BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person.

NAME: **Daniel Berman, MD**

eRA COMMONS USER NAME (credential, e.g., agency login): **BERMANDS**

POSITION TITLE: **Director, Nuclear Cardiology/Cardiac Imaging; Professor of Medicine and Imaging**

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of California, Berkeley & San Francisco	BS	1966	Medical Sciences
University of California, San Francisco	MD	1969	Medical Sciences
Sacramento Medical Center/UC Davis – rotating		1970	
Sacramento Med Ctr/UC Davis Sch of Medicine	Residency	1972	Internal Medicine I & II
Sacramento Med Ctr/UC Davis Sch of Medicine	Residency	1973	Nuclear Medicine
Sacramento Med Ctr/UC Davis Sch of Medicine	Fellowship	1976	Cardiology

A. Personal Statement

I have trained over 125 fellows for one year or more in the field of cardiac imaging including nuclear cardiology, cardiac CT, and cardiovascular MR, and rank among a top few in the world with the number of nuclear cardiology trainees. A large proportion of our trainees have gone on become academic leaders in the field of cardiac imaging. For 9 years, I was the Program Director of a training grant in nuclear cardiology from the American Heart Association. An example of my commitment to training academic clinician-scientists has been shown in my mentorship of Israeli fellows under the auspices of the Save-a-Heart Foundation through which I have mentored 13 fellows, 11 of whom are in academic positions in Israel and 14 fellows from Japan, most of whom have become academic leaders upon their return to their country. One of my trainees was awarded a NIH Career Development award – Dr. Victor Cheng (1K23HL107458-01). A second trainee, Dr. Balaji Tamarappoo was a NIH KL2 Scholar at Cleveland Clinic in Ohio, an award based in work begun during his fellowship at Cedars-Sinai and he also received an American Heart Association Clinical Research Program grant (11CRP5050015). I have also mentored many of the most prominent cardiac imaging researchers and teachers in the country. Among others, these include Drs. Alan Rozanski, Tim Bateman, Rory Hachamovitch, and more recently Aiden Abidov, who is now the Director of Cardiac Imaging and Co-Director of Cardiology at the University of Arizona. My commitment to teaching has been recognized by the American College of Cardiology in 2000 by my being granted the Gifted Teacher Award. In 2012, I was given the Charles de Hevesy Award by the Society of Nuclear Medicine, an honor given annually to an individual for outstanding contributions to the field of nuclear medicine.

For the training program, I conduct weekly research meetings and provide a basic seminar on noninvasive imaging. My fellows and I participate in the weekly or biweekly research meetings with the teams of Dr. Noel Bairey-Merz, Dr. Debiao Li, and Dr. Piotr Slomka. I have weekly one-on-one meetings with each fellow and assist my mentees in the development of their projects and writing of all manuscripts. My work has resulted in over 800 original manuscripts in the field of cardiac imaging, among which over 200 have been first authored by trainees under my mentorship. All of the research trainees attend my three-day course, which has been given annually for 33 years, on nuclear cardiology and cardiac CT.

B. Positions and Honors

Positions

1973-1974 Instructor in Radiology (Nuclear Medicine), UC Davis School of Medicine
1974-1976 Assistant Professor of Radiology (Nuclear Medicine), UC Davis School of Medicine
1976-1977 Assistant Professor of Medicine, UC Davis School of Medicine
1980-1986 Associate Professor of Medicine in Residence, School of Medicine, UCLA

1986-present Professor of Medicine in Residence, School of Medicine, UCLA
1977-present Director, Nuclear Cardiology, Cedars-Sinai Medical Center
1977-present Attending Physician, Departments of Imaging & Medicine, Cedars-Sinai Medical Center
1992-1996 Co-Chairman, Department of Imaging, Cedars-Sinai Medical Center
1998-present Chief, Cardiac Imaging, Cedars-Sinai Medical Center
1999-present Medical Director, Artificial Intelligence in Medicine Program, Cedars-Sinai Medical Center
2009-2010 President, Society of Cardiovascular CT
2009-present Professor of Imaging, Cedars-Sinai Medical Cente4r
2010-present Medical Director, Biomedical Imaging Research Institute, Cedars-Sinai Medical Center
2015 Professor of Medicine, Cedars-Sinai Medical Center

Honors

Herrman L. Blumgart, M.D. Award Cardiovascular Nuclear Medicine (1994); American College of Cardiology Gifted Teacher Award (2000); Taplin Award Western Regional Society of Nuclear Medicine (2003); Pioneer in Medicine Cedars-Sinai Medical Center (2010); Georg Charles de Hevesy Nuclear Pioneer Award (2012)

C. Contribution to Science

I am credited with developing and leading a group of clinician scientists, computer scientists, and physicists that has made key contributions over 4 decades to the fields of nuclear cardiology, cardiac CT, and cardiac MRI and with having trained many of the most influential leaders in the noninvasive cardiac imaging field.

1. **Development of technical aspects of the field of SPECT and PET myocardial perfusion imaging (MPI).** I was an early clinical investigator of myocardial perfusion imaging with planar and SPECT approaches. Our key contributions include development of a standardized segmental scoring system that allows for semiquantitative analysis of myocardial perfusion abnormality, the description and clinical validation of transient ischemic dilation of the left ventricle as a high risk marker, and automated quantitative analysis of ventricular function and myocardial perfusion measures from ECG-gated SPECT.

1) **Berman DS**, Salel AF, DeNardo GL, Mason DT: Non-invasive detection of regional myocardial ischemia using rubidium-81 and the scintillation camera: Comparison with stress electrocardiography in patients with arteriographically documented coronary stenosis. Circulation 52: 619-626, 1975
2) Sharir T, Germano G, Kang X, Lewin HC, Miranda R, Cohen I, Agafitei RD, Friedman JD, **Berman DS**. Prediction of MI Versus Cardiac Death by Gated Myocardial Perfusion SPECT: Risk Stratification by the Amount of Stress-Induced Ischemia and the Post-stress EF. J Nucl Med 2001;42:831-837
3) Germano G, Kavanagh PB, Waechter P, Areeda J, Van Kriekinge S, Sharir T, Lewin HC, **Berman DS**. A new algorithm for the quantitation of myocardial perfusion SPECT. I: technical principles and reproducibility. J Nucl Med. 2000 Apr;41(4):712-9.
4) **Berman DS**, Maddahi J, Tamarappoo BK, Czernin J, Taillefer R, Udelson JE, Gibson CM, Devine M, Lazewatsky J, Bhat G, Washburn D. Phase II safety and clinical comparison with single-photon emission computed tomography myocardial perfusion imaging for detection of coronary artery disease: flurpiridaz F 18 positron emission tomography. J Am Coll Cardiol. 2013 Jan29;61(4):469-77.

2. **Risk assessment and prediction of benefit from revascularization using SPECT-MPI.** Since 1977, I have conducted a prospective collection of clinical, imaging, and outcome information on all patients studied in nuclear cardiology in what has become the largest comprehensive research registry in nuclear cardiology containing over 60,000 consenting patients followed up for a mean of 9.7 years. A large number manuscripts emanating from this work have demonstrated effective risk-stratification of the extent and severity of SPECT-MPI abnormalities in prediction of subsequent cardiac events. We subsequently developed the concept that the amount of ischemia documented by SPECT (>10% of the myocardium) could predict benefit from revascularization, and then documented this prediction in patients in a variety of clinical settings. The results of this work have shaped guidelines regarding the use of ischemia to guide revascularization decisions and form the basis for the current NIH ISCHEMIA trial, being conducted in 8,000 patients evaluating whether moderate to severe ischemia defines a group of patients with stable ischemic heart disease who benefit from revascularization. I directed the nuclear cardiology core laboratory for the COURAGE trial and for the International Study of Comparative Health Effectiveness with Medical and Invasive Approaches (ISCHEMIA) trial. In 2013, we demonstrated the dramatic temporal decline in the frequency of ischemic SPECT-MPI studies, documenting the need for improvement in selection of patients for noninvasive imaging.

1) Hachamovitch R, Hayes SW, Friedman JD, Cohen I, **Berman DS**. Comparison of the Short-term Survival Benefit Associated with Revascularization Compared with Medical Therapy in Patients with No Prior CAD Undergoing Stress Myocardial Perfusion SPECT. Circulation 2003;107:2900-2906.
2) **Berman DS**, Hachamovitch R, Kiat H, Cohen I, Cabico JA, Wang FP, Friedman JD, Germano G, Van Train K, Diamond G. Incremental value of prognostic testing in patients with suspected ischemic heart disease: A basis for the optimal utilization of exercise Tc-99m sestamibi myocardial perfusion SPECT. J Am Col Cardiol 1995;26:639-47
3) Shaw LJ, **Berman DS**, Maron DJ, Mancini GBJ, Hayes SW, Hartigan PM, Weintraub WS, O'Rourke RA, Dada M, Spertus JA, Chaitman BR, Friedman J, Slomka P, Heller GV, Germano G, Gosselin G, Berger P, Kostuk WJ, Schwarts RG, Knudtson M, Veledar E, Bates ER, McCallister B, Teo KK, Boden WE. Optimal medical therapy with or without percutaneous coronary intervention to reduce ischemic berden. Results from the clinical outcomes utilizing revascularization and aggressive drug evaluation (COURAGE) trial nuclerar substudy. Circulation 2008;117:1283-1291.
4) Rozanski A, Gransar H, Hayes SW, Min J, Friedman JD, Thomson LE, **Berman DS**. Temporal trends in the frequency of inducible myocardial ischemia during cardiac stress testing: 1991 to 2009. J Am Coll Cardiol. 2013 Mar 12;61(10):1054-65.

3. Quantitative assessment of nuclear cardiology examinations. Recognizing the importance of standardization of performance and interpretation of myocardial perfusion imaging, I organized and worked with a team of scientists, under the direction of Dr. Germano, to develop methods for computer analysis of myocardial perfusion imaging studies. Our group developed one of the most widely used software approaches for quantitative analysis of perfusion and function using myocardial perfusion SPECT and PET. I have been the principal clinical co-investigator with PI Dr. Slomka in developing the approach into a comprehensive, nearly completely automatic method for analysis of these studies, and in his most recent work in applications of machine learning which integrates all test and clinical information. The machine learning quantitative analysis has been shown to be superior to expert interpretation of these data with respect to diagnostic of obstructive coronary artery disease.

1) Germano G, Kiat H, Kavanagh P, Moriel M, Mazzanti M, Su HT, Van Train K, **Berman DS**. Automatic Quantification of EF from Gated Myocardial Perfusion SPECT. J Nucl Med 1995;36:2138-2147
2) Slomka PJ, Nishina H, **Berman DS**, Kang X, Friedman JD, Hayes SW, Aladl UE, Germano G. Automatic Quantification of Myocardial Perfusion Stress-Rest Change: A New Measure of Ischemia. J Nucl Med. 2004 Feb;45(2):183-91
3) R Arsanjani, Y Xu, D Dey, M Fish, S Dorbala, S Hayes, DS Berman, G Germano, PJ Slomka. Improved accuracy of myocardial perfusion SPECT for the detection of CAD by utilizing a support vector machine algorithm. J Nucl Med., 54(4):549-55, 2013. PMCID: PMC3615055

4. Establishing clinical role CT coronary artery calcium (CAC) scanning and assessment of epicardial fat. In 1996, I broadened the focus of my research to include this modality. I established a prospective research registry which now comprises 22,000 consented patients. We provided evidence that abnormal myocardial perfusion studies are infrequent until a CAC threshold of 400 is reached. I conducted the largest randomized trial to date (EISNER trial) of asymptomatic patients randomized to a CAC scan and no scan group to evaluate the effect of CAC scanning on patient outcomes. We demonstrated improved outcomes with respect to changes in global risk scores. We further demonstrated that CAC scanning did not increase downstream costs. I have been the principal clinical coinvestigator with Dr. Damini Dey in developing and validation of quantitative assessment of epicardial fat from CAC scans, showing assessment provides complementary prognostic information to the CAC score.

1) **Berman DS**, Wong ND, Gransar H, Miranda-Peats R, Dahlbeck J, Hayes SW, Friedman JD, Kang X, Polk D, Hachamovitch R, Shaw L, Rozanski A. Relationship Between Stress-Induced Myocardial Ischemia and Atherosclerosis by Coronary Calcium Tomography. J Am Coll Cardiol 2004;44:923-930
2) Rozanski A, Gransar H, Shaw LJ, Kim J, Miranda-Peats L, Wong ND, Rana JS, Orakzai R, Hayes SW, Friedman JD, Thomson LEJ, Polk D, Min J, Budoff M**, Berman DS**. Impact of CAC Scanning on Coronary Risk Factors and Downstream Testing. J Am Coll Cardiol. 2011; 57(15):1622-32
3) Dey D, Suzuki Y, Suzuki S, Ohba M, Slomka PJ, Polk D, Shaw LJ, **Berman DS**. Automated quantitation of pericardiac fat from noncontrast CT. Invest Radiol 2008;43:145-153

4) Motwani M, Dey D, **Berman DS**, Germano G, Achenbach S, Al-Mallah MH, Andreini D, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Chinnaiyan K, Chow BJ, Cury RC, Delago A, Gomez M, Gransar H, Hadamitzky M, Hausleiter J, Hindoyan N, Feuchtner G, Kaufmann PA, Kim YJ, Leipsic J, Lin FY, Maffei E, Marques H, Pontone G, Raff G, Rubinshtein R, Shaw LJ, Stehli J, Villines TC, Dunning A, Min JK, Slomka PJ. Machine learning for prediction of all-cause mortality in patients with suspected coronary artery disease: a 5-year multicentre prospective registry analysis. Eur Heart J. 2016 Jun 1. pii: ehw188. [Epub ahead of print]

5. Establishing the role of coronary CT angiography in risk assessment and guiding patient management. Following the path that I had developed with SPECT and CAC scanning, I organized a prospective research registry of comprehensive clinical and coronary CT angiography data from over consenting patients. Working with Dr. James Min, I participated in forming the international CONFIRM registry, with comparable data from over 32,000 patients. From these databases, we have published a large series of manuscripts, establishing the prognostic power of coronary CT angiography. Our group showed that adverse plaque characteristics on coronary CTA add to stenosis in predicting myocardial ischemia by SPECT and by invasively measured fractional flow reserve. Working with Dr. Damini Dey of our group, we have developed an automated assessment of noncalcified and calcified plaque burden from coronary CTA.

1) Cheng VY, **Berman DS**, Rozanski A, Dunning AM, Achenbach S, Al-Mallah M, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Chinnaiyan K, Chow BJ, Delago A, Gomez M, Hadamitzky M, Hausleiter J, Karlsberg RP, Kaufmann P, Lin FY, Maffei E, Raff GL, Villines TC, Shaw LJ, Min JK. Performance of the Traditional Age, Sex, and Angina Typicality-Based Approach for Estimating Pretest Probability of Angiographically Significant CAD in Patients Undergoing Coronary CTA: Results From the Multinational Coronary CT Angiography Evaluation for Clinical Outcomes: An International Multicenter Registry (CONFIRM). Circulation. 2011 Nov 29;124(22):2423-32. PMCID: PMC3240578
2) Nakazato R, Shalev A, Doh JH, Koo BK, Gransar H, Gomez MJ, Leipsic J, Park HB, **Berman DS**, Min JK. Aggregate Plaque Volume by Coronary Computed Tomography Angiography Is Superior and Incremental to Luminal Narrowing for Diagnosis of Ischemic Lesions of Intermediate Stenosis Severity.J Am Coll Cardiol. 2013 Jul 30;62(5):460-7
3) Min JK, Dunning A, Lin FY, Achenbach S, Al-Mallah M, Budoff MJ, Cademartiri F, Callister TQ, Chang HJ, Cheng V, Chinnaiyan K, Chow BJ, Delago A, Hadamitzky M, Hausleiter J, Kaufmann P, Maffei E, Raff G, Shaw LJ, Villines T, **Berman DS**; CONFIRM Investigators. Age- and Sex-Related Differences in All-Cause Mortality Risk Based on Coronary CTA Findings Results From the International Multicenter CONFIRM registry of 23,854 Patients Without Known Coronary Artery Disease.J Am Coll Cardiol. 2011 Aug 16;58(8):849-60

List of Published Works in My Bibliography:
http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/48088495/?sort=date&direction=descending

D. Research Support

Selected Current Research

1U01HL105561 (PI: Shaw; PI of Subaward: Berman) 07/22/2011 – 03/30/2017
NIH NHLBI
ISCHEMIA Trial – Ischemia Coordinating Center
The ISCHEMIA trial will test the hypothesis that a strategy of catheterization followed by optimal revascularization combined with OMT is superior to OMT alone for reducing the incidence of major adverse cardiac events in patients with moderate-severe myocardial ischemia and left ventricular ejection fraction >35%. I direct the Nuclear Core Laboratory.
Role: Subcontract PI, Steering Committee member

1R01HL118019-01 (PI: Min; PI of Subaward: Berman) 09/01/2014 – 07/31/2018
NHLBI
Determinants of Vessel-Specific Ischemia by Coronary CT
The goal of this project is to integrate the anatomic and physiologic information derived from computed tomographic angiograms for the precise identification of coronary artery lesions that cause ischemia.
Role: Sub-award Principal Investigator

1R01HL111141-02 (PI: Min; PI of Subaward: Dey) 09/01/2013 – 01/31/2017
NIH NHLBI; Subcontract with Weill Cornell College
Dual Energy Computed Tomography for Determining Coronary Lesion-Specific Ischemia
The major goal of this project is to develop a novel quantitative computed tomography (CT)-based method for precise identification of coronary artery lesions that cause ischemia.
Role: Co-Investigator

2R01HL089765 (PI: Slomka) 08/06/2014 – 05/31/2018
NIH NHLBI
High performance automated system for analysis of fast cardiac SPECT
The major goal of this project is to develop novel methods for fully automated software analysis of fast-MPS, which will significantly outperform expert clinical reading, in a large multi-center study.
Role: Co-Investigator

1R01HL124649 (PI: Li) 05/01/2015 – 02/28/2019
NIH NHLBI
Whole-Heart Myocardial Blood Flow Quantification Using MRI
The major goal of this project is to develop free breathing, whole-heart, high resolution MP-MRI.
Role: Co-Investigator

1R01HL133616 (PI: Dey) 7/06/2016 – 04/30/2020
NIH NHLBI
Automated Quantitative CT Imaging of Epicardial Adipose Tissue and Risk of Cardiac Events
The major goals of this project is to develop fully automated quantification of EAT features from cardiac CT, and to derive and evaluate a new integrated risk score which combines patient clinical data, coronary calcium and EAT features to predict future cardiac events.

1 R56 HL131871-01A (PI: Tamarappoo) 09/15/2016 – 08/31/2017
NIH NHLBI
Detection of vulnerable atherosclerotic plaque with a novel 18F-labeled Integrin targeted PET imaging agent
The goal of this study is to develop qualitative and quantitative evaluation of MR-based vulnerable plaque burden and compositional characteristics.
Role: Co-investigator

1 R01HL136578-01 (PI: Dharmakumar) 05/01/17 – 03/31/21
NIH NHLBI
An Accurate Non-Contrast-Enhanced Cardiac MRI Method for Imaging Chronic Myocardial Infarctions: Technical Developments to Rapid Clinical Validation
The goal of this study is to develop and validate a CMR approach without exogenous contrast agents for imaging chronic myocardial infarction (MI) as well as late-enhancement CMR, which can be performed in a wide-range of MI patients.
Role: Co-investigator

<u>Selected Completed Research</u>

7R01EB002623-06 (PI: Li) 09/25/2003 – 07/31/2014
NIH NIBIB
Contrast-Enhanced Whole-Heart Coronary MRA at 3.0T
Role: Co-Investigator

R01 7R01HL038698-18 (PI: Li) 09/01/1998 – 03/31/2014
NIH NHLBI
Self-Gated, Motion-Resolved Whole-Heart Coronary MRA with Isotropic Resolution
Role: Co-Investigator

1 R01 HL090957-01A1 (PI: Bairey Merz, N) 09/17/2008 – 06/30/2013
NIH NHLBI *Women's Ischemia Syndrome Evaluation (WISE) Coronary Vascular Dysfunction*
Role: Co-Investigator