit Neonates?” American Epilepsy Society Meeting (AES), Washington DC, Dec 4.
- 2018 “Artificial Intelligence in Critical Care Brain Monitoring and Sleep”. March 1. SAGE Therapeutics, Invited Outside Speaker to the Scientific Advisory Board.
- 2018 “Deep Learning in Clinical Neurophysiology.” American Medical Informatics Association, symposium, “Deep Learning: Hype, Or the Real Thing?” March 15, 2018.
- 2018 “Supervised and Unsupervised Machine Learning for Big Clinical Neurophysiology Data”. Center for Neuroengineering and Therapeutics, U. Pennsylvania. April 19, 2018.
- 2018 “Sleep and AI: From Outpatient Brain Health to Critical Care Delirium”. September 30, 2018. Stanford University, Psychiatry Department, Sleep Division Grand Rounds.
- 2018 “EEG Monitoring for sedation and burst suppression in the ICU” American Clinical Neurophysiology Society (ACNS) Fall Course, Boston, MA, Oct 21.

- 2018 “Principles of Spectral Analysis for ICU EEG” American Clinical Neurophysiology Society (ACNS) Fall Course, Boston, MA, Oct 21.
- 2019 “Quantitative EEG Monitoring to Detect Ischemia.” American Clinical Neurophysiology Society Meeting (ACNS) Annual Course. Las Vegas, NV, Feb 7.
- 2019 “Non-epileptiform Abnormalities.” American Clinical Neurophysiology Society Meeting (ACNS) Annual Meeting, Course on “Basic EEG”. Las Vegas, NV, Feb 8.
- 2019 “Measuring Brain Health Via Overnight Polysomnography.” American Clinical Neurophysiology Society Meeting (ACNS) Annual Meeting, Las Vegas, NV. Feb 9.
- 2019 Grand Rounds: “Machine Learning in Neurology.” Neurology Department, University of Wisconsin, Madison, WI. March 4.
- 2019 Grand Rounds: “Early Ischemia Detection Using EEG in Subarachnoid Hemorrhage”. Neurology Department, University Hospitals Cleveland Medical Center, Cleveland, OH, April 1.
- 2019 “Interpreting Quantitative EEG Spectrograms”. Epilepsy Division, Neurology Department, University Hospitals Cleveland Medical Center, Cleveland, OH, April 1.
- 2019 Grand Rounds: “Automating Clinical Neurophysiology”. Neurology Department, Stanford University, April 26.
- 2019 “AI in Sleep Medicine: Sleep Staging, Brain Age, Delirium, and Beyond”. Workshop: “Beyond Epochs and Stages: New Concepts and Methods in Sleep State Analysis” at American Academy of Sleep Medicine annual meeting. San Antonio, TX. June 8.
- 2019 “Monitoring for Cerebral Ischemia using Quantitative EEG”. American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. Atlanta, GA, Sept 22.
- 2019 “Monitoring and Controlling Sedation Guided by EEG”. American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. Atlanta, GA, Sept 22.
- 2019 “Automating Pattern Recognitions Tasks in Clinical Neurophysiology.” Epilepsy Division, Neurology Department, UCSF, San Francisco, CA. Sept 20.
- 2019 “Expert-level automatic detection of epileptiform discharges.” American Neurological Association (ANA), Derek-Denny Brown Award Symposium. St. Louis, MO, Oct 13.
- 2020 “Automated Pattern Recognition in Clinical Neurophysiology.” Epilepsy Division, Neurology Department, Yale, New Haven, CT. Feb 3.
- 2020 “EEG Monitoring for Early Detection of Cerebral Ischemia”. American Clinical Neurophysiology Society Annual Meeting (ACNS). New Orleans, LA, Feb 7.
- 2020 “Automated EEG Analysis in Clinical Care.” Grand Rounds, UCSD Neurology. San Diego, CA (via Zoom, during Covid-19 crisis). April 10, 2020.
- 2020 “Principles of Quantitative EEG for Critical Care.” Neurology Residency Didactic Invited Talk. UCSD Neurology. San Diego, CA (Zoom, during Covid-19 crisis). April 10, 2020.
- 2020 “Developing Biomarkers for Sleep, Epilepsy, and Brain Health Using Big EEG Data Sets and AI.” (via Zoom, during Covid-19 crisis). SAGE Therapeutics Clinical Advisory Board. June 25, 2020.
- 2020 “Automating Clinical Neurophysiology.” Duke Comprehensive Epilepsy Center Quarterly Research Symposium. September 9, 2020.
- 2020 “Big Data and Machine Learning to Advance Status Epilepticus Research.” Annual Meeting of the American Neurological Association, Epilepsy Special Interest Group. Los Angeles, CA (virtual meeting, during COVID-19 pandemic). Oct 4, 2020.
- 2021 “Medical Imaging as a Biomarker”. Talk in 3 day NIH symposium “Curing the Epilepsies 2021: Setting the Research Priorities”, special session: “Biomarkers to Prevent Epilepsy, Predict Progression and Response to Treatment.” Jan 5, 2021.

- 2021 “Automated detection of seizures and ictal interictal continuum patterns using “deep learning.” American Clinical Neurophysiology Society (ACNS) annual meeting, “Advanced quantitative methods in clinical neurophysiology” symposium. Feb. 12, 2021.
- 2021 “Ask The Expert: Interview: Dr. Brandon Westover, MD, PhD, on AI and Sleep Data for Brain Health Research.” American Foundation for Aging Research (AFAR), Podcast. May 17, 2021.
- 2021 “Denoising and Debiasing EEG Interpretation”. NYU Epilepsy Grand Rounds, NYU Langone Health, Comprehensive Epilepsy Center, New York, NY. Oct 6, 2021.
- 2021 “Sleep as a Window Into Brain Health.” Harvard Sleep Grand Rounds. Virtual. Dec. 6, 2021.
- 2022 “A Data-Driven Approach to Grading Encephalopathy”. American Clinical Neurophysiology Society (ACNS) Annual Meeting. Virtual. Jan 30, 2022.
- 2022 “Denoising The Diagnosis of Epilepsy”. Grand Rounds, Einstein Medical Center Philadelphia Neurology Department. March 4, 2022.
- 2022 “Decoding Brain Health from Sleep.” American Neuropsychiatric Association (ANPA) Annual Meeting. March 17, 2022.
- 2022 “EEGTalk” American Academy of Neurology Annual Meeting. Seattle, WA. April 4, 2022.
- 2022 “Avoiding Pitfalls in EEG Interpretation”. American Academy of Neurology Annual Meeting. Seattle, WA. April 4, 2022.
- 2022 “Quantifying the Ictal-Interictal-Injury Continuum.” University of Washington, Neurocritical Care Grand Rounds. June 1, 2022.
- 2022 “Theory of Spectrograms.” American Clinical Neurophysiology Society Meeting (ACNS) Fall Course. San Diego, CA. Oct 3, 2022.
- 2022 “Artificial Intelligence in Sleep Medicine.” American Neurological Association (ANA). Symposium on “Sleep Disorders and Circadian Rhythms. Chicago, IL. Oct 25, 2022.
- 2022 “Addressing Problems in Critical Care Neurophysiology Using Machine Learning.” Machine Learning in Medicine seminar series, Carnegie Mellon University. Nov 16, 2022.
- 2022 “American Academy of Sleep Medicine AI Seminar.” Dec 7, 2022. Online.
- 2023 “Superhuman Management of Seizures in the ICU.” Grand Rounds, Yale School of Medicine, Neurology Department, New Haven, CT. Jan 28, 2023.

International

- 2003 "Achievable rates for pattern recognition." Information theory and learning workshop: The bottleneck and information distortion methods, at Neural Information Processing (NIPS) annual meeting, Whistler, BC, Canada
- 2004 "Towards an information theoretic framework for object recognition" International Symposium on Information Theory. Chicago, IL.
- 2012 "Opportunities for Intelligent Computing in Clinical Neurophysiology" Symposium on Novel Technologies for Clinical Practice in Neurology, Nanyang Technical University, Singapore. May 22, 2012.
- 2013 "Real-Time Measurement and Closed Loop Control of Burst Suppression" 35th Annual International IEEE Engineering in Medicine and Biology Society (EMBS) Conference, Osaka, Japan
- 2015 "Pharmacological Coma: Neurophysiology and Closed-Loop Control". Neurotechnologies Workshop, Nanyang Technical University, Singapore. March 17, 2015.
- 2015 “Optimizing the Treatment of Refractory Status Epilepticus.”

- Networks in Epilepsy Conference, Beijing, China. July 4, 2015.
- 2015 “Engineering in Neurocritical Care: Modeling & Control of Refractory Status Epilepticus” International Symposium on EEG Signal Analysis. Xi’an, China. July 11, 2015.
- 2015 “Spatial Variation in Automated Burst Suppression Detection in Pharmacologically Induced Coma”. Invited talk presented by my student, Jingzhi An, 37th Annual International IEEE Engineering in Medicine and Biology Society (EMBS) Conference, Milano, Italy.
- 2015 “Clustering Analysis to Identify Distinct Spectral Components of Encephalogram Burst Suppression in Critically Ill Patients”. Invited talk presented by my student, David Zhou, 37th Annual International IEEE Engineering in Medicine and Biology Society (EMBS) Conference, Milano, Italy.
- 2015 “Quantitative Electroencephalography for Detection of Seizures and Ischemia.” Beijing International Intraoperative and Intensive Care Unit (ICU) Neuroelectrophysiological Monitoring Forum. Beijing, China.
- 2015 “Fundamentals of Continuous Electroencephalography in Critical Care.” Beijing International Intraoperative and Intensive Care Unit (ICU) Neuroelectrophysiological Monitoring Forum. Beijing, China.
- 2016 “Frequency and Time-Course of Epileptiform Abnormalities in Subarachnoid Hemorrhage.” Invited talk presented by my mentee, Jennifer Kim, MD, PhD, at the Symposium, *Neurocritical Care and Neuroscience Crossroads: From Bench to Bedside*, Annual American Academy of Neurology, Vancouver, BC, Canada. April 20, 2016.
- 2016 “Why Brains Need Computers: How Machine Learning and Big Data Can Help Neurology.” *Extreme Learning Machines Annual Conference*. December 13, 2016. Singapore.
- 2017 “Machine Learning in Neurocritical Care.” *Northwestern University International Forum on Big Data in Healthcare*. October 3, 2017. Xi’an, China.
- 2017 “Towards Precision Brain Monitoring in Critical Care Medicine.” *Extreme Learning Machines 8th Annual Conference*. October 5, 2017. Yantai, China.
- 2017 “New Standards in EEG Monitoring for Subarachnoid Hemorrhage.” *Neurocritical Care Society Annual Meeting, EEG 201 Workshop*. October 10, 2017. Kona, Hawaii.
- 2018 “Quantitative EEG: Detecting Ischemia and Seizures.” *31st International Congress of Clinical Neurophysiology*. May 1, 2018. Washington, DC.
- 2018 “Early Identification of Impending Delayed Ischemic Neurological Deterioration.” *31st International Congress of Clinical Neurophysiology*. May 4, 2018. Washington, DC.
- 2018 “Advances in Assessing EEG Reactivity in Targeted Temperature Management.” *31st International Congress of Clinical Neurophysiology*. May 4, 2018. Washington, DC.
- 2018 “Removing the Confusion from Toxic Metabolic Encephalopathy”. *Mini Symposium in honor of Barry Ruitjer*. Sept. 14, 2018. U. Twente, Enschede, Netherlands.
- 2019 “Transparent Machine Learning Models for Predicting Seizures in ICU Patients from cEEG Signals.” *INFORMS Conference on Business Analytics & Operations Research*. April 16, 2019, Austin, TX. **(Winner of IAAA Award.)**
- 2019 “Closed Loop Control of Burst Suppression.” *Society for Neuroscience in Anesthesiology and Critical Care*. Sept 14, 2019. Phoenix, AZ.
- 2019 “Mapping the Ictal-Interictal-Injury Continuum.” *Neurocritical Care Society*, special session: “Updates on Status Epilepticus”. Oct. 18, 2019. Vancouver, Canada.
- 2019 “Mapping the Ictal Interictal Injury Continuum.” *Critical Care EEG Monitoring Research Consortium (CCEMRC) Winter Meeting*. Dec 8. 2019. Baltimore, MD.

- 2019 “Beyond Phenomenology: Estimating the Effect of Pathological Brain Activity on Neurologic Outcomes in the Critically Ill.” *American Epilepsy Society*. Dec 9, 2019.
- 2019 “Quantifying Expertise in EEG Interpretation.” *American Epilepsy Society*. Dec. 10, 2019. Baltimore, MD.
- 2019 “The ICU Sleep Trial.” *American Epilepsy Society*. Dec. 10, 2019. Baltimore, MD.
- 2020 “Conquering the Ictal-Interictal-Injury-Continuum: Big EEG Data and AI to automate and increase the value of intensive care brain monitoring.” *Brain Matters*, April 29. Webinar / International Broadcast. With Dr. Sahar Zafar. **Record for largest audience tuning.**
- 2020 “Brain Monitoring for Delirium.” *Perioperative Brain Health Initiative Town Hall, American Society of Anesthesiologists*. Virtual event (Zoom). December 10, 2020.
- 2021 “Automated Diagnosis of Epilepsy.” *Conference on Machine Learning and Systems, SysML4Health: Scalable Systems for ML-driven Analytics in Healthcare Workshop*. Virtual event (Zoom). April 9, 2021.
- 2021 “Automated Analysis of Critical Care Electroencephalography.” *Grand Rounds, Guangdong Provincial Hospital of Chinese Medicine*. May 10, 2021. Webinar.
- 2022 “Sleep as a Window into Brain Health.” *The Paul F. Glenn/AFAR Conference on the Biology of Aging: 35th Annual AFAR Grantee Conference*. June 13, 2022. Santa Barbara, CA.
- 2022 “Quantifying the Ictal Interictal Continuum.” *International Conference on Technology and Analysis for Seizures (ICTALS) 2022*. July 8, 2022. Bern, Switzerland.
- 2022 “Superhuman Detection of Seizures, Rhythmic and Periodic Patterns in ICU EEG.” *International Congress on Clinical Neurophysiology (ICCN)*. July 7, 2022. Geneva, Switzerland.

Report of Clinical Activities and Innovations

Current Licensure and Certification

- 2007- Massachusetts Medical License (No. 237703, active through 9/7/2015)
- 2011- Board Certified, American Board of Psychiatry and Neurology (No. 56586, active through 2020)

Practice Activities

- | | | | |
|-------|-----------------|---|------------------------------|
| 2010- | Ambulatory Care | Adult Epilepsy Clinic, Epilepsy Service, MGH Neurology | 1 half-day clinics per week |
| 2012- | Ambulatory Care | Outpatient EEG Reading Epilepsy Service, MGH Neurology | 2 reading sessions per month |
| 2012- | Inpatient Care | Epilepsy Monitoring Unit, Epilepsy Service, MGH Neurology | 2 weeks per year |
| 2012- | Inpatient Care | Critical Care EEG Monitoring Service, Epilepsy Service, MGH Neurology | 10 weeks per year |
| 2012- | Inpatient Care | General Consults, MGH Neurology | 2 weeks per year |
| 2012- | Inpatient Care | Raymond D. Adams inpatient service, Ward Attending, MGH Neurology | 2 weeks per year |

Clinical Innovations

- Decision Making Models 2012- I have used several probabilistic and decision theoretic models to approach important problems of risk vs benefit balance. One notable project led to the conclusion that "statin" drugs may be unsafe in patients who survive intracerebral hemorrhage and

resulted in a widely cited paper that was covered by over 150 news organizations. This work also led Dr. Bianchi and I to design a course for the Harvard/MIT HST program, which we have taught each January since 2012. Since Dr. Bianchi's departure from MGH in 2018, I have taught the course with Dr. Pooyan Kazemian.

Rule of Three-to-Six 2012- With Dr. Syd Cash and colleagues, I developed a general statistical rule (the "rule of 3 to 6") to answer a ubiquitous fundamental question in the care of patients with epilepsy: At what point after a medical intervention can one conclude that the a intervention has rendered a patient "seizure free"? This rule was published in the official journal of the American Epilepsy Society.

ICU-EEG Nomenclature 2014 I led the effort in the national organization Critical Care EEG Monitoring Research Consortium (CCEMRC) to validate the official American Clinical Neurophysiology Society's standardized nomenclature for critical care EEG reporting. Together with my colleague Nicolas Gaspard, MD, PhD, ULB, Belgium, I developed and continue to administer the official ACNS terminology certification test. The test has been taken by 200+ clinical neurophysiologists around the world to date and is used to certify acceptable inter-rater reliability for clinical trials that rely on ICU EEG.

Rapid ICU EEG Screening Method 2014 My colleague and mentee Lidia Moura, MD, MPH, and I developed and validated a method for rapidly screening EEG studies in the acute care and ICU settings to identify seizures and other clinically actionable abnormalities. Our method achieves an average reduction in EEG review time of 75%, without significant loss of sensitivity for critical findings. I have invited to teach this methodology at several national meetings annually since 2014.

QEEG Pattern Nomenclature 2016- My mentees and colleagues Edilberto Amorim, MD, and Craig Williamson, I have developed a standardized nomenclature for neurophysiological patterns that appear in EEGs of patients with critical illness, based on spectrograms (aka "compressed spectral arrays"). We have developed a training program to help nurses and physicians who are non-experts in EEG to rapidly and accurately identify clinically relevant patterns. This nomenclature has appeared in 1 publication and 2 books to date. We are engaged in ongoing efforts to refine and validate the nomenclature.

Skin Lesion Risk of Long-Term EEG 2016- I lead a team consisting of my colleague Dr. Lidia Moura, MD, MPH, chief EEG technologists Joseph Cohen and Christine Scott, and ICU nursing leadership Mary Guanci, RN, to identify the risk factors and characterize the time dependence of skin lesions caused by long-term application of EEG electrodes. This effort was part of an ongoing quality improvement effort on the MGH Critical Care EEG Monitoring Service, which I direct.

EEG Dictionary Discovery 2009-2012 With my collaborators Dr. Cash (MGH) and Keogh (UC Riverside, CA), I developed data mining algorithms to decompose EEG data into a "dictionary" of recurrent waveforms or "motifs". This work has provided fundamental insights

into the human EEG, and the methods developed hold promise for enabling ultra-rapid pattern searching in EEG time series data. A key technical paper from this effort was awarded “Best Paper” at the Association for Computing Machinery’s SIGKDD (Special Interest Group on Knowledge Discovery and Data Mining) annual meeting in 2012.

Automated EEG Interpretation
2012- Ongoing work with several colleagues aims to develop objective, automated methods for detecting epileptic discharges and seizures in patients undergoing diagnostic testing for suspected epilepsy and for patients with acute brain injuries in the ICU /inpatient setting.

Report of Technological and Other Scientific Innovations

Closed Loop Control of Burst Suppression
2012- With colleagues Emery N. Brown (MGH) ShiNung Ching (Wash. U. in St. Louis), Patrick L. Purdon (MGH) and Ken Solt (MGH) I have developed methods for real-time tracking of the depth of EEG burst suppression, and for closed-loop control of propofol-induced burst suppression. We have successfully tested this system in a rat model and are applying to the FDA for an IDE to allow human studies.

Automated Sleep Staging
2016- I lead a team, with colleague Dr. Matt Bianchi, that is using the world’s largest (20,000+) database of clinical sleep EEG recordings so far assembled to develop automated sleep analysis algorithms. Our methods currently achieve levels of inter-rater agreement comparable with that between human experts.

Beacon Biosignals, Inc
2019- With co-founders Jacob Donoghue, PhD, Jarrett Revels, and Sydney Cash, MD, PhD I have founded a startup company dedicated to automating the interpretation of brain monitoring data for patient care and for drug development.

Patent (WO2016028888) SYSTEM AND METHOD FOR ANNOTATING AND ANALYZING EEG WAVEFORMS. Issued, August 17, 2017. This system enables rapid annotation of epileptiform transients in diagnostic EEG recordings.

Report of Education of Patients and Service to the Community

Educational Material for Patients and the Lay Community

Activities

2012 Guest Speaker: "Hearts and Brains"
1 hr presentation to preschoolers of Christ Lutheran Nursery School, Belmont, MA.

2012 Interview for American Academy of Neurology (AAN) Podcast upon receiving an American Brain Foundation grant for the project "On Automated Predictors of Delayed Stroke After Subarachnoid Hemorrhage".

- 2012 Interview for American Academy of Neurology Podcast (answered questions with colleague M. Shafi about our article published in Neurology, "Absence of early epileptiform abnormalities predicts lack of seizures on continuous EEG")
- 2014 "Introduction to Epilepsy and EEG."
2h presentation and hands-on demonstration to Boy Scout Troop 66, Belmont, MA.
- 2014 Electricity in the Brain: Cell Batteries, Action Potentials, and Epilepsy
1-hour presentation to 3rd graders at Butler Elementary School, Belmont, MA.
- 2016 Electricity in the Brain: Batteries, Action Potentials, and Epilepsy
1-hour presentation to 3rd graders at Butler Elementary School, Belmont, MA.

Report of Scholarship

Publications

Research Investigations

1. Eliasmith C, **Westover MB**, Anderson CH. "A general framework for neurobiological modeling: An application to the vestibular system." *Neurocomputing*. 2002. 46:1071-1076. PMID: PMC6788744.
2. **Westover MB**, Eliasmith C, Anderson CH. "Linearly decodable functions from neural population codes." *Neurocomputing*. 2002. 45: 691-696. PMID: PMC7062372.
3. Fischer B, **Westover MB**. "The neural multiple access channel." *Neurocomputing*. 2003. 52-54: 512-518. PMID: PMC7062373.
4. **Westover MB**, Anderson CH. "Layer 4C of monkey V1 may linearize the output of the LGN." *Neurocomputing*. 2003. 52-54: 671-676. PMID: PMC7062374.
5. **Westover MB**, O'Sullivan, JA. "Achievable rates for pattern recognition." *IEEE Transactions on Information Theory*, Jan 2008; 54(1): 299-320. PMID: PMC7062371.
6. **Westover, MB**. "Asymptotic geometry of multiple hypothesis testing." *IEEE Transactions on Information Theory*, July 2008; 54(7): 3327-3329. PMID: PMC6788803.
7. Woeltje KF, Butler AM, Goris AJ, Tutlam NT, Doherty JA, **Westover MB**, Ferris B, Bailey TC. "Automated Surveillance for Central Line Associated Bloodstream Infection in Intensive Care Units." *Infection Control and Hospital Epidemiology*, Sept.2008; 29:842-846. PMID: PMC6788749.
8. Mueen A, Keogh E, Zhu Q, Cash SS, **Westover MB**. "Exact Discovery of Time Series Motifs." *Proceedings of the SIAM International Conference on Data Mining, SDM 2009*, April 30-May 2, 2008, Reno Nevada USA. SIAM 2008. PMID: PMC6814436.
9. Chu-Shore J, **Westover MB**, Bianchi MT. "Power Law versus Exponential State Transition Dynamics: Application to Sleep-Wake Architecture." *PLoS ONE* 5(12): e14204. Dec. 2, 2010. PMID: PMC2996311.
10. Mueen A, Keogh E, Zhu Q, Cash SS, **Westover MB**, Bigdely-Shamlo N. "A disk-aware Algorithm for Time Series Motif Discovery." *Data Mining and Knowledge Discovery*, 2011, 22(1-2): 73-105. PMID: PMC7062370.
11. Zhang W-J, Keary C, **Westover MB**. "Premortem diagnosis of sporadic Creutzfeldt-Jakob disease aided by positron-emission tomography imaging." *American Journal of Neuroradiology*, Neuroradiology. 2011 Jan;32(1):E18. doi: 10.3174/ajnr.A2292. Epub 2010 Nov 11. PMID: PMC6788750.
12. **Westover MB**, Bianchi MT, Eckman MH, Greenberg SM. "Statin Use Following Intracerebral Hemorrhage: A Decision Analysis." *Archives of Neurology*. 2011;68(5):573-579. PMID: PMC3158138.

- **Featured article with accompanying editorial:** *Arch Neurol.* 2011;68(5):565-566. "Statins After Intracerebral Hemorrhage: To Treat or Not to Treat".
 - **Covered in over 150 news feeds, including CBS News, ABC News, US News and World Report, and Medscape Medical News.**
13. **Westover MB**, Westover KD, Bianchi MT. "Significance Testing as Perverse Probabilistic Reasoning." *BMC Medicine*, 9(20). Published Online Feb. 28, 2011. PMID: PMC3058025.
 14. Westover KD, **Westover MB**, Winer EP, Richardson AL, Iglehart JD, Punglia RS. "Should a sentinel node biopsy be performed in patients with high risk breast cancer?" *International Journal of Breast Cancer*. 2011;2011:973245. doi: 10.4061/2011/973245. PMID: PMC3262582.
 15. Eiseman NA, **Westover MB**, Mietus JE, Thomas RJ, Bianchi MT. "Classification algorithms for predicting sleepiness and sleep apnea severity." *Journal of Sleep Research*. 2012 Feb;21(1):101-12. PMID: PMC3698244.
 16. Pascual-Leone A, Freitas C, Oberman L, Horvath JC, Halko M, Eldaief M, Bashir S, Vernet M, Shafi M, **Westover MB**, Vahabzadeh-Hagh AM, Rotenberg A. "Characterizing Brain Cortical Plasticity and Network Dynamics Across the Age-Span in Health and Disease with TMS-EEG and TMS-fMRI." *Brain Topography*, 2011 Oct;24(3-4):302-15. PMID: PMC3374641.
 17. Thakur K, **Westover MB**, "Cerebral Infarction Due to Smoker's Polycythemia." *BMJ Case Reports* 2011; doi:10.1136/bcr.08.2011.4714. PMID: PMC3207785.
 18. **Westover MB**, Cormier J, Bianchi MT, Shafi M, Kilbride R, Cole AJ, Cash SS. "Revising the rule of three for inferring seizure freedom." *Epilepsia*. 2012 Feb;53(2):368-76. PMID: PMC3267849.
 19. **Westover MB**, Bianchi MT. "Should risky treatments be reserved for secondary prevention? A decision theory approach to risk-benefit balance." *Journal of Clinical Epidemiology*, Aug 2012; 65(8):877-86. PMID: PMC6794097.
 20. Chu-Shore C, Kramer MA, Pathmanathan J, Bianchi MT, **Westover MB**, Wison L, Cash SS, "Emergence of stable functional networks in long-term human EEG". *The Journal of Neuroscience*, Feb 2012; 32(8): 2703-2713. PMID: PMC3361717.
 21. Shafi MM, **Westover MB**, Fox MD, Pascual-Leone A, "Exploration and modulation of brain network interactions with noninvasive brain stimulation in combination with neuroimaging." *European Journal of Neuroscience*, 2012 Mar;35(6):805-25. PMID: PMC3313459.
 22. Rakthanmanon T, Campana B, Mueen A, Batista G, **Westover MB**, Zhu Q, Zakaria J, Keogh E, "Searching and Mining Trillions of Time Series Subsequences under Dynamic Time Warping". *Proceedings of ACM SIGKDD 2012*. PMID: PMC6816304.
 - **Best Paper Award at Association for Computing Machinery's annual SIGKDD (Special Interest Group on Knowledge Discovery and Data Mining) meeting, 2012.**
 23. Eiseman NA, **Westover MB**, Ellenbogen JM, Bianchi MT, "The Impact of Body Posture and Sleep Stages on Sleep Apnea Severity in Adults". *Journal of Clinical Sleep Medicine*. 2012 Dec 15;8(6):655-66A. PMID: PMC3501662.
 24. Van Esbroeck A, **Westover MB**, "Data-Driven Modeling of Sleep States from EEG". *Proceedings of the International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'12)*. 2012;2012:5090-3. PMID: PMC6788787.
 25. Shafi, MM*, **Westover MB***, Cole AJ, Kilbride RD, Hoch DB, Cash SS. "Absence of Early Epileptiform Abnormalities Predicts Lack of Seizures on Continuous EEG". *Neurology*. Oct 2012; 79:1796-801. PMID: PMC3475619. ***joint first authorship.**
 26. Srinivasan P, **Westover MB**, Bianchi MT. "Propagation of Uncertainty in Bayesian Diagnostic Test Interpretation". *Southern Medical Journal*. 2012 Sep;105(9):452-9. PMID: PMC6785978.

27. **Westover MB**, Eiseman NA, Cash SS, Bianchi MT. "An Information Theoretic Approach to Uncertainty in Diagnostic Test Interpretation." *The Open Medical Informatics Journal*. 2012 Dec; 6: 36–50. PMID: PMC3537080.
28. **Westover MB**, Cohen AB. "Reversible Vasoconstriction Syndrome with Bilateral Basal Ganglia Hemorrhages". *Journal of Neuroimaging*. 2013 Jan; 23(1): 122-125. PMID: PMC6788746.
29. **Westover MB**, Bianchi MT, Shafi MM, Hoch DB, Cole AJ Chiappa K, Cash SS, "Inferring Seizure Frequency from Brief EEG Recordings". *Journal of Clinical Neurophysiology*. Apr 2013;30:174-7. PMID: PMC3616271.
30. Ferguson M, Bianchi MT, Sutter R, Rosenthal ES, Cash SS, Kaplan PW, **Westover MB**, "Calculating the Risk Benefit Equation for Aggressive Treatment of Nonconvulsive Status Epilepticus." *Neurocritical Care*. 2013 Apr;18(2):216-27. PMID: PMC3767472.
31. Rakthanmanon T, Campana B, Mueen A, Batista G, **Westover MB**, Zhu Q, Zakaria J, Keogh E. "Addressing Big Data Time Series: Mining Trillions of Time Series Subsequences under Dynamic Time Warping." *ACM Transactions on Knowledge Discovery from Data (TKDD)* 2013 Feb; 7.3, 1. PMID: PMC6790126.
32. **Westover MB**, Ching S, Shafi MM, Cash SS, Brown EN "Real-time segmentation and tracking of brain metabolic state in ICU EEG recordings of burst suppression." Conf Proc IEEE Eng. Med Biol Soc. 2013;2013:7108-11. PMID: PMC3939432.
33. Ching S*, Liberman MY*, Chemali JJ*, **Westover MB***, Kenny J, Purdon PL, Solt K, Brown EN. "Real-Time Closed Loop Control in a Rodent Model of Medically-Induced Coma." *Anesthesiology*. 2013 Oct;119(4):848-60. *joint first authorship. PMID: PMC3857134.
34. **Westover MB**, Bianchi MT, Yang C, Schneider JA, Greenberg SM. "Estimating Total Cerebral Microinfarct Burden From Autopsy Samples". *Neurology*. 2013 Apr 9;80(15):1365-9. PMID: PMC3662273.
 - **Featured article with accompanying editorial:** *Neurology*. 2013 Apr 9;80(15):1358-9, "Cerebral Microinfarcts: Enumerating the Innumerable".
 - **Recognized as work of special significance by Faculty of 1000:** Baird A and Adamski M: F1000Prime Recommendation of [Westover MB et al., *Neurology* 2013, 80(15):1365-9]. In F1000Prime, 30 Apr 2013; DOI: 10.3410/f.718000104.793474863. F1000Prime.com/718000104#eval793474863.
35. **Westover MB***, Shafi MM*, Ching S*, Chemali JJ, Purdon PL, Cash SS, Brown EN. "Real-Time Segmentation of Burst Suppression Patterns in Critical Care EEG Monitoring." *Journal of Neuroscience Methods* 2013 Aug 8. (219):131-141. PMID: PMC3939433.
36. Ng MC, **Westover MB**, Cole AJ. "Treating Seizures in Creutzfeldt-Jakob Disease." *Epilepsy and Behavior Case Reports* 2014 Jan; 2:75-79. PMID: PMC4308028.
37. Williamson CA, Wahlster S, Shafi MM, **Westover MB**. "Sensitivity of Compressed Spectral Arrays for Detecting Seizures in Acutely Ill Adults". *Neurocritical Care*. 2014 Feb; 20(1):32-9. PMID: PMC6794096.
38. Eiseman, A, Bianchi MT, **Westover MB**. "The Information Theoretic Perspective on Medical Diagnostic Inference." *Hospital Practice*. 2014 Apr;42(2):125-38. PMID: PMC6993929.
39. Bai Z, Huang GB, Wang D, Wang H, **Westover MB**. "Sparse Extreme Learning Machine for Classification." *IEEE Transactions on Cybernetics*, "Sparse Extreme Learning Machine for Classification," *Cybernetics, IEEE Transactions on*, vol.PP, no.99, pp.1,1 doi: 10.1109/TCYB.2014.2298235. PMID: PMC4883115.
40. Shafi MM*, **Westover MB***, Oberman L, Cash SS, Pascual-Leone A. "Modulation of EEG functional connectivity networks in subjects undergoing repetitive transcranial magnetic stimulation." *Brain Topography*. 2014 Jan;27(1):172-91. doi: 10.1007/s10548-013-0277-y. Epub 2013 Mar 8. PMID: PMC4026010. *joint first authorship.

41. Kheder A, Bianchi MT, **Westover MB**. “Burst Suppression in Sleep in a Routine Outpatient EEG.” *Epilepsy and Behavior Case Reports* 2014 Jan; 2:71-74. PMID: PMC4308090.
42. Bianchi MT, **Westover MB**. “Insomnia and morning motor vehicle accidents: A decision analysis of the risk of hypnotics versus the risk of untreated insomnia.” *Journal of Clinical Psychopharmacology*. 2014 Jun;34(3):400-402. PMID: PMC6794095.
43. Moura LMVR, Shafi MM, Ng M, Pati S, Cash SS, Cole AJ, Hoch DB, Rosenthal ES, **Westover MB**. “Spectrogram Screening of Adult Electroencephalograms is Sensitive and Efficient.” *Neurology*. 2014 Jul 1;83(1):56-64. PMID: PMC4114174.
- **Reviewed in *Epilepsy Currents*, official journal of the American Epilepsy Society: *Epilepsy Currents*. 2015 Jan-Feb;15(1):24-5. doi: 10.5698/1535-7597-15.1.24. PMID: PMC4320952.**
44. Berkowitz AL, **Westover MB**, Bianchi MT, Chou SHY. “Aspirin for Acute Stroke of Unknown Etiology in Resource-Limited Settings: A Decision Analysis.” *Neurology*. 2014; 83:1–7. PMID: PMC4155044.
- **Featured article with accompanying editorial: *Neurology* 2014; 83:1–2. “Expanding antiplatelet use for patients with stroke: The case for stroke of unknown type.”**
45. Gaspard N, Hirsch LJ, LaRoche SM, Hahn CD, **Westover MB**. “Inter-rater agreement for Critical Care EEG Terminology.” *Epilepsia*. 2014 Sep;55(9):1366-73. PMID: PMC4879939.
46. Akeju O, Pavone KJ, **Westover MB**, Vazquez R, Harrell PG, Hartnack KE, Rhee J, Sampson AL, Habeeb K, Lei G, Pierce ET, Walsh JL, Brown EN, Purdon PL. “Comparison of Propofol- and Dexmedetomidine-induced Electroencephalogram Dynamics Using Spectral and Coherence Analysis.” *Anesthesiology* 2014 Nov;121(5):978-89. PMID: PMC4304638.
47. Bianchi MT, Lipoma T, Darling C, Alameddine Y, **Westover MB**. “Automated Sleep Apnea Quantification Based on Respiratory Movement.” *International Journal of Medical Sciences* 2014; 11(8):796-802. PMID: PMC4057486.
48. Jin Jing, Dauwels J, Cash SS, **Westover MB**, “SpikeGUI: Software for Rapid Interictal Discharge Annotation Via Template Matching and Online Machine Learning.” *Proceedings of the International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2014: 4435-4438. PMID: PMC4416962.
49. Akeju O, **Westover MB**, Pavone KJ, Sampson A, Hartnack K, Brown EN, Purdon PL. “Effects of sevoflurane and propofol on frontal electroencephalogram power and coherence.” *Anesthesiology*. 2014 Nov;121(5):990-8. PMID: PMC4206606.
50. Akama-Garren EH, Bianchi MT, Leveroni C, Cole AJ, Cash SS, **Westover MB**. “Weighing the value of memory loss in the surgical evaluation of left temporal lobe epilepsy: A decision analysis.” *Epilepsia*. 2014 Nov;55(11):1844-53. PMID: PMC4877127.
51. Bianchi MT, Hershman S, Bahadoran M, Ferguson M, **Westover MB**. “The Challenge of Undiagnosed Sleep Apnea in Low-Risk Populations: A Decision Analysis.” *Military Medicine* 2014 Aug;179(8S):47-54. PMID: PMC6788752.
52. Weng Y, **Westover MB**, Speier C, Sharp G, Bianchi MT, Westover KD. “Applications of a Capacitor-Based Respiratory Position Sensing Device: Implications for Radiation Therapy.” *Austin Journal of Medical Oncology* 2014;1(2). PMID: PMC6956860.
53. **Westover MB***, Shafi MM*, Bianchi MT, Moura LMVR, O'Rourke D, Rosenthal ES, Chu CJ, Donovan S, Hoch DB, Kilbride RD, Cole AJ, Cash SS. “The Probability of Seizures During EEG Monitoring in Critically Ill Adults.” *Clinical Neurophysiology*. 2014 Jul 11. pii: S1388-2457(14)00362-9. doi: 10.1016/j.clinph.2014.05.037. [Epub ahead of print]. PMID: PMC4289643.
- **joint first authorship.**
 - **Featured article with accompanying editorial: “Early epileptiform discharges and the yield of prolonged EEG monitoring.” Dangayach N, Claassen J., *Clinical Neurophysiology* (2014), doi: <http://dx.doi.org/10.1016/j.clinph.2014.07.002>.**

54. Berkowitz AL*, **Westover MB***, Bianchi MT, Chou SH. "Aspirin for secondary stroke prevention after stroke of unknown etiology in resource-limited settings: A decision analysis." *Neurology* 2014 Sep 9;83(11):1004-11. PMID: PMC4162302. **joint first authorship*
55. Alvarez V, **Westover MB**, Drislane FW, Dworetzky BA, Curley D, Lee JW, Rossetti AO. "Evaluation of a clinical tool for early etiology identification in status epilepticus." *Epilepsia*. 2014 Dec;55(12):2059-2068. PMID: PMC4870016.
56. O'Connor KL, **Westover MB**, Shafi MM, Rosenthal ES. "High Risk for Seizures Following Subarachnoid Hemorrhage Regardless of Referral Bias." *Neurocritical Care*. 2014 Dec;21(3):476-82. PMID: PMC4878846.
57. Kenny JD, **Westover MB**, Ching S, Brown EN, Solt K. "Propofol and sevoflurane induce distinct burst suppression patterns in rats." *Frontiers in Neuroscience* Front Syst Neurosci. 2014 Dec 18;8:237. doi: 10.3389/fnsys.2014.00237. eCollection 2014. PMID: PMC4270179.
58. Ng MC, Gaspard N, Cole AJ, Hoch DB, Cash SS, Bianchi MT, O'Rourke DA, Rosenthal ES, Chu CJ, **Westover MB**. "The Standardization Debate: A Conflation Trap in Critical Care Electroencephalography." *Seizure: European Journal of Epilepsy* 2015 Jan;24C:52-58. PMID: PMC4465375.
59. de Gusmão CM, Berkowitz AL, Hung AY, **Westover MB**. "Cerebrospinal fluid shunt-induced chorea: case report and review of the literature on shunt-related movement disorders." *Practical Neurology*. 2015 Feb;15(1):42-4. PMID: PMC4870013.
60. Shafi MM, Vernet M, Klooster D, Chu CJ, Boric K, Barnard ME, Romatoski K, **Westover MB**, Christodoulou JA, Gabrieli JDE, Whitfield-Gabrieli S, Pascual-Leone A, Chang BS. "Physiological consequences of abnormal connectivity in a developmental epilepsy." *Annals of Neurology* 2015 Mar;77(3):487-503. PMID: PMC4394240.
61. Dranias MR, **Westover MB**, Cash SS, VanDongen AMJ, "Stimulus information stored in lasting active and hidden network states is destroyed by network bursts." *Frontiers in Integrative Neuroscience* 2015 Feb 23;9:14. doi: 10.3389/fnint.2015.00014. eCollection 2015. PMID: PMC4337383.
62. **Westover MB**, Kim SE, Ching S, Purdon PL, Brown EN, "Robust Control of Burst Suppression for Medical Coma." *Journal of Neural Engineering*. 2015 Aug;12(4):046004. doi: 10.1088/1741-2560/12/4/046004. Epub 2015 May 28. PMID: PMC4517835.
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In Press Peer-Reviewed Original Research Articles

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16. **Westover MB**, Halford JJ, Bianchi MT. What it should mean for an algorithm to pass a statistical Turing test for detection of epileptiform discharges. *Clin Neurophysiol*. 2017 Jul;128(7):1406-1407. doi: 10.1016/j.clinph.2017.02.026. Epub 2017 Mar 16. PubMed PMID: 28495216.*
17. Bianchi MT, Thomas RJ, **Westover MB**. An open request to epidemiologists: please stop querying self-reported sleep duration. *Sleep Med*. 2017 Jul;35:92-93. doi: 10.1016/j.sleep.2017.02.001. Epub 2017 Feb 17. PMCID: PMC9371612.

PhD Thesis

Westover MB (2004) "Image Representation and Pattern Recognition in Brains and Machines. Presented in fulfillment of PhD requirements, Physics Department, Washington University in St. Louis. Advisors: Joseph A. O'Sullivan, PhD, Charles H. Anderson, PhD, and John W Clark, PhD.

Narrative Report

My work establishes a quantitative framework for clinical neurophysiology. I have done this by developing mathematical models to identify optimal strategies for medical decision-making situations involving difficult tradeoffs; developing statistical models to predict neurologic outcomes in critical care settings; and developing artificial intelligence algorithms that automate central tasks heretofore performed only by clinical experts. These contributions, by bringing together clinical and technical approaches to create new tools that solve real-world clinical problems, justify the choice of Clinical Expertise and Innovation as my area of excellence.

I graduated with a B.S. in Physics, Magna Cum Laude, from Brigham Young University, earned a PhD in Physics working in information theory and computer vision from Washington University in St Louis, and an MD from Washington University in St. Louis School of Medicine (WUMS). After completing a medical internship at WUMS, I trained as a resident in Neurology at Massachusetts General Hospital (MGH) and Brigham and Women's Hospital, and subsequently as a fellow in Epilepsy and Clinical Neurophysiology at MGH. After fellowship training, I was recruited to lead the MGH Critical Care EEG Monitoring Service. I received further research training at MGH as an Instructor and Assistant Professor with an award from the American Brain Foundation and a K23 Career Development Award from the NIH. As a faculty member at MGH, I have built a major research laboratory that attracts trainees from across the nation and around the world. I have founded and continue to lead a medical informatics center, the Clinical Data Animation Center, which enables researchers throughout the MGH research community to access large medical data sets and apply machine learning approaches in their

research. I have become known as a leader in the application of advanced mathematical and computational approaches to problems in neurology and to medical decision making, and as a lecturer, teacher and clinical innovator. I presently devote 20% of my time to clinical work and administration, and 80% to patient-oriented research. My academic achievements appear in >175 peer-reviewed publications to date. My expertise in computational and systems neuroscience enables my translational research and clinical innovation.

In my Area of Excellence, *Clinical Expertise and Innovation*, I have developed an international reputation for my research contributions and clinical expertise. In this connection, I have given numerous national and international invited talks and contributed 178 peer-reviewed published articles, the majority as first- or senior-author publications. Recent research advances and current projects (and funding) include: development of a closed-loop control system for pharmacological coma in rodents, with an FDA IDE under review for human testing; a study of pain, sedation, and delirium in ventilated ICU patients, aiming to develop physiological monitoring technology to reduce morbidity due to over- and undersedation (NIH-NINDS K23, completed); a multi-institutional effort to develop physiological methods for predicting impending cerebral infarction in patients with subarachnoid hemorrhage (Andrew David Heitman Neuroendovascular Research Fund); development of EEG-based methods for detecting and seizures and other harmful brain states in ICU patients (SAGE Therapeutics); I-CARE (International Cardiac Arrest EEG Research Consortium), an international consortium developing ways to predict neurologic outcomes using quantitative EEG trends; an NIH RO1-funded clinical trial investigating the link between sleep and delirium; a second NIH-RO1 funded study investigating the effects of seizures and seizure-like brain activity on neurologic outcomes; a third NIH-RO1 funded investigation of biomarkers of recovery of consciousness from coma following cardiac arrest; a fourth NIH-RO1 funded investigation of motor activity biomarkers in Alzheimer's disease; a Glenn / American Federation for Aging Research (AFAR) award to develop the "brain age index", a biomarker of brain aging derived from EEG of sleep; an American Academy of Sleep Medicine (AASM) Strategic AI Research Award, to develop data-driven biomarkers of sleep quality; and the MGH Clinical Data Animation Center, a center providing technical expertise in Big Data Analytics to the MGH Neurology Community and to the MGH research community at large. I am a frequently invited speaker at meetings of the American Clinical Neurophysiology Society (ACNS), American Control Conference, and American Epilepsy Society, Nanyang Technical University (Singapore), Northwestern University (China), and Georgia Tech (GA, USA). I have chaired the American Clinical Neurophysiology Society Social Media Committee. I have served on the Annual Meeting Scientific Program Committees for AES and the ACNS, and ACNS Research Committee. I have served on several DSMBs, and on the Acute Neural Injury & Epilepsy (ANIE) grant review committee for the NIH. On two occasions I have co-chaired an international research conference on machine learning with a colleague in Singapore. I currently serve on the editorial board for the journal, *Clinical Neurophysiology*. I am the current president of the Critical Care EEG Monitoring Research Consortium, and international group of more than 50 academic institutions dedicated to advancing the clinical practice and scientific foundations of the field of critical care clinical electroencephalography. I was recently awarded the Derek Denny-Brown Young Neurological Scholar Award, the highest award conferred by the American Neurological Association (ANA), given for outstanding scientific advances toward the prevention, diagnosis, treatment, and cure of neurological diseases

I am strongly committed to teaching. I teach residents and medical students on the Neurology wards and consult services. I have trained almost 30 fellows to date, many of whom have gone on to academic positions and leadership roles around the world, and 3 of whom have joined our faculty. I created and co-teach an annual course in the Harvard Medical School Health Sciences & Technology program on

Medical Decision Analysis. I led 32 residents and attending physician faculty to write a best-selling book, *Pocket Neurology*, now on its way to a third edition. I routinely provide mentorship to fellows, residents, medical students, undergraduates, and graduate PhD candidates. Most of my mentees have authored peer reviewed publications. Several have won research fellowships, and one was awarded a Rhodes Scholarship to Oxford University. In addition, I am frequently asked to organize symposia and lecture at major meetings and continuing medical education programs nationally and internationally. I have successfully recruited junior faculty members and mentored them as their careers have developed, including two K23 award recipients.

Significant supporting activities include my roles in Investigation and Administration and Institutional Service. My activity in *Investigation* is demonstrated by scientific research publications, a steady stream of research grants including a K23 award, winning the MGH-MIT Grand Challenge (2018-2019), multiple industry-sponsored research projects, grants from the American Heart Association, Glenn Foundation for Medical Research (Glenn BIG Award), the American Academy for Sleep Medicine (AASM Foundation 2019 Strategic Research Award), the Department of Defense, BARDA-DRIVE, 5 R01s (PI on two, co-PI on 3). My activity in *Administration and Institutional Service* is demonstrated my role as Director of the MGH Critical Care EEG Monitoring Service, in which I am responsible for creating and maintaining clinical protocols, educating fellows and colleagues in critical care EEG, and bringing new methods and technology into the practice. Finally, I was recently appointed as Director of Artificial Intelligence Research in Neurology for the Henry and Allison McCance Center for Brain Health, and as Medical Director of the “Landmark 4 Project” in the Mass General Brigham (MGB) Research Information Science & Computing, leading a team of engineers in creating self-serve access to data from medical devices throughout MGB hospitals.

In summary, my work demonstrates innovation, expertise, and dedication in pursuit of improving medical care for the critically ill and teaching others how to contribute to this field.