CURRICULUM VITAE

Date of Revision January 6, 2016

Name **Marcus W. Bosenberg, M.D., Ph.D.**

Appointment Associate Professor of Dermatology and Pathology
Clinician-Scholar Track

Term July 1, 2013 – June 30, 2018

School Yale University School of Medicine

Reason for Promotion

Education

B.A.	Cornell University (Chemistry and Physics)	1983 – 1986
Ph.D. Candidate	Cornell University (Chemistry)	1986 – 1987
Ph.D.	Cornell University (Cell Biology) Advisor: Joan Massagué, PhD	1987 – 1993
M.D.	Cornell University Medical College	1987 – 1994

Postdoctoral Training

Clinical

Resident, Anatomic Pathology	Brigham & Women's Hospital	1996 – 1998
Chief Resident, Anatomic Pathology	Brigham & Women's Hospital	1999
Fellow, Dermatopathology	Harvard Med. Sch. Training Program	1999 – 2000

Scientific

Research Fellow, Genetics	University of Wisconsin Advisor: Judith Kimble, PhD	1994 – 1996
Research Fellow, Oncology	Dana-Farber Cancer Institute Advisor: Ronald DePinho, MD	2000 – 2002

Career/Academic Appointments

1996 – 1999	Clinical Fellow in Pathology	Harvard Medical School, Boston, MA
1999 – 2000	Clinical Fellow in Dermatopathology	Harvard Medical School, Boston, MA
2000 – 2002	Research Fellow in Adult Oncology	Dana-Farber Cancer Institute, Boston, MA
2001 – 2002	Instructor in Pathology	Harvard Medical School, Boston, MA
2002 – 2008	Assistant Professor of Pathology	University of Vermont, Burlington, VT
2002 – 2008	Member	Vermont Cancer Center, Burlington, VT
2007 – present	Founding Faculty Member	Academy of Genomic Pathology, Davis, CA
2008 – present	Associate Professor of Dermatology and Pathology	Yale University, New Haven, CT
2009 – present	Member	Yale Cancer Center, New Haven, CT
2009 – present	Faculty Member	The Raymond and Beverly Sackler Institute for Biological, Physical, and Engineering Sciences Yale University, New Haven, CT

2010 – present Faculty Member Melanoma Commons (Internet-based)

Administrative Positions

Yale University

2011 – 2015 Associate Director, MD-PhD Program, Yale University School of Medicine
2012 – present Co-Director, Cancer Metabolism Program (in development), Yale Cancer Center
2014 – present Co-Leader, Cancer Genomics, Genetics and Epigenetics Program, Yale Cancer Center

Board Certification

Anatomic Pathology	American Board of Pathology	September 11, 2000
Dermatopathology	American Board of Pathology American Board of Dermatology	November 16, 2001

Professional honors/recognition

2015 Martin C. Mihm Lecturer, Massachusetts General Hospital, Harvard Medical School
2013 Sokoloff Family – Melanoma Research Alliance Team Science Award
2012 Established Investigator Award, Melanoma Research Alliance and Melanoma Research Foundation
2010 Elected membership, American Society of Clinical Investigation
1993 Julian R. Rachele Prize, Cornell University Graduate School of Medical Science
1993 Vincent du Vigneaud Prize, Cornell University Graduate School of Medical Science

Grant history

Current Grants

Agency: Melanoma Research Foundation Award
Title: "Mechanisms Controlling Melanoma Dormancy and Metastatic Progression"
I.D.#: MRF Team Science Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 10%
Direct costs per year: $200,000
Project period: 10/01/2015-09/30/2017
Summary: The goal of this project is to determine the factors that regulate the transition from dormant tumor micrometastases to clinically-relevant tumors.

Agency: NIH/National Cancer Institute
Title: "Yale Cancer Center – Cancer Center Support Grant"
I.D.#: P30 CA016359
P.I.: Marcus Bosenberg, M.D., Ph.D. (Co-Leader, Cancer Genomics, Genetics, and Epigenetics Program
Percent effort: 10%
Direct costs per year: $2,600,006
Project period: 08/01/2014-07/31/2017
Summary: The cancer center support grant provides funds to support the research and clinical activities of the Yale Cancer Center.

Agency: NIH/National Cancer Institute
Title: "Penalization methods for identifying gene environment interactions and applications to melanoma and other cancer types"
I.D.#: R21 CA191383

P.I.: Shuangge Ma, Ph.D. (Marcus Bosenberg, M.D., Ph.D, Co-Investigator)
Percent effort: 4%
Direct costs per year: $144,855
Project period: 12/24/2014-12/31/2017
Summary: The goal is to define methods for identifying gene environment interactions with applications to melanoma and other cancer types.

Agency: Transimmune AG
Title: "Evaluation of extracorporeal photophoresis in mouse models of cancer"
I.D.#: Unrestricted gift
P.I.: Marcus Bosenberg, M.D., Ph.D. and Richard Edelson, M.D.
Percent effort: No salary support
Direct costs per year: $120,000 (total)
Project period: 01/01/2015 (period unrestricted)
Summary: The goal of this project is to develop extracorporeal photophoresis into an effective immune therapy for melanoma and to understand the mechanism of action.

Agency: NIH/NCI
Title: "Yale SPORE in Skin Cancer"
I.D.#: P50 CA121974
P.I.: Ruth Halaban, Ph.D, Director; Marcus Bosenberg, M.D., Ph.D., Co-Director
Biospecimen Resource Core Co-P.I: Ruth Halaban, Ph.D. and Marcus Bosenberg, M.D., Ph.D.
Project 2: Lieping Chen, Ph.D., P.I., Marcus Bosenberg, M.D., Ph.D, Co-I.
Percent effort: 22%
Direct costs per year: $1,512,584 ($161,961 for Biospecimen Core and $154,371 for Project 2)
Project period: 07/01/12-06/30/2017
Summary: The overall goals of the Yale SPORE in Skin Cancer (YSPORE) are to improve prevention, diagnosis and treatment of melanomas by performing translational studies in four subjects: a) genomic sunlight dosimeters for melanoma prevention (Project 1); b) the B7-H1/PD-1 pathway in melanoma immunity (Project 2); c) molecular diversity of melanomas and response to targeted therapy (Project 3); and d) the RAC1 pathway as a target for melanoma therapy (Project 4). The program includes Developmental Research and Career Development Programs, Biospecimen Resource and Bioinformatics/Biostatistics Cores that support the translational research needs of all investigators in the YSPORE.

Current Subcontracts

Agency: The San Diego Foundation
Title: "AGC Kinases and ER Stress as Novel Targets for Critical Unmet Needs in Melanoma"
I.D.#: Team Science Award
P.I.: Ze'ev Ronai, Ph.D. (Sanford Burnham Medical Research Institute)
Subcontract PI: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 2%
Direct costs per year: $67,500 (for subcontract)
Project period: 07/01/14-01/31/18
Summary: The goals of this project are to evaluate the PDK1 kinase as a therapeutic target in melanoma. Studies will include identification of melanomas with high PDK1 activity and subsets of melanoma that are particularly responsive to PDK1 inhibition.

Pending Grants

Agency: NIH/National Cancer Institute
Title: "Congenic Mouse Models of Melanoma for the Characterization of Tumor Immune Responses"
I.D.#: R01 CA196660-01
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 20%
Direct costs per year: $396,000
Project period: 04/01/2016-03/31/2019
Summary: The goal of this project is to develop, characterize, and validate congenic mouse models of melanoma for the characterization of tumor immune responses.
Status: Score = 17, percentile = 3%, council meeting January, 2016

Agency: NIH/National Cancer Institute
Title: "ER Stress and Mitochondrial Biogenesis in Melanoma"
I.D.#: P01 CA128814-06A1
P.I.: Ze'ev Ronai, Ph.D. (Marcus Bosenberg, M.D., Ph.D., P.I. of Project 2)
Percent effort: 10%
Direct costs per year: $1,149,194
Project period: 04/01/2016-03/31/2021
Summary: This Program Project grant is focused on the role of cellular stresses, including ER stress, mitochondrial stress, and stress associated with nutrient deprivation on melanoma formation and responses to therapy.
Status: Overall score = 23, Project 2 score = 20, council meeting January, 2016

Agency: NIH/National Cancer Institute
Title: "Physical properties of the tumor microenvironment determine cancer growth and invasion"
I.D.#: U54 CA202282-01A1
P.I.: Multi-P.I. (Marcus Bosenberg, M.D., Ph.D., Corey O'Hern, Ph.D., Andre Levchenko, Ph.D.)
Percent effort: 20%
Direct costs per year: $1,498,766
Project period: 07/01/2016-06/30/2021
Summary: This Physical Sciences-Oncology Center will bring together physicists, biomedical engineers, biologists, and the strong cancer research community at Yale to understand the physical properties of skin tumors that determine the mechanism of their growth and invasion into surrounding tissues. This knowledge will lead to improved diagnosis and treatment of melanoma, which is the most lethal form of skin cancer, as well as other forms of cancer.
Status: Study section review February, 2016

Past Grants

Agency: Yale Cancer Center
Title: "Targeting Melanoma Brain Metastases with Novel Therapies"
I.D.#: Accelerated Research in Cancer grant
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: No salary support
Direct costs per year: $50,000
Project period: 7/1/14-12/30/15
Summary: A team of 6 Yale investigators evaluated the role of the tumor microenvironment in melanoma brain metastasis and response to therapies.

Agency: Melanoma Research Alliance – Sokoloff Family
Title: "Development of Effective Melanoma Combination Therapies"
I.D.#: Sokoloff Family – Melanoma Research Alliance Team Science Award
P.I.: Marcus Bosenberg, M.D., Ph.D. (William Jorgensen, Ph.D., Frank Slack, Ph.D., Narendra Wajapeyee, Ph.D. Co-PI)
Percent effort: 10%
Direct costs per year: $250,000
Project period: 5/01/13-4/30/15
Summary: The goal of this proposal is to define the role of DNA methylation and miRNAs in melanoma formation and progression and to develop novel therapeutics to target DNA methyltransferases and specific miRNAs.

Agency: Melanoma Research Alliance / Melanoma Research Foundation
Title: "Development of Effective Melanoma Combination Therapies"
I.D.#: Established Investigator Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 3%
Direct costs per year: $100,000
Project period: 5/01/12-4/30/15
Summary: The goal of this proposal is to develop effective combined therapies by combining small molecule kinase inhibitors with immunomodulatory approaches.

Agency: NIH/NCI
Title: "Provision of Melanoma Samples & Normal Controls for The Cancer Genome Atlas"
I.D.#: HHSN2612010000331
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: No salary support
Total costs: $124,375 (Based on Cases)
Project period: 4/27/10-3/14/15
Summary: The goal of this contract is to provide high quality annotated melanoma samples and normal controls for characterization as part of The Cancer Genome Atlas.

Agency: Yale Cancer Center
Title: "Determination of Metabolic Mechanisms of Resistance to Targeted Therapies"
I.D.#: Co-Pilot grant
P.I.: Marcus Bosenberg, M.D., Ph.D. (with Richard Kibbey, M.D., Ph.D.)
Percent effort: No salary support
Direct costs per year: $100,000
Project period: 5/1/13-4/30/14 (No cost extension to 10/31/2014)
Summary: The goal of this collaborative project is to determine the cellular metabolic changes that occur in sensitive and resistant melanoma cells undergoing BRAF inhibitor therapy.

Agency: NIH/NCI
Title: "PDK1 as a Novel Target in Melanoma"
I.D.#: R01 CA179170-01
P.I.: Ze'ev Ronai, Ph.D. (Sanford Burnham Medical Research Institute)
Subcontract PI: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 2%
Direct costs per year: $42,536 (for subcontract)
Project period: 9/01/13-8/31/14
Summary: The goals of this project are to evaluate the PDK1 kinase as a therapeutic target in melanoma. Studies

will include identification of melanomas with high PDK1 activity and subsets of melanoma that are particularly responsive to PDK1 inhibition.

Agency: Department of Defense
Title: "UVL, ROS, Pigmentation, Genetic Predisposition, and Epigenetic Gene Silencing in Melanoma"
I.D.#: CA093473P2
P.I.: Marcus Bosenberg, M.D., Ph.D., Ruth Halaban, Ph.D., Douglas Brash, Ph.D.
Percent effort: 7.2%
Direct costs per year: $77,358
Project period: 9/15/2010-9/14/13 (no cost extension through 9/14/14)
Summary: The goal of this project is to understand the relationship between ultraviolet light exposure, reactive oxygen species, and pigmentation that lead to the genetic and epigenetic changes that cause melanoma.

Agency: NIH/NCI
Title: "Targeted Chemoprevention for Melanoma"
I.D.#: R01 CA136667-A1
P.I.: Gavin Robertson, Ph.D.
Subcontract PI: Marcus Bosenberg, M.D., Ph.D.
Percent effort: No salary support
Direct costs per year: $46,259
Project period: 4/01/10 - 3/31/13
Summary: The goal of this project is to evaluate the use of topical nanoparticle-delivered siRNAs as a therapeutic and preventative modality using mouse models of melanoma. The subcontract has evolved into a contract for services related to providing genetically engineered mouse melanoma lines for the above experiments.

Agency: Yale Cancer Center
Title: "Role of DNMT3B in Melanoma Formation and Progression"
I.D.#: Pilot grant
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: No salary support
Direct costs per year: $50,000
Project period: 1/01/12-12/31/12
Summary: The goal of this project is to evaluate the role of Dnmt3b in melanoma formation and progression.

Agency: Melanoma Research Alliance
Title: "Sequencing of the Melanoma Exome, Transcriptome, and Epigenome"
I.D.#: Team Science Award
P.I.: Ruth Halaban, Ph.D., Marcus Bosenberg, M.D., Ph.D., David Stern, Ph.D., Michael Krauthammer, Ph.D.
Percent effort: 2%
Direct costs per year: $333,333
Project period: 9/1/09-8/31/12
Summary: The goal of this project was to characterize features of short term patient-derived melanoma cultures by sequencing the exome, transcriptome, and epigenome.

Agency: Fidelity Trust
Title: "Personalizing Melanoma Therapy"
P.I.: Marcus Bosenberg, M.D., Ph.D., David Stern, Ph.D.
Percent effort: 3%
Direct costs per year: $200,000
Project period: 5/1/09-8/31/12

Summary: The goal of this project was to utilize short term melanoma cell cultures derived from patients and high throughput screening to determine optimal combination therapies for individual melanoma patients.

Agency: NIH/NCI
Title: "Identification and Characterization of Melanoma Cancer Propagating Cells"
I.D.#: P50 CA121974 Career Development Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 15%
Direct costs per year: $63,748
Project period: 7/1/08-6/30/10
Summary: The goal of this project was to distinguish melanoma cells that can reform tumors from those that cannot. Melanoma cancer stem cells will then be further characterized to determine key pathways that enable tumorigenesis and resistance to therapeutic interventions.

Agency: NIH/NCI
Title: "The Role of Beta Catenin Signaling in Malignant Melanoma"
I.D.#: R01 CA112054-01A1
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 20%
Direct costs per year: $177,750
Project period: 7/01/05–04/30/10
Summary: The major goal of this project was to evaluate the role of beta catenin signaling in melanoma initiation and progression using a mouse model of melanoma in which an activated beta catenin is expressed under the control of its own promoter, specifically in melanocytes.

Agency: Meyer-Milstein Center for Melanoma Research
Title: "Pre-Clinical Testing Core"
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 8.3%
Direct costs per year: $150,000
Project period: 7/1/08-6/30/10
Summary: The purpose of the core was to direct and oversee testing of therapeutic and imaging agents in mouse models of melanoma.

Agency: University of Vermont Cancer Center
Title: "DNA Methylation in Melanoma"
I.D.#: Pilot grant
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: No salary support
Total costs: $15,000
Project period: 7/01/04–6/30/05
Summary: The major goal of this project is to evaluate the role of beta catenin signaling in melanoma initiation and progression using a mouse model of melanoma in which an activated beta catenin is expressed under the control of its own promoter specifically in melanocytes.

Agency: NIH/NCI
Title: "Pten Signaling in Melanoma"
I.D.#: K08 CA89124
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 75%

Direct costs per year: $133,650
Project period: 9/01/01–8/30/06
Summary: The major goal of this project is to evaluate the role of Pten signaling in melanoma initiation and progression using a mouse model of melanoma in which Pten was deleted specifically in melanocytes.

Agency: Howard Hughes Medical Institute
Title: "Pten Signaling in Melanoma"
I.D.#: Physician Postdoctoral Research Fellow Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 100%
Direct costs per year: $67,000
Project period: 7/01/00–6/30/01
Summary: The major goal of this project is to evaluate the role of Pten signaling in melanoma initiation and progression using a mouse model of melanoma in which Pten was deleted specifically in melanocytes.

Agency: Jane Coffin Childs Memorial Fund for Medical Research
Title: "GLP-1 and LIN-12 Signaling in C. elegans"
I.D.#: Postdoctoral Research Fellow Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 100%
Total costs: $25,000
Project period: 7/01/94–6/30/96
Summary: The goal of this project was to identify the downstream signaling elements in the Notch signaling pathway in *C. elegans*.

Agency: Howard Hughes Medical Institute
Title: "Regulated Cleavage of proTGF-α"
I.D.#: Predoctoral Research Fellow Award
P.I.: Marcus Bosenberg, M.D., Ph.D.
Percent effort: 100%
Direct costs per year: $22,000
Project period: 7/01/90–3/31/92
Summary: The major goal of this project is to evaluate the mechanism and determinants of regulated cleavage of proTGF-α.

Invited Speaking Engagements, Presentations, Symposia & Workshops Not Affiliated With Yale

International/National

2015 Melanoma Brain Metastasis Symposium, Philadelphia, PA. Invited speaker, "Congenic Melanoma Brain Metastasis Models"
2015 Inter-SPORE Symposium, Philadelphia, PA. Invited presentation, "Metabolic Changes in Melanoma Cells Associated with Response to MAPK-pathway Inhibition"
2015 12th International Melanoma Research Congress, San Francisco, CA. Invited lecturer "".
2015 Montagna Symposium, Gleneden Beach, OR. Invited speaker, ""Cancer Stem Cells and Melanoma Tumor Heterogeneity"
2015 Melanoma Research Alliance, Washington, DC. Invited presentation, "Modeling the Role of Epigenetics in Melanoma"
2015 Genentech, South San Francisco, CA. Invited visit, "Tumor Microenvironment Assessment by Quantitative Imaging"
2014 11th International Melanoma Research Congress, Zurich, Switzerland. Invited panel member "Women in Science."

2014 Melanoma Research Network, Regensburg, Germany. Invited presentation "Insights from Mouse Models on the Molecular Mechanisms of Development and Progression of Malignant Melanoma"
2014 Adelson Medical Research Foundation, Las Vegas, NV. Invited participant.
2014 Jackson Laboratories at the University of Connecticut, Farmington, CT. Invited presentation "Modeling Cancer in Mice."
2013 Pan-American Society of Pigment Cell Research, Madison, WI. Invited presentation, "Genetic mouse models of pigmentation and melanoma."
2013 Inter-SPORE Symposium, Houston, TX. Invited presentation, "Developing effective melanoma therapies"
2013 10th International Melanoma Research Congress, Philadelphia, PA. Session chair and discussion leader (Dog melanoma as a clinical model), and invited presentation, "Combination therapies in melanoma"
2013 United States & Canadian College of Pathology, Baltimore, MD. Session chair (Patholobiology).
2013 Melanoma Research Alliance, Washington, DC. Invited presentation, "Development of effective targeted and immune combination therapies."
2012 9th International Melanoma Research Congress, Hollywood, CA. Session chair and discussion leader (MAPK signaling), and invited presentation, "Melanoma pathology for the non-pathologist."
2012 International Academy of Pathology, Cape Town, South Africa. Invited presentation, "Molecular pathology of cutaneous melanoma."
2011 8th International Melanoma Research Congress, Tampa, FL. Invited presentation, "The role of beta catenin in Braf/Pten melanoma formation and metastasis."
2011 Banbury Conference on Melanoma, Cold Spring Harbor, NY. Invited presentation, "Modeling melanoma in mice".
2011 NIH, Center for Cancer Research, Bethesda, MD. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2010 Inter-SPORE Symposium, Houston, TX. Invited presentation, "Development of DNA methylation-based biomarkers in melanoma."
2010 7th International Melanoma Research Congress, Sydney, Australia. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2010 Society of Investigative Dermatology, Atlanta, GA. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2010 American Association of Cancer Research, Washington, DC. Invited presentations and Session Co-Chair, "Modeling Skin Cancer in Mice" and "Pre-clinical Models for the Evaluation of Molecularly Targeted Melanoma Therapies."
2010 United States & Canadian Academy of Pathology. Short course, invited presentation, "Careers in investigative pathology: the academic tract(s)."
2009 6th International Melanoma Research Congress, Boston, MA. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2009 Inter-SPORE Symposium, Pittsburgh, PA. Invited presentation, "Clinical considerations for melanoma biomarker development."
2009 Society of Investigative Dermatology, Montreal, CA. Invited presentation, "Multispectral Imaging."
2009 United States & Canadian Academy of Pathology, Short course "Careers in investigative pathology: the academic tract(s)."
2008 Workshop on the Pathology of Mouse Models for Human Diseases, Ithaca, NY. Invited presentation, "The pathology of mouse models of skin cancer
2007 4th International Melanoma Research Congress, New York, NY. Invited presentation, "Conditional mouse models of melanoma."
2006 Collaborative Group of the Americas on Inherited Colorectal Cancer Meeting, Nashville, TN. Invited presentation, "Cutaneous manefestations of familial colon cancer syndromes."
2006 Workshop on the Pathology of Mouse Models for Human Disease, Seattle, WA. Invited presentation, "Mouse models of melanoma."
2006 Skin SPORE, MD Anderson Cancer Center, Houston, TX. Invited presentation, "Developing new mouse melanoma models."
2005 Melanoma Tissue Resources Consortium Meeting, National Cancer Institute. Invited participant.

2005 Conference on the Biology of Malignant Melanoma, Hilton Head, SC. Invited presentation,
2004 Workshop on Precancer, National Cancer Institute, Washington, DC. Invited participant.
2004 Self-Assessment Course, American Society of Dermatopathology Meeting. Invited case presentations and discussion.
2003 Mouse Models of Human Cancer Consortium, 2nd Cutaneous Oncology Workshop Leaders Meeting. Invited presentation,
2002 Self-Assessment Course, American Society of Dermatopathology Meeting. Invited case presentations and discussion.
2002 Research presentation, Howard Hughes Medical Institute Fellows Meeting. Invited presentation.
2001 Mouse Models of Human Cancer Consortium/National Cancer Institute Cutaneous Oncology Workshop on Mouse Models of Skin Cancer. Invited case presentations and discussion.
2000 Modeling Colorectal Carcinoma in the Mouse, Jackson Laboratories, Bar Harbor, ME Invited lecture.

Regional

2015 Martin C. Mihm Lecturer, Massachusetts General Hospital, Boston, MA. Invited lecturer "Melanoma: Mechanisms, Models, and Morphology"
2015 Department of Dermatology, University of California Los Angeles, Los Angeles, CA. Invited presentation, "Mouse Models of Melanoma: Insights on Melanoma Formation and Progression"
2014 Yale Stem Cell Center Symposium, New Haven, CT. "Melanoma Cancer Stem Cells."
2013 University of Pennsylvania, Philadelphia, PA. Duhring Dermatology Lectureship, "Malignant Melanoma: Genetic Pathways and New Therapies."
2013 Moffitt Cancer Center, Tampa, FL. Invited presentation, "Malignant Melanoma: The Biology of Tumor Progression."
2013 Rutgers University, Piscataway, NJ. Invited presentation, "Developing and Understanding Effective Melanoma Therapies."
2012 Cancer Center, University of Chicago, Chicago, IL. Invited presentation, "Developing Effective Melanoma Therapies."
2012 Sanford Burnham Research Institute, La Jolla, CA. Invited presentation, "The role of beta catenin in Braf/Pten melanoma formation."
2011 Department of Dermatology, Northwestern University, Chicago, IL. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2011 Sanford Burnham Research Institute, La Jolla, CA. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2011 Cancer Center, University of Virginia, Charlottesville, VA. Invited presentation, "Insights from new mouse melanoma models."
2010 Harvard SPORE in Skin Cancer, Boston, MA. Invited presentation, "Advances in conditional mouse melanoma models."
2010 Department of Dermatology, Massachusetts General Hospital, Boston, MA. Invited presentation, "FISHing for a diagnosis."
2010 Cancer Center, University of North Carolina, Chapel Hill, NC. Invited presentation, "Characterization of Individual Cells Capable of Melanoma Formation."
2009 Wistar Institute, Philadelphia, PA. Invited presentation, "Identification of murine melanoma cancer stem cells."
2007 Department of Pathology, University of Texas Southwestern, Dallas, TX. Invited presentation, "New mouse models of melanoma."
2007 Norris Cotton Cancer Center, Dartmouth Medical School, Lebanon, NH. Invited presentation, "A novel Braf/Pten mouse melanoma model."
2007 Cancer Center, Stanford University, Palo Alto, CA. Invited presentation, "Novel mouse models of melanoma."
2007 Genentech, South San Francisco, CA. Invited presentation, "Pre-clinical testing in the Braf/Pten mouse melanoma model."

2007 Cancer Center, Penn State University, Hershey, PA. Invited Keynote speaker, Melanoma Symp. "Novel mouse melanoma models."
2007 Department of Dermatology, Yale University, New Haven, CT. Invited, Dermatology Grand Rounds. "DNA methylation in melanoma" and "Clinical features of heavily pigmented melanoma."
2007 Department of Pathology, Massachusetts General Hospital, Boston, MA. Invited presentation, "Modeling melanoma in mice."
2006 Department of Pathology, Brigham and Women's Hospital, Boston, MA. Invited presentation, "Conditional mouse melanoma models."
2006 Fall Foliage Clinical Dermatology Meeting, White Sulphur Springs, WV. Invited presentation.
2006 New England Dermatological Society, Burlington, VT. Invited presentation, "Molecular correlates in dermatopathology".
2005 Department of Dermatology, Case Western, Cleveland, OH. Invited presentation, "Developing new mouse melanoma models."
2005 Wistar Institute, University of Pennsylvania, Philadelphia, PA. Invited presentation, "Developing new mouse melanoma models."
2005 20th Regional Cancer Symposium, Vermont Cancer Center, Burlington, VT. Co-Chair and invited presentation.
2004 Atlantic Dermatology Conference, Boston, MA. Invited presentation.
2003 18th Regional Cancer Symposium, Vermont Cancer Center, Burlington, VT. Co-Chair and invited presentation.

Professional service

Peer Review Groups/Study Sections

2014	Grant Review Committee	Yale Center for Clinical Investigation
2013 – present	Grant Review Committee	Yale Cancer Center, New Haven, CT
2012 – present	Grant Review Committee	Melanoma Research Foundation
2011 – 2015	Grant Review Committee	Joanna M. Nicolay Melanoma Foundation
2011	Reviewer, Tissue Microenvironment U54 Review Panel	National Cancer Inst, Bethesda, MD
2010 – present	Grant Review Committee	Melanoma Research Alliance
2009, 2013, 2015	Ad hoc member, Tumor Cell Biology Study Section (TCB)	National Inst of Health, Bethesda, MD
2009	Ad hoc member, SPORE Review Panel, Skin, Brain, and Prostate	National Cancer Inst, Bethesda, MD
2009	Ad hoc member, Tumor Cell Biology Study Section (TCB)	National Inst of Health, Bethesda, MD
2007	Ad hoc member, Tumor Cell Biology Study Section (TCB)	National Inst of Health, Bethesda, MD
2007	Ad hoc member, Molecular Oncogenesis Study Section (MONC)	National Inst of Health, Bethesda, MD
2007	Loan Repayment Program Review Panel	National Cancer Inst, Bethesda, MD
2005	Ad hoc member, SPORE Review Panel, Skin and Prostate	National Cancer Inst, Bethesda, MD

External Advisory Boards

2014 – present	P01 External Advisory Board	New York University, New York, NY
2011 – 2013	External Advisory Board P01 CA128814	Sanford Burnham Research Institute San Diego, CA
2011 – present	External Advisory Board Environmental Pathology T32 Grant	University of Vermont, Burlington, VT
2010 – 2012	External Advisory Board	Harvard University, Boston, MA

	Skin SPORE Grant	
2007-2008	External Advisory Board Skin SPORE grant	Yale University, New Haven, CT

Journal Service

Editor

2012 – 2015	Co-Editor-in-Chief, Pigment Cell & Melanoma Research

Editorial Board

2010 – present	Assistant Editor, Melanoma Commons
2009 – present	Editorial Board, Pigment Cell & Melanoma Research
2004 – 2008	Editorial Board, Innovations, Vermont Cancer Center

Reviewer

2001 – present	*Nature, Cell, Science, Nature Genetics, Cancer Cell, Cell Reports, Cancer Discovery, Cancer Research, Journal of Investigative Dermatology, Pigment Cell & Melanoma Research, British Journal of Dermatology, Journal of Cutaneous Pathology*

Professional Service for Professional Organizations

2012 – present	Scientific Review Panel, Melanoma Research Foundation
2010 – present	Scientific Review Panel, Melanoma Research Alliance
2009 – 2015	Member, Disease Working Group, The Cancer Genome Atlas (TCGA), National Cancer Institute
2000 – 2012	Pathology Organ Site Leader (Skin), Mouse Models of Human Cancer Consortium, NCI

Meeting Planning/Participation

2016	Chair, Society for Immunotherapy of Cancer Workshop, Washington, DC
2013	Session Chair, Society of Melanoma Research Meeting, Hollywood, CA
2013	Session Chair, United States and Canadian Academy of Pathology Meeting, Baltimore, MA
2012	Session Chair, Society of Melanoma Research Meeting, Hollywood, CA
2010	Session Chair, American Association of Cancer Research Meeting, Washington, DC
2005	Meeting Co-Chair, 20th Regional Cancer Symposium, Vermont Cancer Center
2003	Meeting Co-Chair, 18th Regional Cancer Symposium, Vermont Cancer Center
2003	Meeting Co-Chair Melanoma Mini-Symposium, Vermont Cancer Center

University Service

University Committees

2015 – present	Internal Advisory Board, M.D.-Ph.D. Program, Yale University
2011 – 2015	Associate Director, M.D.-Ph.D. Program, Yale University
2010 – present	Member, M.D.-Ph.D. Committee, Yale University
2009 – 2012	Member, Institutional Animal Care and Use Committee, Yale University
2003 – 2008	Member, Faculty Senate, University of Vermont

Medical School Committees

2014 – present	Executive Committee, Yale Cancer Center
2010 – present	Grand Rounds Committee, Yale Cancer Center
2010 – 2014	Shared Resources Committee, Yale Cancer Center

2009 – present	Tissue Committee, Yale SPORE in Skin Cancer
2008 – 2009	Cancer Biology Search Committee, Yale Cancer Center
2008 – 2009	Immunobiologist Search Committee, Yale Cancer Center
2007 – 2008	Director Search Committee, Vermont Cancer Center
2007 – 2008	Strategic Planning Subcommittee, Vermont Cancer Center
2007 – 2008	Transition Steering Committee, Vermont Cancer Center
2007	Administrator Search Committee, Vermont Cancer Center
2006 – 2008	Vermont Cancer Center Redesign Oversight Committee
2006 – 2007	Cell Signaling & Tranlational Cancer Program Search Committee, Vermont Cancer Center
2006 – 2007	Vermont Cancer Center Steering Committee
2006 – 2008	Environmental Pathology Training Grant Executive Committee
2005 – 2006	Translational Cancer Research Design Team Leader
2003 – 2008	MD-PhD Steering Committee, University of Vermont

Departmental Committees

2010 – 2013	Admissions Committee, Dermatology, Yale University
2005 – 2008	Faculty Appointment and Promotion Committee, Pathology, University of Vermont

Hospital Boards & Committees

2007 – 2008	Branding Oversight Committee, Fletcher Allen Health Care, Burlington, VT

Public Service

2008	Presenter, Melanoma Symposium (educational), Burlington, VT

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Citations = 5394

h-index = 36

i10 index = 65

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92. Schartl M, Larue L, Goda M, **Bosenberg MW**, Hashimoto H, Kelsh RN. What is a vertebrate pigment cell? *Pigment Cell Melanoma Res*. 2016, 29:8-14.

Invited Editorials and Commentaries

93. Curley D and **Bosenberg MW**. A new mechanism of release from senescence: suppression of p16INK4a by beta-catenin. *Pigment Cell Melanoma Res*. 2008, 21:5-6.

94. Held M, **Bosenberg M**. A role for the JARID1B stem cell marker for continuous melanoma growth. *Pigment Cell Melanoma Res*. 2010, 23:481-3.

95. Damsky WE, **Bosenberg M**. Unwelcome guests: macrophages promote UV-induced melanoma. *Pigment Cell Melanoma Res*. 2011, 24:265-7.

96. Damsky WE, **Bosenberg M**. From bedding to bedside: genetically engineered mouse models of cancer inform concurrent clinical trials. *Pigment Cell Melanoma Res*. 2012, 25:404-5.

97. Arnheiter H, **Bosenberg M**, Kelsh R. Editorial: onward and upward with PCMR. *Pigment Cell Melanoma Res*. 2013, 26:1.

98. **Bosenberg M**, Arnheiter H, Kelsh R. The test of time. *Pigment Cell Melanoma Res*. 2013, 26:157.

99. Kelsh R, Arnheiter H, **Bosenberg M**. Of mice and men … but so much more too! *Pigment Cell Melanoma Res*. 2013, 26:285.

100. Kelsh R, Arnheiter H, **Bosenberg M**. The immune system in pigment cell biology: villain or hero? *Pigment Cell Melanoma Res*. 2013, 26:433.

101. **Bosenberg M**, Kelsh R, Arnheiter H. Inspiration, collaboration, and cooperation in the PCMR community. Pigment Cell Melanoma Res. 2013, 26:785.

102. **Bosenberg M**, Arnheiter H, Kelsh R. Melanoma in mankind's best friend. *Pigment Cell Melanoma Res*. 2014, 27:1.

103. Arnheiter H, Kelsh R, **Bosenberg M.** Stripes, dots and dali. *Pigment Cell Melanoma Res*. 2014, 27:153.

104. **Bosenberg M.** Thank you for your support! *Pigment Cell Melanoma Res*. 2014, 27:321.

105. **Bosenberg M**, Arnheiter H, Kelsh R. The world of pigment cell research. *Pigment Cell Melanoma Res*. 2014, 27:683.

106. Aplin A, **Bosenberg M**, Soengas M, Kos L, Arnheiter H, Kelsh R. Unmet needs in melanoma research. *Pigment Cell Melanoma Res*. 2014, 27:1003.

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108. Arnheiter H, **Bosenberg M**, Aplin A, Kelsh R. The value of thesis advisers. *Pigment Cell Melanoma Res*. 2015, 28:125.

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Case Reports, Technical Notes, Letters

111. Chang HY, Wong KM, **Bosenberg M**, McKee PH, Haynes HA. Myelogenous leukemia cutis resembling stasis dermatitis. *J Am Acad Dermatol*. 2003;49:128-129.

112. Pritt B, **Bosenberg M**, Winn W. A Painful Cutaneous Nodule on the Forearm of an Immunocompromised Patient. *Lab Med*. 2006, 37(6):343-345.

113. Chandler W, **Bosenberg M**. Autoimmune Acrosyringitis with Ductal Cysts: Reclassification of Eruptive Syringoma. *J Cutan Pathol*. 2009, 36:1312-5.

114. Trufant JW, Brenn T, Fletcher CDM, Virata AR, Cook DL, **Bosenberg M**. Melanotic schwannoma arising in association with nevus of Ota: 2 cases suggesting a shared mechanism. *Am J Dermatopathol*. 2009, 31:808-13.

115. Trufant JW, Kreizenbeck GM, Carlson KR, Muthusamy V, Girardi M, **Bosenberg MW**. A transient epidermolysis bullosa simplex-like phenotype associated with bexarotene treatment in a G138E KRT5 heterozygote. *J Cutan Pathol*. 2010, 37:1155-1160.

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117. Trufant J, Kurz W, Frankel A, Muthusamy V, McKinnon W, Greenblatt M, Lazar A, Cook D, **Bosenberg M**. Familial multiple pilomatrixomas as a presentation of attenuated adenomatosis polyposis coli. *J Cutan Pathol*. 2012, 39:440-3.

118. Shvartsbeyn M, Mason AR, **Bosenberg MW**, Ko CJ. Perifollicular fibroma in Birt-Hogg-Dubé syndrome: an association revisited. *J Cutan Pathol*. 2012, 39:675-9.

119. Bunick CG, Leffell D, **Bosenberg M**, Yahalom J, Choi JN. Cutaneous Rosai-Dorfman disease of the right ear responsive to radiotherapy. *J Am Acad Dermatol*. 2012, 67:e225-6.

120. Lott JP, Gross CP, **Bosenberg M**. County-level association of melanoma and papillary thyroid cancer: evidence of shared environmental risk? *Pigment Cell Melanoma Res*. 2015, 28:120-3.

121. Antonov NK, **Bosenberg MW**, Halasz CL. Melanosis of the areola and nipple with an atypical pigment network. *Int J Dermatol*. 2015, doi: 10.1111/ijd.12898.

Scholarship In Press

Papers Submitted

121. Micevic G, Muthusamy V, Damsky W, Theodosakis N, Liu X, Meeth K, Wingrove, E, Santhankrishnan, M, **Bosenberg M**. Dnmt3b regulates the mTORC2 component Rictor and is critical for melanoma formation. [In second revision at *Cell Reports*].

CV SUPPLEMENT: DESCRIPTION OF YALE ACTIVITIES

Date of Preparation: January 6, 2016

Name: Marcus Bosenberg, MD, PhD
Position: Associate Professor of Dermatology and Pathology

1. Percent Effort

Clinical activities	25
Educational activities	10
Research/Scholarship	50
Administration	15
Total	100%

2. Narrative Description

I am an Associate Professor of Dermatology and Pathology in the Clinician Scholar tract. My time is primarily divided between being the principal investigator of a research laboratory focused on malignant melanoma and clinical service as a dermatopathologist. My laboratory has made fundamental discoveries on how core melanoma signaling pathways interact to drive tumor formation and progression. In the process, we have developed several genetically engineered mouse melanoma models that are currently the standard in the field and are used in over 50 laboratories worldwide. I consult with many of these laboratories, providing expertise in modeling and the histopathological analysis of tumor phenotypes. In addition to these research efforts, I have served as an Associate Director for the Yale MD-PhD program, mentor several MD-PhD, MD, and PhD thesis students, Co-Direct the Cell Biology 601 course, and teach in medical, graduate, and postdoctoral courses. From 2012-2015, I was Co-Editor-in-Chief of Pigment Cell & Melanoma Research, the leading research journal in my field. I am also the Co-Leader of the Cancer Genetic and Genomics Program in the Yale Cancer Center. In 2010, I was elected as a member of the American Society of Clinical Investigation, the physician-scientist honor society, and one of only 38 active members associated with Yale.

3. Clinical Activities

A. Narrative Description of Clinical Activities

I am a board-certified dermatopathologist in the Yale Dermatopathology Lab. This division of the Dermatology Department is internationally known for it's clinical and scholarly expertise and performs the full spectrum of specialty services related to interpretation of the pathology of skin biopsies and excisions. This includes primary cases, consult cases, immunohistochemical analyses, and immunofluorescent analyses. I typically perform clinical duties two days per week, however, because of the high volume of the service, this translates to the median service equivalent for clinical full-time clinical academic pathology or dermatology faculty members. Specifically, I sign out an average of 5,800 cases (7,600 specimens) per year (5,800 RVUs). Over past 3 years, this has resulted in an average of $1.9 million in clinical charges per year that yield $1.1 million in payments per year. I also serve as the consultant dermatopathologist for the Surgical Pathology Division of the Department of Pathology at Yale-New Haven Hospital 3 weeks/year and at the West Haven VA Hospital for 8 days/each per year. I frequently participate in the weekly Yale-New Haven Hospital melanoma tumor board and at the Department of Dermatology Grand Rounds.

B. Documentation of Clinical Activities

1) Table I (inpatient and ambulatory care responsibilities)

Table I: Clinical Activities

Clinical Care Responsibility	Role[2,3]	Frequency of Activity	Average Frequency of Session[1]
*Yale Dermatopathology	Provider	2008-2014	1-2 days/wk
* Yale-New Haven Hospital Dermatopathology	Attending	2008-2014	2-3 wks/yr
*West Haven VA Dermatopathology	Attending	2009-2014	8 days/yr

*Denotes clinical care responsibilities associated with teaching of residents, fellows, and students.

2) Percent of clinical time in clinical care activities (total = 100%)
- Yale Dermatopathology, dermatopathology – 90%
- Yale-New Haven Hospital, dermatopathology cases – 5%
- West Haven VA Hospital, dermatopathology – 5%

3) RVU or equivalent for your specialty
- 5,600 RVUs/year
- 5,800 cases/year
- 7,600 specimens/year
- $1.9 million in clinical charges/year
- $1.1 million in payments/year

4) Quality of care measures
- 92% of cases signed out within 1 day of receipt.

D. Regional/National Clinical Activities

1) Member, International Melanoma Study Group. Composed of internationally recognized leaders in the clinical aspects of melanoma pathology. Meets annually to review current state of melanoma pathology, advances within the last year, and issues consensus publications related to guidelines.

E. Other Clinical Activities (optional)

Melanoma Disease Working Group (DWG) member, The Cancer Genome Atlas (TCGA) (National Cancer Institute). The DWG determined the clinical correlates that are analyzed in conjunction with large scale melanoma genomic efforts sponsored by the National Cancer Institute.

4. Educational Activities

A. Narrative Description of Educational Contributions

From 2011-2015, I served as an Associate Director of the MD-PhD program and Co-Director the Cell Biology 601 course. I also teach in several medical and graduate courses, and participate in dermatology resident, pathology resident, and dermatopathology fellowship education. At present, I am mentoring three Yale MD-

PhD thesis students, two Yale PhD thesis student, and a Yale medical student performing thesis research. I have also mentored four medical students that were Howard Hughes Medical Institute Fellows in the last five years. I have also served/continue to serve on the PhD thesis committees of 16 students and 9 admission to candidacy exams.

B. Documentation of Teaching Activities

1) Table II: Formal lectures, courses

Table II: Formal Teaching Activities

Learner	**Course/Module**	**Role**[1]	**Year (s)**	**Ave. Annual Instructional Hours/yr**[2]
MD student	*CBIO 601 Molecular and Cellular Basis of Human Disease	Course Co-Director	2011-present	22
MD student	*PATH 200	Small Group Instructor	2013-present	1.5
Graduate	*PATH 650 Cellular and Molecular Biology of Cancer	Lecturer	2010-present	2
Graduate	*PATH 690 Molecular Mechanisms of Disease	Lecturer	2010-present	1
Graduate	*GENE 703 Mouse in Biomedical Research	Lecturer	2010-present	0.5
Postdoctoral	Dermatopathology teaching for Dermatology Residents	Lecturer	2008-present	4
Postdoctoral	Dermatopathology teaching for Pathology Residents	Lecturer	2008-present	2
Total Average Annual Instructional Hours: 33 hours				

C. *Indicates formal teaching evaluations are available for this activity

D. [2]Include only time spent in direct contact with learners, either in the classroom or in scheduled office hours.

1) Table III: Other major lectures or educational activities conducted over prior term of appointment within the Medical Center and affiliated institutions

E. Table III: Other Major Lectures and Educational Activities

Name of Series	**Date or Frequency of Presentation**	**Subject of Presentation**
Dermatology Research	Once yearly	Varied each year

Seminar		
Pathology Grand Rounds	09/2009	Modeling Melanoma in the Mouse
Yale SPORE in Skin Cancer Seminar	02/12/2010	Identification of Phenotypically Distinct Melanoma Propagating Cells
Yale Cancer Center Grand Rounds	09/07/2010	Modeling Tumor Heterogeneity in Malignant Melanoma
Yale Cancer Center Retreat	05/15/2012	Determining the Synergistic Effects of Combinatorial Genetic Hits in Malignant Melanoma
Pathology Research Lecture	09/17/2013	Malignant Melanoma: Signaling Pathways that Drive Tumor Fromation and Progression
Karl and Selma Folkers Lecture in Biomedical Research	02/07/2014	Finding the Path: Building a Career as a Physician-Scientist

F. Mentoring Activities

1) Student mentoring: Thesis advisor for predoctoral and masters degree students (MD, PhD, or MPH students)

PhD thesis

Name of trainee: David Curley, MD, PhD
Position and period of mentorship: University of Vermont MD-PhD student; 2005-2009
Thesis title: "BrafV600E cooperates with Pten silencing to induce metastatic melanoma"
Presentations/publications: 7 publications (see CV references #17, 19, 21, 26, 29, 41, 68, 87), # 26 is a co-first author publication in Nature Genetics with 329 citations to date.
Awards & honors: Warshaw Prize for best PhD Thesis by MD-PhD student; Keystone Symposium poster award winner
Current position: Assistant Professor, Emergency Medicine, Brown Alpert Medical School, Providence, RI

Name of trainee: C. Matthew Bradbury, MD, PhD
Position and period of mentorship: University of Vermont MD-PhD student; 2006-2009
Thesis title: "Identification of tumor suppressive cytokines in melanoma"
Current position: Radiation Oncologist, Memorial Medical Center, Springfield, IL

Name of trainee: Matthew Held, PhD
Position and period of mentorship: University of Vermont PhD student; 2005-2009
Thesis title: "Phenotypic and functional characterization of melanoma propagating cells"
Presentations/publications: 3 publications (see CV references #29, 46), #29 is a first author publication in Cancer Research with 63 citations to date

Current position: Postdoctoral Fellow, Harvard University

Name of trainee: William Damsky, PhD
Position and period of mentorship: University of Vermont MD-PhD student; 2007-2013
Thesis title: "Melanocyte metabolic and differentiation programs regulate melanoma formation and metastasis"
Presentations/publications: 7 publications (see CV references #26, 41, 61, 64, 67, 70, 71, 87), # 41 is a first author publication in Cancer Cell 53 citations to date
Awards & honors: Warshaw Prize for best PhD Thesis by MD-PhD student, Joanna M. Nicolay Melanoma Research Foundation Scholar
Current position: Resident, Dermatology, Yale-New Haven Hospital, New Haven, CT

Name of trainee: Katrina Meeth
Position and period of mentorship: Yale University PhD Student; 2011-present
Thesis title: "The role of macrophages in melanoma formation and progression"
Awards & honors: Oral Abstract Award, 2013 Congress, Society of Melanoma Research, Philadelphia, PA
Current position: PhD Student, Yale University

Name of trainee: Nicholas Theodosakis
Position and period of mentorship: Yale University MD-PhD student; 2012-present
Thesis title: "Metabolic responses to targeted therapeutic agents in melanoma"
Presentations/publications: 4 publications (see CV references #67, 87)
Awards & honors: Joanna M. Nicolay Melanoma Research Foundation Scholar, American Skin Association Medical Research Grant recipient, NIH F30 grant recipient
Current position: MD-PhD student, Yale University

Name of trainee: Goran Micevic
Position and period of mentorship: Yale University MD-PhD student; 2013-present
Thesis title: "Epigenetic changes that drive melanoma formation and progression"
Awards & honors: Joanna M. Nicolay Melanoma Research Foundation Scholar, American Skin Association Medical Research Grant recipient, NIH F30 grant recipient
Current position: MD-PhD student, Yale University

Name of trainee: Xiaoni Liu
Position and period of mentorship: Yale University MD-PhD student; 2013-present
Thesis title: "Epigenetic regulation of melanoma intratumor heterogeneity"
Awards & honors: Gruber Foundation Fellow
Current position: PhD student, Yale University

Name of trainee: Irina Krykbaeva
Position and period of mentorship: Yale University MD-PhD student; 2016-present
Thesis title: "Factors regulating melanoma brain metastases"
Current position: MD-PhD student, Yale University

MD thesis
Name of trainee: Joshua Trufant, MD
Position and period of mentorship: YSM medical student; 2009-2010
Thesis title: "Phactr1 as an immunohistochemical biomarker to distinguish malignant melanomas from nevi"
Presentations/publications: 4 publications (see CV references #)
Current position: Resident, Dermatology, New York University

Name of trainee: Lara Rosenbaum, MD
Position and period of mentorship: YSM medical student; 2010-2011
Thesis title: "Evaluating the Role of E-cadherin in Melanoma Invasion and Metastasis"
Presentations/publications: 2 publications (see CV references #41, 64). Poster presentations at Keystone meeting, AACR, SID, and HHMI meetings.
Awards & honors: HHMI medical student research fellow
Current position: Intern, Beth Israel Hospital, Boston, MA

Name of trainee: Alexander Marzuka-Alcala
Position and period of mentorship: YSM medical student; 2011-2012
Thesis title: "Metabolic effects of BRAF inhibitor therapy"
Presentations/publications: Poster presentations at AACR, SID, and HHMI meetings.
Awards & honors: HHMI medical student research fellow
Current position: Medical student, YSM

Name of trainee: Laura Huang
Position and period of mentorship: YSM medical student; 2012-2014
Thesis title: "Identification of effective melanoma combination therapies"
Current position: Medical student, YSM

Name of trainee: Billy Lockhart
Position and period of mentorship: YSM medical student; 2013-2014
Thesis title: "Identification of effective melanoma immune combination therapies"
Presentations/publications: Poster presentations at HHMI meetings.
Awards & honors: HHMI medical student research fellow
Current position: Medical student, YSM

Name of trainee: Jake Wang
Position and period of mentorship: YSM medical student; 2015-2016
Thesis title: "Identification of effective melanoma immune combination therapies"
Presentations/publications: Poster presentations at HHMI meetings and Society of Investigative Dermatology meeting.
Awards & honors: HHMI medical student research fellow
Current position: Medical student, YSM

2) Postdoctoral mentoring: Postdoctoral fellows, clinical fellows and/or residents

Name of trainee: Jason Lott, MD

Position and period of mentorship: Robert Wood Johnson Clinical Scholar; 2012-present
Research project: "Epidemiologic evaluation of environmental causes of melanoma and thyroid carcinoma"
Awards & honors: Recipient of a Robert Wood Johnson Clinical Scholarship
Current position: Robert Wood Johnson Clinical Scholar and Dermatology Resident; Yale School of Medicine

3) Faculty mentoring

Name of trainee: Viswanathan Muthusamy, PhD
Position and period of mentorship: Research Associate Scientist; 2008-2013
Role as mentor: faculty member within my laboratory
Presentations/publications: 6 publications (see CV references #16, 17, 19, 23, 36, 48, 60)
Current position: Research Associate Scientist, Chemistry, Yale University

4) Other mentoring activities

PhD Thesis committees

Katherine Tworkoski	2009-2013
Ellen Vollmers	2010-2013
Yukun Pan	2010-2015
Casey Langdon	2010-2015
Jeremy Jacox	2010-present
Alicia Little	2010-2012
Katherine Uyhazi	2011-2012
Brian Rosenberg	2012-2015
Jason Brown	2012-2015
Victoria Clark	2012-present
Deborah Ayeni	2013-present
Alexandra Albert	2014-present

D. Educational Program Leadership & Curriculum Development

1) Describe the development or administration of courses, programs and other educational activities in which you play a leadership role within the Medical Center.

2011-present YSM Cell Biology 601 Course Co-Director
- Helped re-structure course format/curriculum

2) Describe your involvement in the development of curricula and educational tools for courses and programs at Yale in which you do not play a direct leadership role

2013 YSM Pathology 200
- Developed a small group discussion on melanoma

3) Describe involvement in educational activities regionally and nationally

2009, 2014 Jackson Laboratories and the National Cancer Institute course on the histopathology of mouse models of cancer

• Invited lecturer on the pathology of skin cancer models

5. Research/Scholarship

A. Narrative Description

My research efforts are focused on various aspects of malignant melanoma, the most lethal form of skin cancer. Many of our efforts utilize an approach in which we model human melanoma-relevant genetic changes in the melanocytes of mice. In order to do this, we first developed a mouse line that enabled inducible, tissue-specific Cre-lox recombination in mouse melanocytes (*Bosenberg, Genesis, 2006*). These mice represented a technical breakthrough, allowing for spatially and temporally restricted inactivation (or activation) of particular genes in melanocytes of mice. Following mating with suitable mice that contained lox-flanked alleles of interest, these mice were used to generate the first tractable model of human melanocytic nevi and to show the rapid progression to melanoma if the Pten lipid phosphatase was also inactivated (*Dankort, Nature Genetics, 2009*). The synergy between these two genetic hits suggested that the MAPK and PI3K pathways could represent the core signaling changes in many melanomas. This had not been appreciated up to that time, as BRAF is frequently mutated (~50% of human melanoma), but PTEN is mutated in only 5% of melanoma, and non-genetic inactivation of PTEN was not yet clearly established. In follow-up experiments aimed at evaluating the Wnt signaling pathway in melanoma, we found that alteration of beta catenin levels had profound effects on melanoma formation, pigmentation, and metastasis (*Damsky, Cancer Cell, 2011*), establishing Wnt signaling as a target for melanoma therapy. We also showed that stabilization of beta catenin resulting in constitutive Wnt signaling resulted in markedly >10 fold increase in melanoma metastases to lung and lymph nodes. In ongoing experiments, we have identified key genetic changes that release melanocytic nevi from oncogene-induced senescence, but do not automatically result in progression to malignancy (*Damsky, Cancer Cell, 2015*). This series of experiments has demonstrated the complex interactions between the MAPK and PI3K pathways that drive melanoma formation and progression.

Using the Braf/Pten model described above, we observed that many but not all melanocytes rapidly progress to melanoma. To account for this apparently stochastic but rapid change that regulates tumor progression, we have evaluated the role of DNA methylation in melanoma formation, as promoter DNA methylation represents a mechanism that cancer cells can use to turn off genes that might otherwise suppress tumor growth. Surprisingly, we found that melanocytes and Braf/Pten melanomas do not require DNA methyltransferase 1 (Dnmt1), which is thought to be needed to maintain existing patterns of DNA methylation. However, we have found that loss of Dnmt3b profoundly inhibits Braf/Pten melanoma formation, in part by alterning the expression of growth-regulatory micro RNAs. These novel findings also suggest that Dnmt3b is a very attractive target for drug development in melanoma. As such, we have begun a collaboration with William Jorgensen (Yale Chemistry) to develop novel DNMT- inhibitory drugs. Dr. Jorgensen is a world-leading expert in computation methods of drug discovery and initial virtual screens have already resulted in the identification of compounds with low micromolar potency and selective inhibition of Dnmt3b. We will continue to evaluate derivatives of lead compounds in collaboration with Dr. Jorgensen with the expectation that a drug like compound with low nanomolar potency can be identified within 2 years. These compounds will be useful for the treatment of a variety of cancer types, potentially in combination with other small molecule inhibitors or with immune-based therapies.

The models that we have generated represent the first mouse models of melanoma driven by human-relevant genetic changes in genetically uniform mice with an intact immune system. The reason why this is important is that the immune system can induce regression of melanoma in human patients and because of this,

melanoma is the most-studied cancer type to study tumor immunology. In ongoing collaborations with Susan Kaech's laboratory at Yale, we are combining our respective fields of expertise (Bosenberg - modeling and tissue pathology; Kaech – flow cytometry and functional immunology) to make seminal advances in the initiation, establishment, and control of tumor immune responses. We have also generated congenic mouse melanoma lines that are driven by defined genetic changes. Based on level of interest in the unpublished lines, we anticipate that these lines will be the principal lines used in tumor immunology experiments worldwide moving forward, as analogous lines do not exist. In separate collaborative efforts with David Stern (Yale Pathology), we have used an unbiased screening approach to identify combination therapies that are effective in melanomas driven by particular genetic changes. While many cancer physicians see the clear need for combination therapies based on the relative lack of efficacy at patient maximum tolerated doses, rational efforts to identify combination therapies have been surprisingly rare.

In addition to the specific contributions noted above and future research directions, my scholarly efforts include: being the primary author for the National Cancer Institute's diagnostic criteria for the mouse models of human cancer consortium and an international authority on the pathology of mouse models of skin cancer, making cutting-edge observations on the features of individual cells capable of cancer formation, helping lead efforts to identify melanoma cases and data characteristics that allow for optimal analysis by the National Cancer Institute's The Cancer Genome Atlas, developing new targets and approaches to use changes in focal DNA methylation as a way to accurately stage patients, identifying the melanin-dependent UV-induced genetic changes that appear to be driven by redox signaling, and serving as co-director for the Yale SPORE in Skin Cancer Biospecimen Core.

B. Annotated Samples of Scholarship

Bosenberg M, Muthusamy V, Curley DP, Wang Z, Hobbs C, Nelson B, Nogueira C, Horner JW 2nd, Depinho R, Chin L. Characterization of melanocyte-specific inducible Cre recombinase transgenic mice. *Genesis*. 2006, 44:262-267. **IF=2.018**, **citations=52**

- This manuscript describes the construction and characteristics of the *Tyr::CreER*^{T2} mouse allele that I generated. In this line, a chimeric fusion protein of Cre with a mutated form of the estrogen receptor is expressed selectively in melanocytes. The Cre fusion protein is retained in inactive form in the cytoplasm until exposed to a specific chemical (4-hydroxytamoxifen), which allows for nuclear translocation and recombination of lox-flanked alleles. This line is particulary useful, as induction can be performed by local topical application of 4-hydroxytamoxifen to skin. Without this line and advice on its use, several prominent collaborative studies in Cell, Nature, Nature Genetics, Cancer Cell would not have been possible (CV reference #26, 30, 33, 34, 37, 39, 41, 45, 47, 49, 51, 52). We estimate that over 50 laboratories worldwide are now basing a significant portion of their experimental work around the use of this allele and models that it makes possible.

Dankort D, Curley DP, Cartilage RA, Nelson B, Karnezis AN, Damsky WE, You MJ, DePinho RA, McMahon M, **Bosenberg M**. Braf^{V600E} cooperates with Pten silencing to induce metastatic melanoma. *Nat Genet*. 2009, 41:544-52. **IF=29.352**, **citations=505**

- The remarkable synergy between MAPK and PI3K signaling in melanoma formation and progression is described in this manuscript, which was a collaborative effort with Martin McMahon at UCSF. Conditional activation of the Braf Ser/Thr kinase with loss of the Pten phosphatase results in rapid formation and metastasis of thousands of melanomas within days of recombination. These findings underscored the functional role of the PI3K pathway in melanoma, as existing mutational data suggested a more modest role. The Braf/Pten mouse melanoma model is now distributed by Jackson Laboratories, the leading supplier of genetically-engineered mice, and is used widely in the pre-clnical evaluation of new melanoma therapies.

Damsky WE, Curley DP, Santhanakrishnan M, Rosenbaum LE, Platt JT, Gould Rothberg BE, Taketo MM, Dankort D, Rimm DL, McMahon M, **Bosenberg M**. β-catenin signaling controls metastasis in Braf-activated Pten-deficient melanomas. *Cancer Cell*. 2011, 20:741-54. **IF= 23.523**, **citations=113**

- We followed up on the above *Nature Genetics* manuscript by identifying a central role for Wnt signaling in Braf/Pten melanoma formation. In particular, beta catenin was shown to be required for rapid induction of melanoma formation in the Braf/Pten model, which was not known or predicted from the existing literature. We also showed that alteration of Wnt activity in this context resulted in a 200-fold differences in lung and lymph node metastasis. These studies provide the basis for ongoing studies of genotype-driven cancer metastasis.

Damsky WE, Micevic, G, Meeth K, Muthusamy V, Curley DP, Santhankrishnan M, Platt JT, Erdelyi I, Huang L, Theodosakis N, Zaidi MR, Tighe S, Davies M, Dankort D, McMahon M, Merlino G, Bardeesy N, **Bosenberg M**. miR-100 family members repress mTORC1 signaling in BrafV600E-induced growth arrest in vivo. *Cancer Cell*. 2015; 27:41-56. **IF= 23.523, citations=9**

- We demonstrated that Braf-induced growth arrest in melanocytic lesions was circumvented by mTORC1 inhibition and showed that other theories for the mechanisms of oncogene-induced growth arrest (including a p53-mediated DNA damage response or p16Ink4a induced cell arrest).

Held MA, Curley DP, Dankort D, McMahon M, **Bosenberg MW**. Characterization of melanoma cells capable of propagating tumors from a single cell. *Cancer Res*. 2010, 70:388-97. **IF=9.329, citations=80**

- In this manuscript we defined unique properties of different subpopulations of mouse melanoma cells. In particular, we identified a subpopulation of cancer cells that formed a tumor every time after injection as single cells (21/21 times). We also identified a second population of tumor cells that was only rarely tumorigenic in similar assays as well as a third population that formed tumors from single cell injections at intermediate rates. This was the first time that a uniformly tumorigenic population of cells had been identified in any cancer system. It was also the first time that two different populations of phenotypically distinct "cancer stem cells" had been identified from the same tumor.

C. Summarize your role in collaborative projects within the Medical Center and with other institutions.

Yale Collaborations

David Stern, PhD (Pathology), Howard Hochster (Medicine-Oncology), MD, Lajos Pustaj (Medicine-Oncology), MD, PhD - David Stern and I have developed experimental and bioinformatics approaches to identifying effective combinations for cancer therapy. We are collaborating with Drs. Hochster and Pustaj to identify novel combination therapies that can be used in new clinical trials for pancreatic cancer and triple-negative breast cancer. These collaborations have resulted in several research contracts with pharmaceutical companies with Drs. Stern and Bosenberg (Debiopharm, Lausanne, Switzerland, others in progress) (CV references #36, 43, 46, 50).

Susan Kaech, PhD (Immunobiology) – Dr. Kaech and I have been collaborating over the past 5 years in efforts related to characterizing the tumor immune response our mouse models of melanoma. These efforts have resulted in several funded collaborative grants (Yale pilot funding and from the Melanoma Research Alliance and Melanoma Research Foundation) (CV reference #89).

Ruth Halaban, PhD (Dermatology), Douglas Brash, PhD (Therapeutic Radiology) – Dr. Halaban, Dr. Brash and myself are equal Principal Investigators for a Department of Defense grant that is focused on the relationship between UV light, melanocytic pigmentation, and epigenetics. Dr. Halaban and I (along with Drs. Krauthammer and Stern) were equal Principal Investigators on the grant that funded genomic characterization of melanoma that resulted in two *Nature Genetics* manuscripts (CV reference #43).

William Jorgensen, PhD (Chemistry) – Dr. Jorgensen and I have begun a collaboration to develop novel drugs that inhibit DNA methyltransferases (DNMTs). The selection of DNMT3B as an attractive target was based on our preliminary data in mouse models. Dr. Jorgensen's group is utilizing structure-based computational drug discovery and chemical synthesis for lead optimization. My laboratory is performing all of the assay work to determine inhibitory activity. Compounds with low micromolar potency have already been identified. A Yale Cancer Center pilot grant was funded related to this work and the work is currently funded by the Sokoloff Family Team Science Award of the Melanoma Research Alliance. Additional Yale collaborators in this effort include Karen Anderson, PhD (X-ray crystallography and pharmacology), Frank Slack, PhD (miRNA biology), and Narendra Wajapeyee (miRNA screening).

Tian Xu, PhD (Genetics) – I have provided Dr. Xu with mouse alleles that have made a mouse transposon insertional mutagenesis screen possible and have performed histopathological evaluation of mouse tumors resulting from this and other cancer screens. (CV reference #39, 51)

Anthony van den Pol, PhD (Neurosurgery) – We have collaborated in a project related to the use of oncolytic viruses in human and mouse melanoma. (Manuscript in revision, CV reference #49)

Richard Kibbey, PhD (Medicine) – Dr. Kibbey and I are collaborating to develop metabolomics approaches to studying the transition from benign growths to malignancy as well as the metabolic changes induced by targeted cancer therapies. Dr. Kibbey is a co-mentor on the F30 pre-doctoral fellowship application for MD-PhD student Nicholas Theodosakis that is in my laboratory. Dr. Kibbey, myself, and Dr. Xiaoyong Yang are Co-Directors of a Cancer Metabolism program that is being developed for inclusion in the Yale Cancer Center. Dr. Kibbey and myself are the recipients of the Yale Cancer Center Co-Pilot award to fund this work during 2013-2014.

Harriet Kluger, PhD (Medicine-Oncology) – Dr. Kluger and I are collaborating to develop novel models of melanoma brain metastasis as part of a funded Yale Cancer Center T-TARE grant. I am the PI of the Pathology and Mouse Modeling Core of a P01 related to melanoma brain metastasis that was submitted in Sept. 2013. This grant includes collaborative efforts with Peter Glazer (Therapeutic Radiology), Lieping Chen (Immunobiology), Richard Carson (Diagnostic Radiology), Dr. Kluger, and David Rimm (Pathology).

Qin Yan, PhD (Pathology) – Dr. Yan has two grants to fund collaborative experiments with the Bosenberg laboratory that involve evaluation of JARID family member histone demethylases in cancer.

Gerald Schadel, PhD (Pathology) – We have begun a collaboration to evaluate the role of mitochondrial function and redox signaling in melanoma formation and progression.

Tarek Fahmy, PhD (Biomedical Engineering) – Dr. Fahmy and Dr. Hanlon recently received Yale SPORE in Skin Cancer funds to evaluate the effects of stimulation of immune responses in our mouse melanoma models using PLGA nanoparticles loaded with immune-modulatory agents.

Donald Engelman, PhD (Chemistry) – We have evaluated the potential use of pHLIP in imaging and therapeutic applications in melanoma.

Christine Ko, MD (Dermatology) – Dr. Ko, Dr. Jen McNiff, Dr. Keith Choate and I have collaborated on the molecular characterization of keratoacanthomas. (CV reference #42)

Rossitza Lasova, MD (Dermatology) – I have assisted Dr. Lasova with experimental design and interpretation of experiments on the molecular characterization of Spitz nevi.

Michael Girardi, MD (Dermatology) – Dr. Girardi and I have initiated a collaboration on the role of Langerhans cells in chemical carcinogenesis. (CV reference #81)

Other Institutions

Mary Jo Turk, PhD, Steven Fiering, PhD – Immunobiology, Dartmouth Medical School, Lebanon, NH. We collaborated in studies using our mouse models of melanoma to evaluate immune mechanisms of melanoma therapy (see CV reference #54)

Gavin Robertson, PhD – Department of Pharmacology, Penn State College of Medicine, Heshey, PA. I am PI of the subcontract of the R01 application "Targeted Chemoprevention in Melanoma", G. Robertson, principal investigator. These studies involve preclinical testing in models that we developed (CV reference #13)

Ze'ev Ronai, PhD, Jeffrey Smith, PhD – Sanford-Burnham Institute for Medical Research, La Jolla, CA. Several ongoing collaborations include developing new approaches to cancer metabolomics, evaluation of the role of the PDK1 kinase in melanoma, and development of novel combination therapies involving PDK1 inhibition. These collaborative efforts include my inclusion as principal investigator of one of the three projects in the P01 grant resubmission that will occur within the next 9 months. (CV reference #35, 44, 55)

Michael Mann, PhD, Nancy Jenkins, PhD, Neil Copeland, PhD – Cancer Genetics Laboratory, Insititute of Molecular and Cellular Biology, Singapore (now at Baylor University, Houston, TX). This collaborative efforts involve large insertional mutagenic screens based on the sleeping beauty transposon and our Tyr::CreER-T2 mouse strain. The experimental work has been completed and we expect to submit a manuscript within the next 6 months.

Martin McMahon, PhD – Cancer Research Institute, University of California San Francisco. We have collaborated to produce the Braf/Pten and several other models by combining Martin's conditionally activatable BrafCA mouse allele and our Tyr::CreER-T2 allele. (CV reference #26, 29, 41, 45, 52, 53)

Ian Tonks, PhD, Graeme Walker, PhD, Nicholas Hayward, PhD – QCF Transgenic Laboratory and Laboratory of Oncogenomics, Queensland Institute of Medical Research, Brisbane, Australia. Collaboration related to the use of the Tyr::CreER-T2 to conditionally induce deletion of Rb and family members specifically in melanocytes. (CV reference #33, 34)

David Fisher, MD, PhD – Chairman, Department of Dermatology Massachusetts General Hospital, Boston, MA. Advice and interpretation of results related to the use of Tyr::CreER-T2. (CV reference #30, 45, 90)

Isabel Chiu, PhD, Joerg Heyer, PhD, Min Wu, PhD – AVEO Pharmaceuticals, Inc. Cambridge, MA. Mouse histopathological studies as a paid consultant and collaborator related to novel mouse models of cancer. (CV reference #25, 28)