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TITLE:

Targeting Histone Abnormality in Triple-Negative Breast Cancer

PRINCIPAL INVESTIGATOR:

Nancy E. Davidson, M.D.

CONTRACTING ORGANIZATION:

University of Pittsburgh, Pittsburgh, PA 15213

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Fort Detrick, Maryland 21702-5012

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14. ABSTRACT Like other cancers, triple negative breast cancer (TNBC) develops as a consequence of cumulative genetic and epigenetic changes. The goal of this funded proposal is to understand how changes in interaction of chromatin-remodeling enzymes contribute to TNBC development and to test novel targeted combination approaches of epigenetic drugs in restoration of aberrantly silenced tumor suppressor genes and inhibition of breast tumor growth. Our previous work suggested that TNBC had enhanced crosstalk between histone enzymes LSD1 and HDAC5 that promoted aberrant gene silencing and TNBC cell growth. Our ongoing studies demonstrated that crosstalk between LSD1 and HDAC5 may represent a novel and effective target for therapeutic target for TNBC. We further identified that sulforaphane, a natural HDAC inhibitor found in cruciferous vegetables, uniquely suppressed HDAC5 mRNA expression that facilitated LSD1 protein destabilization. Sulforaphane significantly inhibited growth in cultured breast cancer cells and MDA-MB-231 xenografts. Combined use with a novel LSD1 inhibitor, HCI-2509, significantly promoted antineoplastic efficacy of sulforaphane. Moreover, microarray screening in HDAC5-KD and LSD1-KD cells identified a unique subset of genes whose expression was co-regulated by HDAC5 and LSD1 signaling pathways. These novel findings suggest that HDAC5-LSD1 axis may represent a novel and effective therapeutic target for TNBC.						
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Table of Contents

	<u>Page</u>
1. Introduction.....	4
2. Keywords.....	4
3. Accomplishments.....	4-9
4. Impact.....	9
5. Changes/Problems.....	9
6. Products.....	9
7. Participants & Other Collaborating Organizations.....	10-11
8. Special Reporting Requirements.....	11
9. Appendices.....	11-69

1. INTRODUCTION

Triple negative breast cancer (TNBC) is a more aggressive subtype of breast cancer and early distant recurrences are more common than with hormone receptor-positive counterparts. TNBC is not amenable to anti-estrogen therapy or to agents that target HER2. Therefore, new targeted approaches are urgently needed to improve TNBC therapy. Like other cancers, TNBC develops as a consequence of cumulative genetic and epigenetic changes. The epigenetic alterations include DNA methylation and histone tail modifications. Our early work suggests that enhanced crosstalk between histone enzymes LSD1 and HDAC5 promotes aberrant gene silencing and TNBC tumor cell growth. The goals of this funded proposal are to: (1) understand how changes in interaction of HDAC5 and LSD1 contribute to TNBC development; and (2) test if combined use of LSD1 and HDAC inhibitors is more efficacious in restoration of aberrantly silenced tumor suppressor genes and inhibiting tumor growth. This awarded project is a partnership between Dr. Yi Huang (initiating PI) and Dr. Nancy E. Davidson (partner PI). In the first funding year, the two labs have been working closely together, using multiple *in vitro* and *in vivo* models to decipher how to apply novel epigenetic agents in the most favorable combination strategy against TNBC and investigate how these epigenetic changes might contribute directly to TNBC tumorigenesis. The Davidson lab tested the *in vivo* therapeutic effect of a natural HDAC inhibitor (HDACi), sulforaphane, alone or in combination with LSD1 inhibitor HCI-2509 in MDA-MB-231 xenografts in mice. Moreover, the Davidson team collaborated with the Huang team on the analysis of basic mechanisms underlying how HDAC5 interacts with LSD1 complex and stabilizes its protein expression and activity in breast cancer. These new findings provided strong evidence to support our hypothesis that HDAC5-LSD1 axis represents a promising therapeutic target for improving HDACi efficacy in TNBC.

2. KEYWORDS

breast cancer, HDAC5, LSD1, USP28, sulforaphane, combination therapy, microarray study

3. ACCOMPLISHMENTS

a. What were the major goals of the project?

The hypothesis for our work is that silencing of key tumor suppressive genes by enhanced crosstalk between LSD1 and HDACs is a unique epigenetic mechanism promoting TNBC growth and metastasis, and blockade of the LSD1/HDAC axis results in profound inhibition of TNBC growth and metastasis, mediated at least in part via induction of RGS16. This is to be addressed through three specific aims:

1. Delineate the molecular basis by which inhibition of LSD1 promotes HDACi-induced apoptosis through reactivation of aberrantly silenced tumor suppressor genes.
2. Elucidate the role of LSD1 in HDACi therapy and chemoprevention of TNBC in animal models.
3. Evaluate therapeutic effects of combination strategies in patient-derived xenografts (PDXs).

b. What was accomplished under these goals?

Proposed Aims	Accomplishment
Specific Aim 1: Delineate the molecular basis by which inhibition of LSD1 promotes	The Davidson team collaborated with the Huang team on the analysis of basic mechanisms underlying

HDACi-induced apoptosis through reactivation of aberrantly silenced tumor suppressor genes.	how HDAC5 interacts with LSD1 complex and stabilizes its protein expression and activity in breast cancer and how HDAC5-LSD1 axis promotes breast cancer tumorigenesis.
Major Task 1: Determine the role of LSD1/HDACs axis in promoting tumorigenic transformation of TNBC.	
Subtask 1: Submit IRB approval for use of LSD1/HDAC expression plasmids. (Month 1-2)	The proposed work was approved by University of Pittsburgh Institutional Review Board (PRO14030148, 3/10/2014).
Subtask 2: Establish MCF-10A cells with overexpression of LSD1, HDAC1, HDAC5 or combination. (Month 3-6)	These studies were carried out in Huang Lab (see Dr. Huang's report)
Subtask 3: Treat transfected MCF-10A cells for 6 months with mutagen ICR191 and test the potential transformation of transfected MCF-10A cells in 3D culture (Month 7-15).	We have provided Dr. Huang technical support in performing these experiments, e.g. breast cancer cell 3D culture on soft agar (see the results in Dr. Huang's report).
Major Task 2: Elucidate the role of RGS16 signaling pathway in LSD1-mediated HDACi efficacy in TNBC.	
Subtask 1: Stable knockdown of RGS16 expression in MCF-10A cells (Month 5-8).	The generation of stable MCF-10A-RGS16-KD cell line is still in progress.
Subtask 2: Evaluate whether silencing of RGS16 promotes MCF-10A tumorigenesis (Month 8-12).	Once the stable MCF-10A-RGS16-KD cell line is successfully generated, we will examine the effect of RGS16 inhibition on MCF-10A cell tumorigenesis.
Other reportable results: To study the correlation in protein expression of HDAC5 and LSD1 in human breast cancer.	To study the potential association of HDAC5 and LSD1 in human breast cancer, we examined mRNA levels of HDAC5 and LSD1 in human immortalized normal mammary epithelial MCF10A cells, fully malignant MCF10A-CA1a cells transformed from MCF10A cells with transfection of <i>HRAS</i> oncogene, and several human breast cancer cell lines. qPCR studies showed that there was no clear association of mRNA expression of HDAC5 and LSD1 in breast cancer cell lines (Fig. 1A). However protein expression of both HDAC5 and LSD1 was significantly elevated in all malignant breast cell lines compared with MCF10A (Fig. 1B). Quantitative immunoblotting analysis showed that protein levels of HDAC5 and LSD1 were positively correlated (Fig. 1C). The correlation of HDAC5 and LSD1 protein expression was further evaluated in 50 primary breast cancer patient specimens by immunohistochemistry (IHC) using a commercially available tissue microarray (US Biomax, Rockville, MD). Standard staining procedure for paraffin sections was used for

IHC according to manufacturer's recommendations (Vector Labs, Inc., Burlingame, CA). Monoclonal antibodies were used for detection of LSD1 (1:800; Cell Signaling, Danvers, MA) and HDAC5 (1:100; Santa Cruz). The staining was visualized using diaminobenzidine, and quantitated using IHC Profiler, an ImageJ plugin to calculate H-score. Chi-square study was used to assess the correlation between HDAC5 and LSD1 protein expression in these tumors ($p < 0.05$) (**Fig. 1D**). Furthermore, IHC analysis showed that breast cancer tissues ($n=18$) expressed significantly higher level of HDAC5 and LSD1 than their matched normal adjacent tissues ($n=18$) (**Fig. 1E**). The mean H-score for HDAC5 staining in stage 3 breast tumors ($n=25$) was statistically significantly higher than stage 2 counterparts ($n=25$). The mean H-score of LSD1 staining for stage 3 tumors was also higher than that of stage 2 tumors with a p-value of 0.07 (**Fig. 1F**). Taken together, these findings suggest that HDAC5 and LSD1 proteins are coordinately overexpressed in human breast cancer cell lines and tissue specimens.

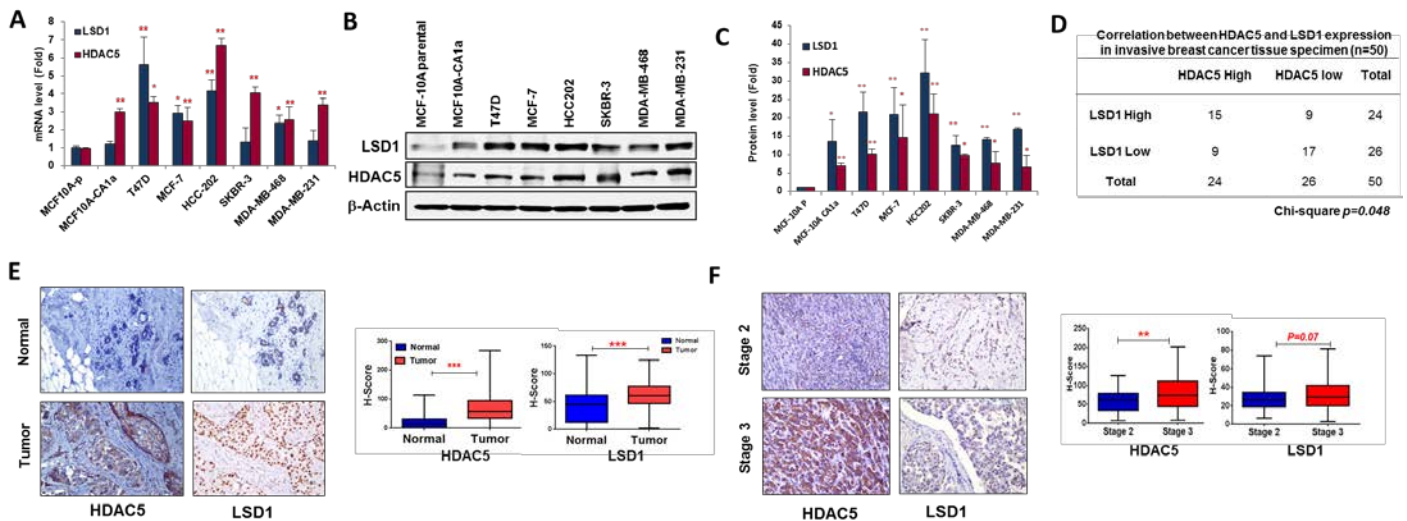


Figure 1. Protein expression of HDAC5 and LSD1 is positively correlated. (A) mRNA expression of HDAC5 and LSD1 in breast cancer cell lines was compared with that of MCF10A cells as fold 1. Data are means \pm SD of three independent experiments. (B) Immunoblots with anti-HDAC5 and LSD1 in indicated cell lines. (C) Histograms represent the mean protein levels of HDAC5 or LSD1 in breast cancer cell lines versus MCF10A cells (as fold 1) in three determinations. Data are means \pm SD of three independent experiments. β -actin was used as control. (D) 50 primary human invasive breast tumor samples were immunostained with antibodies against HDAC5 or LSD1. Chi-square study was performed by using median H-scores as the cutoff for high vs low protein expression. (E) Representative HDAC5 and LSD1 staining (20x) in invasive breast carcinoma and adjacent normal tissue from one representative patient. H-scores represent average staining intensity in breast tumors ($n=18$) versus adjacent normal breast tissue ($n=18$). (F) Representative HDAC5 and LSD1 staining (20x) in stage 2 and 3 invasive breast carcinoma patients. H-scores represent average staining intensity in stage 3 breast tumors ($n=25$) versus stage 2 breast tumors ($n=25$). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (student's t-test).

Proposed Aims	Accomplishment
<p>Specific Aim 2: Elucidate the role of LSD1 in HDACi therapy and chemoprevention of TNBC in animal models.</p>	<p>The Davidson lab carried out the animal experiments and orchestrated the sample collection and analysis, histological and pathological examinations of tissues, and interpretation of the results generated from <i>in vivo</i> studies. Her team also collaborated with the Huang team on the analysis of epigenetic markers in the tissues derived from these studies.</p>
<p>Major Task 4: Evaluate <i>in vivo</i> therapeutic effects of combination strategies using LSD1 inhibitors and HDACi in different subtypes of breast tumors.</p>	
<p>Subtask 1: Submit documents for local IACUC review (Month 6-8).</p>	<p>The research proposal has been approved by The University of Pittsburgh's Institutional Animal Care and Use Committee (Protocol #: 14033448, 3/24/2014, PI: Davidson).</p>
<p>Subtask 2: Examine the <i>in vivo</i> effects of LSD1/HDAC signaling on tumorigenic transformation of MCF-10A cells (Month 8-16).</p>	<p>We are currently evaluating the role HDAC5/LSD1 in breast tumorigenesis in cell line model, and anticipate that the study in MCF-10A xenograft-bearing mice will start soon after we complete the <i>in vitro</i> examination.</p>
<p>Subtask 3: Evaluate combination strategies using LSD1i and HDACi in different subtypes of breast tumors (Month 10-26).</p>	<p>We first investigated the combinatorial effect of sulforaphane and a novel LSD1 inhibitor HCI-2509 in TNBC cells. shRNA-mediated depletion of LSD1 sensitized MDA-MB-231 cells to sulforaphane evidenced by significantly reduced IC₅₀ value (Fig. 2A), suggesting that loss of LSD1 enhances growth inhibition by sulforaphane. Next, we investigated whether combined use of HCI-2509 with sulforaphane could lead to a synergistic effect on growth inhibition. MDA-MB-231 and MDA-MB468 cells were simultaneously treated with sulforaphane and HCI-2509. By using Chou-Talalay model, strong synergistic growth inhibition between sulforaphane and HCI-2509 was observed in both cell lines (CI<1) (Fig. 2B).</p> <p>On the basis of the above findings, we further tested the <i>in vivo</i> therapeutic effect of sulforaphane alone or in combination with HCI-2509 using MDA-MB-231 xenografts in athymic nude mice. BALB/c nu/nu athymic nude mice (Harlan Bioproducts, Indianapolis, IN) were implanted at fat pad with 3×10⁶ MDA-MB-231 cells. When average tumor size was > 50 mm³ (Tumor volume</p>

= width × width × length/2), mice were randomized into control and treatment groups with the following doses: Vehicle (DMSO, n=12), sulforaphane treatment (50 mg/kg, n= 12), HCI-2509 (30mg/kg, n = 13), combination treatment (sulforaphane 50mg/kg, HCI-2509mg/kg, n=14). The drugs were administered by intraperitoneal (i.p.) injection 5 days/week for 4 weeks. Tumor volumes and body weights were measured every three days following the initial treatment and continued throughout the course of the study. Treatment with either sulforaphane or HCI-2509 alone significantly inhibited growth of MDA-MB-231 xenografts. Combined treatment with both compounds exhibited statistically significantly greater inhibitory effect on tumor growth than either therapy alone (**Fig. 3A & 3B**). During the course of treatment, there was no obvious weight loss observed in groups treated with sulforaphane or HCI-2509 alone, except a moderate decrease of weight (<10% of body weight) in the group treated with both compounds. No animals died from treatment (**Fig. 3C**). These results indicate that sulforaphane effectively inhibits growth of TNBC tumor *in vivo* and is more effective when used in combination with an LSD1 inhibitor.

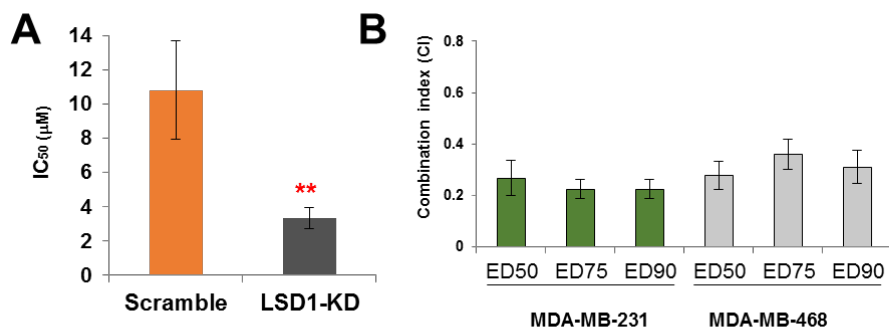


Figure 2. LSD1 inhibitor sensitizes breast cancer cells to sulforaphane-induced growth inhibition. (A) Scramble or LSD1-shRNA transfected MDA-MB-231 cells were treated with 25 µM sulforaphane followed by crystal violet assays. (B) Effect of combination therapy on growth. Synergy was defined as any CI < 1. Data are means ± SD of three independent experiments. ** p<0.01, student's t-test.

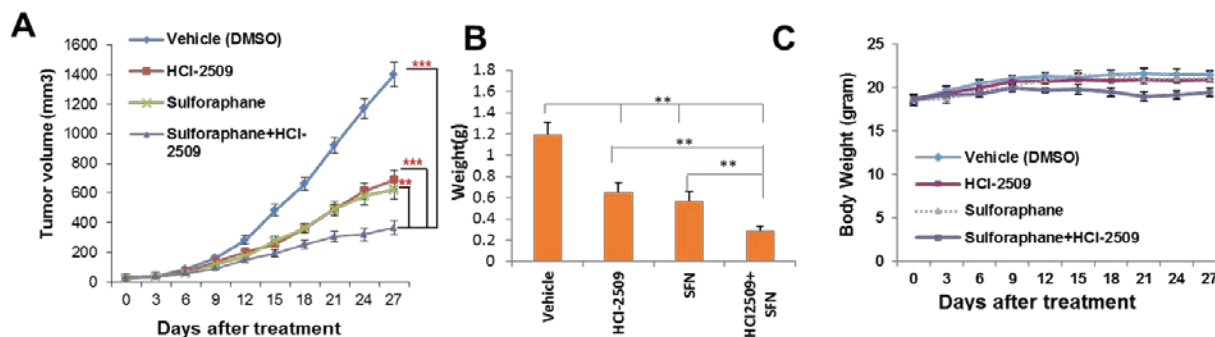


Figure 3. LSD1 inhibitor sensitizes breast cancer cells to sulforaphane-induced growth inhibition. (A) Tumor volumes of mice measured twice weekly. The vertical bars indicate mean tumor size (in mm³)±SE. (B) Weight of animal tumors was measured at the end of experiment. (C) Weights of mice were measured in the indicated days. The vertical bars represent mean mouse weight±SE** p<0.01, *** p<0.001 (student's t-test).

c. What opportunities for training and professional development has the project provided?

This award provides an excellent vehicle for a postdoctoral fellow, Chunyu Cao, PhD, who has worked on this project to advance his breast cancer research career and transition to independence.

d. How were the results disseminated to communities of interest?

The progress of this work was presented by Dr. Cao at the 2015 annual meeting of American Association of Cancer Research (AACR): Cao C, Vasilatos S, Oesterreich S, Davidson NE, Huang Y. Functional crosstalk between histone deacetylase 5 (HDAC5) and lysine-specific demethylase 1 (LSD1) as a novel therapeutic target in triple-negative breast cancer cells. The 106th AACR Annual Meeting, Philadelphia PA, Cancer Res, Abstract 3838, 2015.

This work was also presented by Dr. Cao at 27th Annual University of Pittsburgh Cancer Institute Scientific Retreat in June, 2015 as well as the Women's Cancer Research Center Annual retreat at the University of Pittsburgh in October, 2015.

One manuscript has been submitted to *Oncogene* for publication and it is currently under revision.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period we will continue to elucidate how sulforaphane suppresses HDAC5-LSD1 signaling and alters chromatin structures in TNBC. We will clarify the mechanism of sulforaphane-induced downregulation of HDAC5 transcription, and examine how sulforaphane inhibit LSD1-USP28 interaction through downregulation of HDAC5 expression. Finally we will acquire or generate HDAC5 transgenic/knockout mouse models to validate our hypothesis that HDAC5-LSD1 axis represents a promising therapeutic target for TNBC.

4. IMPACT

(a) What was the impact on the development of the principal discipline(s) of the project?

TNBC comprises those breast cancers that lack expression of estrogen receptor (ER), progesterone receptor (PR), and HER-2 protein. Clinically, TNBC is more aggressive and distant recurrences in visceral organs are more common in TNBC patients than their hormone receptor-positive counterparts. Our studies have opened a new avenue for the potential utility of crosstalk between HDAC5 and LSD1 as a new therapeutic target in TNBC. Our work addresses an important research area that has been understudied in invasive breast cancer. As epigenetic therapies are currently being clinically tested, our new strategy using a natural HDAC inhibitor and a novel LSD1 inhibitor has great potential to be rapidly translated into clinical trials. The information derived from our newly completed microarray study reported in the Huang progress report will likely identify a new panel of aberrantly silenced tumor suppressor genes targeted by HDAC5/LSD1 axis that has the potential to serve as a novel panel of biomarkers to predict response or resistance to epigenetic therapy in TNBC patients.

(b) What was the impact on other disciplines? Nothing to Report

(c) What was the impact on technology transfer? Nothing to Report

5. CHANGES/PROBLEMS

(a) Changes in approach and reasons for change

No major changes in approach have been made since the initiation of the award.

(b) Actual or anticipated problems or delays and actions or plans to resolve them

Nothing to Report

(c) Changes that had a significant impact on expenditures

Nothing to Report

(d) Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

The natural HDAC inhibitor sulforaphane and novel LSD1 inhibitor HCI-2509 have been added as new agents to study their ability in targeting HDAC5-LSD1 axis in breast cancer. We will obtain approval to extend our findings to human tissues.

6. PRODUCTS

(a) Publications, conference papers, and presentations

Cao C, Vasilatos S, Oesterreich S, Davidson NE, Huang Y. Functional crosstalk between histone deacetylase 5 (HDAC5) and lysine-specific demethylase 1 (LSD1) as a novel therapeutic target in triple-negative breast cancer cells. The 106th AACR Annual Meeting, Philadelphia PA, Cancer Res, Abstract#: 3838, 2015.

(b) Website(s) or other Internet site(s) Nothing to Report

(c) Technologies or techniques Nothing to Report

(d) Inventions, patent applications, and/or licenses Nothing to Report

(e) Other Products Nothing to Report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

a) Individuals have worked on the project

Name:	Nancy Davidson	Yi Huang	Chunyu Cao	Shauna Vasilatos
Project Role:	Co-PI	Co-PI	Postdoc Fellow	Technician
Researcher Identifier (e.g. ORCID ID):	N/A	N/A	N/A	N/A
Nearest person month worked:	1.2	3.6	6.0	9.0

Contribution to Project:	Oversaw IHC studies and animal experiments, and interpreted the results generated from <i>in vivo</i> studies	Designed and oversaw the studies to define in depth the basic mechanisms and biological consequences of the functional interplay between HDAC5/LSD1 in breast cancer	Studied molecular mechanisms by which LSD1 and HDAC interacted, and carried out animal study	Performed IHC and microarray studies, oversaw critical lab management activities
Funding Support:	CDMRP Breast Cancer Breakthrough Award and Breast Cancer Research Foundation	CDMRP Breast Cancer Breakthrough Award and Breast Cancer Research Foundation	CDMRP Breast Cancer Breakthrough Award	CDMRP Breast Cancer Breakthrough Award

b) Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Dr. Tiffany Katz completed her postdoctoral fellow training, and Dr. Chunyu Cao joined the laboratory carry out the studies.

c) What other organizations were involved as partners?

Nothing to Report

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS: Initiating PI, Dr. Yi Huang, will submit his annual report separately.

QUAD CHARTS: N/A

9. APPENDICES: updated curriculum vitae is attached

CURRICULUM VITAE
University of Pittsburgh
School of Medicine

BIOGRAPHICAL

Name: Nancy Ellen Davidson, MD

Business Address:

University of Pittsburgh Cancer Institute
University of Pittsburgh
UPMC Cancer Pavilion
5150 Centre Avenue, Suite 500
Pittsburgh, PA 15232

EDUCATION and TRAINING

UNDERGRADUATE:

1975 BA, Wellesley College, Wellesley, Massachusetts

GRADUATE:

1979 Harvard Medical School, Boston, Massachusetts

POSTGRADUATE:

1979-1980 Intern, Internal Medicine, Hospital of the University of Pennsylvania
Philadelphia, Pennsylvania

1980-1982 Resident, Internal Medicine, The Johns Hopkins Hospital
Baltimore, Maryland

1982-1985 Medical Staff Fellow, National Cancer Institute,
National Institutes of Health, Bethesda, Maryland

APPOINTMENTS and POSITIONS

ACADEMIC: (Institutional)

1985-1987 Guest Worker
Medical Breast Cancer Section, Medicine Branch, National Cancer Institute
Bethesda, Maryland

1985-1986 Research Assistant Professor of Pharmacology
Uniformed Services University of Health Sciences
Bethesda, Maryland

1986-1992 Assistant Professor of Oncology
The Johns Hopkins University School of Medicine
Baltimore, Maryland

1992-1999 Associate Professor of Oncology
The Johns Hopkins University School of Medicine
Baltimore, Maryland

1995-2009 Breast Cancer Research Chair of Oncology,
The Johns Hopkins University School of Medicine
Baltimore, Maryland

1999-2009 Professor of Oncology
The Johns Hopkins University School of Medicine
Baltimore, Maryland

1986-2009 Active Staff, Johns Hopkins Hospital
Baltimore, Maryland

1994-2009 Director, Breast Cancer Program
The Johns Hopkins Oncology Center
Baltimore, Maryland

1997-2009 Joint Appointment in Department of Biochemistry and Molecular Biology
The Johns Hopkins Bloomberg School of Public Health

2009- Adjunct Professor of Oncology, The Johns Hopkins University School of Medicine
Baltimore, Maryland

2009-2010 Chief, Division of Hematology/Oncology
University of Pittsburgh School of Medicine
Pittsburgh, PA

2009- Director, University of Pittsburgh Cancer Institute and UPMC CancerCenter
Professor of Medicine and Pharmacology and Chemical Biology
Associate Vice Chancellor for Cancer Research
Hillman Professor of Oncology
University of Pittsburgh, PA

2010- Professor, Clinical and Translational Science Institute

2013- Distinguished Professor of Medicine

CERTIFICATION AND LICENSURE

SPECIALTY CERTIFICATION:

<u>Certifying Board</u>	<u>Year</u>
National Board of Medical Examiners	1980
American Board of Internal Medicine	1982
Medical Oncology	1985
<u>Medical or other Professional Licensure:</u>	
State of Maryland	1982
Commonwealth of Pennsylvania	2009

MEMBERSHIPS IN PROFESSIONAL SCIENTIFIC SOCIETIES

SOCIETIES

1985-present

	American Society of Clinical Oncology
1992, 1998, 2002-3	Member, Program Committee
1992, 1993, 1998	Session Chairman
1992-1996	Member, Public Issues Committee
1992-1996	Member, Award Selection Committee
1994-1995	Chair, Award Selection Committee
1993-1994	Member, Ad hoc Technology Assessment Committee for Development of Growth Factor Clinical Practice Guidelines
1996- present	Co-Chair, Breast Cancer Follow-up Testing Guidelines Expert Panel
1997-1999	Member, Membership Committee
1996-1999	Member, Board of Directors
1999-2002	Member, Grants Selection Committee
1999-2004	Member, Task Force on Quality of Cancer Care
2004-2007	Member, Publications Committee
2005-2006	Chair, Publications Committee
2005-2006	Member, Translational Research Task Force
2006-2009	President-Elect, President, and Immediate Past President
2007-present	Member, Value in Cancer Care Task Force
2008-2009	Chair, Special Awards Selection Committee
2008-2009	Member, Translational Research Professorship Selection Committee
2013-2015	Government Relations Committee
2010-2014	By-laws Committee, Chair 2012-14

1988- present

	American Association for Cancer Research
1991, 1995, 1998, 2004, 2006, 2013	Session Chair
1993-1997	Member, Maryland Legislative Committee

2000-2001, 2002-2003	Member, Program Committee
2003-2004	Co-Chair, Program Committee
2001	Member, Clinical Cancer Research Committee
1998-1999, 2001-2003	Member, AACR-Richard and Hinda Rosenthal Foundation Award Selection Committee
2002-2005	Member, Board of Directors
2003-2004	Chair, Education Committee
2004-2005	Member, Grants Selection Committee
2004-2005	Member, Lifetime Achievement Award Selection Committee
2005-2006	Member, Landon Award Selection Committee
2008-2009	Chair, AACR-Breast Cancer Research Foundation Grants Selection Committee
2008-2009	Member, Landon Translational Award Selection Committee
2008	Co-Chair, Program Committee, 7 th Annual Frontiers in Cancer Prevention Research Conference
2010-2012	Member and Chair (2010-11), AACR Nominating Committee
2010-present	Member, Continuing Medical Education Committee, (Chair 2015-)
2012-2013	Member, Education Committee
2011-2014	Member, Program Committee, AACR-San Antonio Breast Cancer Symposium
2015-2018	President-Elect, President, and Immediate Past President
1987-present	Eastern Cooperative Oncology Group
1987-present	Member, Breast Cancer Core Committee
1992-1996	Chair, Breast Cancer Biology Committee
1992-1996	Co-Chair, Breast Cancer Committee
1997-2002	Chair - Breast Cancer Committee
2009-present	American College of Physicians
	Member
2010-present	Member, National Surgical Adjuvant Bowel and Breast Project
2010-2013	Member, Board of Directors, Association of American Cancer Institutes
2015-	Member, Association of American Physicians Council

HONORS

1974	Phi Beta Kappa
1975	Sigma X
1986-1987	American Society of Clinical Oncology Young Investigator Award
1987-1988	Susan Komen Foundation Award
1988-1991	American Cancer Society Clinical Oncology Career Development Award
1989-1990	Merck Clinician Scientist Award
1995-2009	Breast Cancer Research Chair in Oncology, Johns Hopkins

1998	ACS Research Award, American Cancer Society - Maryland Division
1999	Brinker International Award for Breast Cancer Research
2000	Wellesley College Alumnae Achievement Award
2001	William L. McGuire Memorial Lectureship, 24 th Annual San Antonio Breast Cancer Symposium
2003	Avon Foundation Medical Advancement Award
2007-8	President, American Society of Clinical Oncology
2008	7 th Rosalind E. Franklin Award for Women in Science, National Cancer Institute
2008	11 th American Association for Cancer Research-Women in Cancer Research Charlotte Friend Award
2009	Johns Hopkins University Alumni Association Distinguished Alumna Award
2010	American Society of Clinical Oncology Gianni Bonadonna Breast Cancer Award
2010	Association of American Physicians
2011	National Academy of Medicine (formerly the Institute of Medicine)
2012	Pennsylvania Breast Cancer Coalition Potamkin Award
2013	Distinguished Professor of Medicine, University of Pittsburgh.
2014	Thomson Reuters Highly Cited Researchers 2014
2015	The Johns Hopkins Women's Medical Alumnae Association Hall of Fame
2016	Fellow, American College of Physicians

Publications

Articles Published in Professional Journals

1. Kensler TW, Busby WF, Jr., Davidson NE, and Wogan GN. Aflatoxin inhibition of glucocorticoid binding capacity of rat liver nuclei. *Biochim. Biophys. Acta* 473:200-10, 1976. PMID 181075
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2. Davidson NE and Lippman ME. Stimulation of breast cancer with estrogens: how much clinical value? *Eur. J. Cancer Clin. Oncol.* 23:897-900, 1987
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5. Davidson NE. Hormone replacement therapy: Breast vs heart vs bone. *N. Engl. J. Med.* 332:1638-9, 1995
6. Davidson NE. and Yager JD. Pesticides and breast cancer: fact or fad? *J. Natl. Cancer Inst.* 89:17434, 1997
7. Nass SJ, Hahm HA and Davidson NE. Breast cancer biology blossoms in the clinic. *Nature Medicine.* 4:761, 1998
8. Davidson NE. Combined endocrine therapy for breast cancer - new life for an old idea? *J. Natl. Cancer Inst.* 92:859-60, 2000
9. Davidson NE and Levine ME. Breast cancer consensus meetings: vive la difference? *J Clin Oncol.* 20:1719-20, 2002
10. Davidson NE and Helzlsouer KJ. Good news about oral contraceptives. *N. Engl. J. Med.* 346:2078-9, 2002
11. Park BH and Davidson NE. Estrogen receptor status, cell cycling and paclitaxel looking for a "hormone"-ious explanation. *Cancer Biology & Therapy* 3:468-9, 2004

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14. Davidson NE and Sukumar S. Of Snail, mice and women. *Cancer Cell.* 8:173-4, 2005
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18. Visvanathan K, Sukumar S and Davidson, NE Epigenetic biomarkers and breast cancer: cause for optimism, *Clinical Cancer Research* 12:6591-92, 2006
19. Stebbing J, Stearns V, and Davidson NE. Role of CYP2D6 testing in selection of endocrine therapy for breast cancer. *Pharmacogenomics.* 8:1-3, 2007
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35. Davidson NE, Rimm DL. Expertise vs evidence in assessment of breast biopsies: an atypical science. JAMA 17:313(11):1109-10, 2015. PMID 25781438

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2. Davidson NE. Hormone replacement therapy in perspective; Medical and Health Annual, Encyclopedia Britannica, Inc., Chicago, IL pp. 361-6, 1997.

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2. Davidson NE. The Breast: Comprehensive Management of Benign and Malignant Diseases. J. Natl. Cancer Inst. 84:806, 1992.
3. Davidson NE. Diseases of the Breast. J Natl Cancer Inst. 89:85, 1997.
4. Davidson NE. Emperor of All Maladies: A Biography of Cancer. Lancet 377:801, 2011.

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The Breast Comprehensive Management of Benign and Malignant Disease (Second edition), Edited by Bland KI, Copeland EM, III, Davidson NE, Mendenhall NP, Page DL, and Wilkinson EJ. W.B. Saunders Company, Philadelphia, PA, 1998.

The Breast Comprehensive Management of Benign and Malignant Disorders (Third edition) Edited by Bland KI, Copeland, III, EM, Davidson NE, Page DL, Recht A, and Unst MM. Saunders, Philadelphia, PA, 2004.

Book Chapters

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3. Davidson NE and Lippman ME. Treatment of metastatic breast cancer. In Diagnosis and Management of Breast Cancer, Lippman, ME, Lichter, AS, and Danforth, DN (eds). W.B. Saunders and Co., Philadelphia, 1988, pp 375-406.
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7. Davidson NE and Abeloff MD. Adjuvant chemotherapy for axillary lymph node-positive breast cancer. In: *Adjuvant Therapy of Breast Cancer*. Ed by Henderson, IC, Kluwer Academic Publishers, Norwell, MA, 1992, pp 115-145.
8. Kensler TW, Davidson NE, Egner PA, Guyton KZ, Groopman JD, Curphy TJ, Liu Y-L and Roebuck BD. Chemoprotection against aflatoxin-induced hepatocarcinogenesis by dithiolethiones, In: *Mycotoxins, Cancer, and Health*. Ed by Bray, G. and Ryan, D. LSU Press, Baton Rouge, LA, 1991, pp 238-252.
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11. Davidson NE. Breast cancer - molecular approaches and cell kinetics in assessing risk, In: *Current Therapy in Oncology*, Ed. by Niederhuber J, BC Decker Inc., Philadelphia, 1993, pp 304-308.
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13. Davidson NE and Kennedy JM. Protein kinase C and breast cancer. In: *Mammary Tumor Cell Cycle, Differentiation and Metastasis*. Eds by Dickson RB and Lippman ME, Kluwer Academic Publishers, Boston, 1996, pp 91-105.
14. McCloskey DE, Armstrong DK, Jackisch C and Davidson NE. Programmed cell death in human breast cancer cells. In: *Recent Progress in Hormone Research*, Vol 51, Ed. by Conn, PM. The Endocrine Society, Baltimore, MD, 1996, pp 493-508.
15. Couzi RJ and Davidson NE. Breast cancer. In: *Women's Health in Primary Care*, Ed. by Rosenfeld JA, Williams & Wilkins, Baltimore, MD, 1996, pp 683-702.
16. Denmeade SR, McCloskey DE, Joseph IBJK, Hahm HA, Isaacs JT and Davidson NE. Apoptosis in hormone - responsive malignancies. In: *Advances in Pharmacology*, Ed. By Kaufmann, S.H., Academic Press, Inc., San Diego, 1997, pp 553-583.
17. Ferguson AT, Lapidus RG and Davidson NE. The regulation of estrogen receptor expression and function in breast cancer. In: *Biological and Hormonal Therapies of*

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18. Davidson NE. Treatment of breast cancer with autologous bone marrow transplantation. In: Current Surgical Therapy, Ed. by Cameron, J.L. Mosby, Inc., St. Louis, 1998, pp 640-643.
 19. Davidson NE and Kennedy MJ. Dose-intensive chemotherapy for breast cancer. In: Diseases of the Breast Updates, Ed. by Harris, J.R. and Lippman, M.E. Lippincott-Raven, 1998, vol. 2, No. 3, pp 1-10.
 20. Davidson NE and Valagussa P. Summary. In: Adjuvant Therapy of Primary Breast Cancer VI, Ed by Senn H-J, Gelber R, Goldhirsch A and Thurliman B. Springer-Verlag, Berlin, 1998, pp 368-370.
 21. Davidson NE, Hahm HA and Armstrong DK. Apoptosis and breast cancer. In: Cancer Chemotherapy and Apoptosis, Ed. by Hickman, J.A. and Dive, C., Humana Press, 1999, pp 291-303.
 22. Davidson NE. Breast Cancer. In: Scientific American Medicine, Ed. by Dale DC and Federman, DD, Scientific American, Inc., New York City, 1999, 12 ONCO VII 1-13.
 23. Wolff AC, Lange JR and Davidson NE. Occult primary cancer with axillary node metastasis. In: Advanced Therapy of Breast Disease Ed. by Singletary, S.E. and Robb, G.L. BC Decker Inc., 2000, pp 191-195.
 24. Emens LA, Davidson NE. Postoperative Endocrine Therapy in Invasive Breast Cancer, Steven T Rosen MD Series Editor. In: Cancer Treatment and Research, Ed by Monica Castiglione, Martine J. Piccart. Springer, 2009 pp 139-161.
 25. Davidson NE, Kennedy MJ and Armstrong DK. Dose-intensive chemotherapy. In: Diseases of the Breast, Ed. by Harris JR, Lippman ME, Morrow M and Osborne CK. Lippincott Williams & Wilkins, Philadelphia. 2000, pp 633-644.
 26. Kensler TW, Davidson NE, Groopman JD and Muñoz A. Biomarkers and surrogacy: relevance to chemoprevention. In: Biomarkers in Cancer Chemoprevention. Ed. by Miller AB, Bartsch H, Boffetta P, Dragsted L and Vainio H. IARC Scientific, International Agency for Research on Cancer. Lyon, 2001, pp 27-47.
 27. Brewster A and Davidson N. Breast cancer screening. In: Handbook of Women's Health: An evidence-based approach. Ed. By Rosenfeld, J.A. Cambridge University Press, N.Y., N.Y., 2001, pp 383-398.
 28. Wolff AC, Stearns V and Davidson NE. Adjuvant systemic therapy of breast cancer. In: The Breast Comprehensive Management of Benign and Malignant Disorders. Ed. By Bland KI, Copeland III EM, Davidson NE, Page DL, Recht A, and Unst MM. Saunders, Philadelphia, PA, 2004, pp 1189-1232.
 29. Stearns V and Davidson NE. Adjuvant chemotherapy and chemoendocrine therapy for primary breast cancer. IN: Diseases of the Breast. Ed. By Harris JR, Lippman ME, Morrow M and Osborne CK. Lippincott Williams & Wilkins, Philadelphia, PA., 2004, pp 893-920.
 30. Davidson NE and Osborne CK. Adjuvant systemic therapy treatment guidelines. IN: Diseases of the Breast. Ed. By Harris JR, Lippman ME, Morrow M and Osborne CK. Lippincott, William & Wilkins, Philadelphia, PA., 2004, pp 945-950.

31. Carraway H and Davidson NE. Adjuvant hormonal therapy in premenopausal women. VII. Systemic management of stage I and II breast cancer. In: *Advanced Therapy of Breast Disease*. Second Edition. Ed. By Singletary, E., Robb, Hortobagyi, G. BC Decker Inc., Hamilton, Ontario, 2004, pp 451-458.
32. Davidson NE. Breast Cancer IN: *WebMD 12 VII Breast Cancer* 1-15, 2004.
33. Prowell T, Davidson N. Metastatic breast cancer: Tailored endocrine therapy for premenopausal women. IN: *Breast Cancer Management in the Era of Molecular Medicine—Towards Tailored Approaches*. Ed. By Piccart M, Wood W, Hung M-C, Solin L, Cardoso F. Springer-Verlag, in press.
34. Visvanathan K and Davidson NE. Adjuvant endocrine therapy: controversies and perspectives. IN: *Textbook of Breast Cancer: A Clinical Guide to Therapy*, Third Edition. Ed. By Bonadonna G, Hortobagyi GN, Valagussa P. Taylor & Francis Group, 2006, pp 205-223.
35. Huang Y and Davidson NE. Breast cancer. IN: *Principles of Molecular Medicine*, Second Edition. Ed. By Runge, M.S. and Patterson, C. Humana Press, Inc., 2006, pp 728-735.
36. Stearns V, Zhou Q, and Davidson NE. Epigenetic regulation as a new target for breast cancer therapy. IN: *Breast Cancer: Translational Therapeutic Strategies*. Ed. by Lyman GH, Burstein H. Informa Healthcare USA, Inc. New York City, 2007, pp 285-295.
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38. Bao T and Davidson NE. Gene expression profiling of breast cancer. IN *Advances in Surgery* Volume 42 Ed. by Cameron JL, 2008, pp 249-60.
39. Stearns V, Davidson NE. Adjuvant Systemic Therapy: Chemoendocrine IN: *Diseases of the Breast*. Ed. by Harris JR, Lippman ME, Morrow M and Osborne CK. Lippincott, Williams & Wilkins, Philadelphia, PA 2009, pp 645-656.
40. Davidson NE, Winer EP, Osborne CK. Guidelines for Adjuvant Systemic Therapy IN: *Diseases of the Breast*. Ed. By Harris JR, Lippman ME, Morrow M and Osborne CK Lippincott, William & Wilkins, Philadelphia, PA., 2009, pp 711-713.
41. Emens LA, Davidson NE, Postoperative Endocrine Therapy for Invasive Breast Cancer IN: *Adjuvant Therapy for Breast Cancer*. Ed by Castiglione M, Piccart MJ. Springer, 2009, pp 139-161.
42. Reeder, JG, Lembersky BC, Davidson NE. Advances in Adjuvant and Neoadjuvant Therapy for Breast Cancer. IN: *Current Surgical Therapy 10th Edition*, Ed. by Cameron JL, Cameron AM. Elsevier Saunders, 2011, pp 547-552.
43. Davidson, NE. Breast Cancer and Benign Breast Disorders IN: *Goldman's Cecil Medicine 24th Edition*. Ed. by Goldman L, Schafer AI. , Elsevier Saunders, 2012, pp 1309-1316.
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45. Wolff AC, Domchek SM, Davidson NE, Sacchini V, McCormick. Cancer of the Breast. IN: *Abeloff's Clinical Oncology*, 5th Edition. Ed. by Niederhuber JE, Armitage JO,

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46. Stearns V, Davidson NE. Adjuvant Systemic Therapy: Chemoendocrine IN: Diseases of the Breast 5th Edition. Ed. by Harris JR, Lippman ME, Morrow M and Osborne CK, Lippincott Williams & Wilkins, 2014. pp 649-666.
 47. Multiple authors including Davidson NE. The Health Consequences of Smoking—50 Years of Progress. A Report of the Surgeon General. US Department of Health and Human Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014, pp 1-943.
 48. Jankowitz RC, Davidson NE. Breast Cancer IN: Hematology-Oncology Therapy – Second Edition, Ed. by Boyiadzis MM, Frame JN, Kohler DR, Fojo T, McGraw Hill Education, 2014, pp 88-190.
 49. Lee AV, Oesterreich S, Davidson NE. The Molecular Biology of Breast Cancer. IN: The Molecular Basis of Cancer 4th Edition. Ed. by Mendelsohn J, Gray JW, Howley PM, Israel MA, Thompson CB, Elsevier Saunders, 2015, pp 523-30.

Professional activities

TEACHING:

1988-2005	Lecturer, Pathophysiology Course for 2 nd Year Medical Students
1991	Medical Student Advisor
1996-2009	Lecturer, Fundamentals of Clinical Oncology for Public Health Practitioners
1997-2009	Lecturer, Topics in Molecular Endocrinology, School of Public Health
2004-2009	Lecturer, Pathophysiology of Disease, Cellular and Molecular Medicine
2009-present	Lecturer, Cancer Biology and Therapy

Mentoring

<u>Postdoctoral Fellows – Laboratory</u>	<u>Current Position</u>
1988-1990 M. John Kennedy, MD	Consultant, St. James Hospital, Dublin, Ireland
1989-1992 Deborah K. Armstrong, MD	Professor of Oncology, Johns Hopkins
1991-1993 Yvonne L. Ottaviano, MD	Private Practice, Baltimore, MD
1993-1996 Diane McCloskey, PhD	Associate Professor of Cellular & Molecular Physiology, Penn State, Hershey, PA
1993-1997 Rena Lapidus, PhD	Assistant Professor, University of Maryland
1993-1998 Anne Ferguson, PhD	Non-profits, San Francisco, CA
1994-1995 Christian Jackisch, MD	Chief, Clinic for Gynecology and Obstetrics, Klinikum Offenbach, Offenbach, Germany
1996-1999 Hillary Hahm, MD, PhD	Private Practice, Atlanta, GA
1997-1999 Sharyl Nass, PhD	Policy Analyst, Institute of Medicine, Washington, DC
1998-2001 Xiaowei Yang, MD, PhD	Staff Scientist, National Cancer Institute
1999-2001 Valerie Dunn, MD	Private Practice, Rochester, NY

2000-2001	Lan Yan, MD, PhD	Staff Scientist, Amgen, Thousand Oaks, CA
2001-2006	Yi Huang, MD, PhD	Assistant Professor, University of Pittsburgh, Pittsburgh, PA
2001-2004	Judith C. Keen, PhD	National Breast Cancer Coalition, Washington DC
2002-2003	Dipali Sharma, PhD	Associate Professor of Oncology, Johns Hopkins University School of Medicine, Baltimore, MD
2004-2006	Qun Zhou, MD, PhD	Associate Professor of Biochemistry and Molecular Biology, University of Maryland Medical School
2005-2006	Allison Tracy, PhD	Lecturer of Chemistry and Biochemistry, UMBC
2006-2009	Qingsong Zhu, PhD	Chief Operating Officer, In Silico Medicine, Inc.
2006-2009	Madhavi Billam, PhD	Senior Toxicologist, L'Oreal USA & RI
2011-2013	Tiffany Katz, PhD	Postdoctoral Associate, University of Pittsburgh
2014-present	Nilgun Tasdemir, PhD	Postdoctoral Fellow, University of Pittsburgh

Doctoral Students

2000-2005	Julie Blum, PhD	Clinical Content Manager, MED-IQ
2001-2005	Allison Pledge, PhD	Senior Lecturer in Chemistry and Biochemistry at University of Maryland Baltimore County (UMBC)
2004-2010	Abigail Witt, PhD	Postdoctoral Fellow, University of Miami School of Medicine
2005-2010	Talmesha Richards, PhD	Chief Academic and Diversity Officer at STEMconnector
2006-2010	Patrick Shaw, PhD	Chief, Pathogen Detection Lab. USA Public Health Command Region-Pacific Camp Zama, Japan

Graduate Training Programs

1997-2011	Biochemistry and Molecular Biology, Hopkins Bloomberg School of Public Health (adjunct 2009-2011)
1999-2013	Cellular and Molecular Medicine, Hopkins School of Medicine (adjunct 2009-2013)

RESEARCH:

1. CURRENT GRANT SUPPORT:

Grants Awarded as Principal Investigator

2009-	NIH P30CA047904. Cancer Center Support Grant
1998-	Breast Cancer Research Foundation
2009-2016	TBCRC Translational Breast Cancer Research Consortium and the Komen Foundation.
2009-2016	TBCRC Translational Breast Cancer Research Consortium and the Avon Foundation.
2010-2016	North American Breast Cancer Group/Breast International Group Collaboration and the Breast Cancer Research Foundation

2014-2017 Department of Defense, W81XWH-14-1-0238, Targeting Histone Abnormality in Triple-Negative Breast Cancer

1a. PRIOR GRANT SUPPORT

Grants Awarded as Principal Investigator

1986-1987 American Society of Clinical Oncology Young Investigator Award, "Isolation of estrogen-induced genes from human breast cancer."
1987-1988 American Cancer Society Institutional Grant, "The relationship between epidermal growth factor receptor and estrogen receptor in breast cancer."
1987-1989 American Cancer Society Maryland Division. "The role of epidermal growth factor and its receptor in breast cancer."
1987-1988 Susan G. Komen Foundation. "The role of epidermal growth factor and its receptor in human breast cancer."
1988-1991 American Cancer Society Clinical Oncology Career Development Award.
1989-1995 NIH Grant R29 CA 49634. "Epidermal growth factor receptor in human breast cancer."
1989-1990 Phil N. Allen Charitable Trust Grant. "Novel approaches to hormone-unresponsive breast cancers."
1989-1990 Merck Clinician Scientist Award, Johns Hopkins University School of Medicine.
1990-1991 Johns Hopkins University School of Medicine Institutional Research Grant, "Elimination of breast cancer cells from human bone marrow by counterflow centrifugal elutriation".
1991-1993 Susan G. Komen Breast Cancer Foundation Fellowship.
1991-1992 Mildred Mindell Cancer Foundation, Inc. "Incidence of p53 mutations in the germ-line of young women with breast cancer".
1992-1994 NIH Grant R01 CA57545. "Programmed cell death in human breast cancer cells"
1992-1994 NIH Grant P30 CA06973 pilot. "DNA methylation and estrogen receptor expression in human breast cancer cells"
1995-1997 Susan G. Komen Breast Cancer Foundation Fellowship.
1994-1998 NIH Grant R21 CA/ES 66204 "Development of a breast cancer program at Johns Hopkins".
1994-1995 NIH Grant 5P50 CA-58236 pilot. "Effects of polyamine analogues on growth of human prostatic cancer cells"
1995-1999 NIH Grant 1 U01 CA66084. "New therapeutic approaches for breast cancer".
1995-1998 American Cancer Society BE-237 "Methylation of steroid receptors in human breast cancer".
1996-1997 Susan G. Komen Foundation, "Functional significance of DNA methylation of estrogen receptor in breast cancer."
1998-2004 NIH Grant R01 CA78352 "DNA methylation as a determinant of hormone resistant breast cancer."
1999-2003 DOD-USAMRDC DAMD 17-99-1-9242. "Therapeutic and chemopreventive actions of a novel polyamine analog against breast cancer"
1998-1999 NIH Grant P50 pilot. "Activity of a novel polyamine analog against breast cancer"

- 2001-2009 Avon Foundation
 2001-2005 Susan G. Komen Foundation Postdoctoral Fellowship
 2003-2005 Susan G. Komen Foundation Predoctoral Fellowship
 2000-2009 American Breast Cancer Foundation
 2006-2008 Susan G. Komen Foundation, BCTR 65706, “Polyamine analogues as novel anti-estrogen receptor alpha agents
 2007-2009 Lee Jeans Translational Breast Cancer Research Program (with Entertainment Industry Foundation)
 2008-2011 Susan G. Komen for the Cure, KG080923, Inhibition of lysine specific demethylase 1 (LSD1) as a strategy for re-expression of epigenetically silenced genes in breast cancer Robert Casero, Jr. and Nancy E. Davidson (Co-PIs)
 2000-2013 NIH P50 CA88843. SPORE in Breast Cancer (co-PI of University of Pittsburgh site 2009-2012)
 2011-2013 Gynecologic Center of Excellence. Henry M. Jackson Foundation
 2009-2013 Stand up to Cancer (AACR). Bringing epigenetic therapy to the forefront of cancer. (Dream Team Principal with Stephen Baylin and Peter Jones)

2. Seminars and Invited Lectureships

Invited Seminars

- 1985 Grand Rounds, Washington Veterans Administration Hospital, Washington, DC
 1986 Medical Grand Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 Symposium on Breast Cancer, Millville Hospital, Vineland, NJ
 Department of Hematology-Oncology, University of Missouri, Kansas City, MO
 Kansas City Round Table of Hematology/Oncology, Kansas City, MO
 American Association of Osteopathic Internists, Washington, DC
 Cincinnati Cancer Conference V, Cincinnati, OH
 Advances in Oncology, Cherry Hill, NJ
 1987 13th Annual Symposium on Diagnosis and Treatment of Neoplastic Disorders Course, Johns Hopkins Medical Institutions, MD
 Breast Cancer Session, Eastern Cooperative Oncology Group, Clearwater, FL
 1988 Early Breast Cancer Conference, Memorial Hospital, Colorado Springs, CO
 Grand Rounds, Liberty Medical Center, Baltimore, MD
 Medical Grand Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 Annual Hematology/Oncology Conference, The Medical Center of Delaware, Wilmington, DE
 Department of Medicine Professors Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 Medical Residents Journal Club, Johns Hopkins Medical Institutions, Baltimore, MD
 Plastic Surgery Grand Rounds, Johns Hopkins Medical Institutions, Baltimore, MD

- 1989 Department of Medicine Bench to Bedside, Johns Hopkins Medical Institutions, Baltimore, MD
 Twelfth Annual Symposium on Current Concepts in Medicine and Surgery, Peninsula General Hospital, Salisbury, MD
 Topics in Internal Medicine Course, Johns Hopkins Medical Institutions, Baltimore, MD
 15th Annual Symposium on Diagnosis and Treatment of Neoplastic Disorders, Johns Hopkins Medical Institutions, Baltimore, MD
 Eleventh Annual Cancer Symposium Selected Topics in Oncology, Raleigh, NC
 Plastic Surgery Grand Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 St. George's Society, Johns Hopkins Medical Institutions, Baltimore, MD
 Hematology-Oncology Division Seminar, Indiana University School of Medicine, Indianapolis, IN
- 1990 Grand Rounds, St. Agnes Hospital, Baltimore, MD
 Department of Medicine Bench to Bedside, Johns Hopkins Medical Institutions, Baltimore, MD
 American Cancer Society, Maryland Division, Baltimore, MD
 Medical Grand Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 16th Annual Symposium on Diagnosis and Treatment of Neoplastic Disorders, Johns Hopkins Medical Institutions, Baltimore, MD
 NCI Strategy Meeting on High Dose Chemotherapy in Breast Cancer, National Cancer Institute, Bethesda, MD
 Hematology-Oncology Division Seminar, University of Maryland School of Medicine, Baltimore, MD
- 1991 Hematology-Oncology Conference, Chester Hospital, West Chester, PA
 Department of Medicine Professors Rounds, Johns Hopkins Medical Institutions, Baltimore, MD
 Symposium on Early Breast Cancer, Montgomery General Hospital, Olney, MD
 Hematology-Oncology Division Seminar, Northwestern University School of Medicine, Chicago, IL
 Pennsylvania Oncology Society, Gettysburg, PA
 Susan G. Komen Foundation Scientific Symposium, University of Texas - Southwestern Medical School. Dallas, TX
- 1992 Breast Cancer Symposium, Crozer-Chester Hospital, Upland, PA
 Hematology-Oncology Grand Rounds, University of Maryland School of Medicine, Baltimore, MD
 Department of Medicine Ambulatory Care Rounds, Johns Hopkins Medical Institutes, Baltimore, MD
 Staff Conference, Roswell Park Cancer Institute, Buffalo, NY
 Tumor Board, Anne Arundel Hospital, Annapolis, MD
 18th Annual Symposium on the Diagnosis and Treatment of Neoplastic Disorders, Johns

- Hopkins Medical Institutions, Baltimore, MD
 American Cancer Society, Teaneck, NJ
 Australia - New Zealand Breast Cancer Trials Group, Surfers Paradise, Australia
 Laboratory of Biologic Chemistry, National Cancer Institute, Bethesda, MD
 Lederle Advisory Board, New York City, NY
 Gordon Conference on Cancer, Newport, RI
 American Society of Clinical Pathologists, Las Vegas, NV
 The Cancer Center at Fairfax Hospital, Fairfax, VA
 American Fertility Society, New Orleans, LA
 Visiting Professor, Department of Medicine, Hahnemann University School of Medicine,
 Philadelphia, PA
- 1993 NCI Strategy Meeting on Breast Cancer in Young Women, National Institutes of Health,
 Bethesda, MD
 St. Georges Society, University of Maryland School of Medicine, Baltimore, MD
 US-Japanese Joint Scientific Meeting on New Breast Cancer Therapies, Oakland, CA
 Isaac Lewin Symposium, Baystate Medical Center, Springfield MA
 Discussant, Adjuvant Breast Cancer Session, American Society of Clinical Oncology,
 Orlando, FL
 Educational Session, National Cancer Institute Phase I Meeting, Bethesda, MD
 Working Group on the Pulmonary Complications Associated with Breast Cancer
 Therapy, National Heart, Lung, and Blood Institute, National Institutes of Health,
 Bethesda, MD
 Shanghai Cancer Institute, Shanghai, Peoples Republic of China
 Ethics and Politics in Clinical Trials, Johns Hopkins Medical Institutions, Baltimore, MD
 NCI Workshop on Prognostic and Predictive Factors in Breast Cancer, Bethesda, MD
- 1994 Hematology/Oncology Grand Rounds, Wayne State University School of Medicine,
 Detroit, MI
 Clinical Oncology Program Grand Rounds, National Cancer Institute, Bethesda, MD
 NCI Strategy Meeting on High Dose Chemotherapy for Breast Cancer, Bethesda, MD
 11th Annual Advances in Cancer Treatment Research, Albert Einstein College of
 Medicine, New York City, NY
 Recent Advances in the Biology of Breast, Colon, and Lung Cancer, American Society of
 Clinical Oncology, Dallas, TX
 Discussant, Plenary Session, American Society of Clinical Oncology, Dallas, TX
 Women's Health Seminar Series, Breast Cancer, National Institutes of Health,
 Bethesda, MD
 Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
 The State of Breast Cancer 1994: An Interactive Symposium, University of California at
 San Francisco, San Francisco, CA
 Grand Rounds, Washington County Hospital, Hagerstown, MD
 Y-ME of the Cumberland Valley, Hagerstown, MD

- 1995 Department of Pharmacology and Toxicology, Robert C. Byrd Health Sciences Center of West Virginia University, Morgantown, WV
 12th Annual International Breast Cancer Conference, Miami, FL
 Controversy Session, American Association for Cancer Research, Toronto, Canada
 Department of Pharmacology, Mayo Clinic, Rochester, MN
 Susan G. Komen Foundation Congressional Breakfast, Washington, DC
 Commonwealth of Massachusetts Course on Breast Cancer, Boston, MA
 Law and Health Care Program, University of Maryland and Baltimore School of Law, Baltimore, MD
 Discussant, Breast Cancer Session, American Society of Clinical Oncology, Los Angeles, CA
 Topics in Clinical Medicine, Johns Hopkins University School of Medicine, Baltimore, MD
 Gordon Research Conference on Mammary Gland Biology, New London, NH
 The Endocrine Society's 51st Conference on Recent Progress in Hormone Research, Stevenson, WA
 Eighteenth Thomas W. Green Memorial Lecture, East Tennessee State University James H. Quillen College of Medicine, Bristol, TN
 Fifth International Congress on Hormones and Cancer, Quebec City, Canada
 Cancer Medicine, Harvard Medical School, Boston, MA
 Medical Oncology Board Review, George Washington University School of Medicine, Washington, DC
 The First Annual Kimmel-Slavin Memorial Lecture, George Washington University School of Medicine, Washington, DC
 Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
 Meet the Professor, American Society of Clinical Oncology Fall Educational Conference, Washington, DC
 Grand Rounds, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD
 Division of Hematology/Oncology, Washington Hospital Center, Washington, DC
 18th Annual San Antonio Breast Cancer Symposium, San Antonio, TX
 Department of Medicine, St. Joseph Hospital, Baltimore, MD
 Dana-Farber Cancer Institute, Boston, MA
 22nd Annual Symposium on the Diagnosis and Treatment of Neoplastic Disorders, Johns Hopkins
- 1996 Department of Embryology, Carnegie Institute of Washington, Baltimore, MD
 Mayo Clinic Cancer Center, Rochester, MN
 New Approaches to Cancer Therapy, The Johns Hopkins Oncology Center, Baltimore, MD
 Topics in Clinical Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

University of Maryland Cancer Center, Baltimore, MD
 Discussant, Breast Cancer Session, American Society of Clinical Oncology, Philadelphia, PA
 Bowman Gray Comprehensive Cancer Center, Wake Forest University, Winston-Salem, N.C.
 American College of Surgeons, San Francisco, CA
 Session Chair, Gordon Conference on Cancer Chemotherapy, Oxford, UK
 Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
 City of Hope National Medical Center, Duarte, CA
 Upstate New York Cancer Research and Education Foundation, Syracuse, NY
 Wendy and Emery Reeves International Breast Cancer Symposium, University of Texas Southwestern
 Medical Center, Dallas, TX 30th Anniversary Symposium, National Institute of Environmental Health Sciences, Research Triangle, NC
 Meet the Professor, American Society of Clinical Oncology Fall Educational Conference, Phoenix, AZ
 Maryland Cancer Control Symposium, Baltimore, MD
 Lombardi Cancer Center, Georgetown University Medical Center, Washington, DC
 Department of Biochemistry, Johns Hopkins School of Hygiene and Public Health, Baltimore, MD

1997 Breast Cancer Think Tank 7, St. Lucia
 4th Annual Breast Cancer Symposium of the New York Metropolitan Breast Cancer Group, New York City, NY
 2nd Annual Multidisciplinary Symposium on Breast Disease, Amelia Island, FL
 University of Colorado Cancer Center, Denver, CO
 Cambridge Symposium, Genetic Approaches to Breast and Prostate Cancer, Lake Tahoe, CA
 St. George's Society, University of Maryland Medical School, Baltimore, MD
 Issues in the Treatment of Breast Cancer, Greater Baltimore Medical Center, Baltimore, MD
 University of Chicago Cancer Center, Chicago, IL
 Conjoint Clinic, Johns Hopkins University School of Medicine, Baltimore, MD
 Breast Cancer Tumor Panel, American Society of Clinical Oncology, Denver, CO
 Pittsburgh Cancer Institute, University of Pittsburgh Medical School, Pittsburgh, PA
 International Cancer Alliance, Washington, DC
 Perspectives in Breast Cancer, Emory University, Atlanta, GA
 US Public Health Services Office on Women's Health Healthy Women 2000, Washington, DC
 Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
 American College of Surgeons, Chicago, IL
 Susan G. Komen Foundation Breast Cancer Symposium, Dallas, TX

- Medical Oncology Board Review, George Washington University School of Medicine,
Washington, DC
- Case Western Reserve University/Ireland Cancer Center, Cleveland, OH
- Holy Cross Hospital, Silver Spring, MD
- Department of Medicine and Cancer Center, University of California at San Francisco,
San Francisco, CA
- American Society of Clinical Oncology Fall Education Conference, Orlando, FL
- 14th Annual American College of Physicians/Army Regional Meeting, Reston, VA
- Fallston Hospital, Fallston, MD
- 1998 Breast Cancer Think Tank 8, Tobago
- Session Co-Chair, 6th International Conference on Adjuvant Therapy of Primary Breast
Cancer, St. Gallen, Switzerland
- Controversy Session Chair, American Association for Cancer Research, New Orleans,
LA
- 24th Annual Symposium on Diagnosis and Treatment of Neoplastic Diseases, Johns
Hopkins Medical Institutions, Baltimore, MD
- Breast Cancer Symposium, Inova Fairfax Hospital, Fairfax, VA
- Discussant, Plenary Session, American Society of Clinical Oncology, Los Angeles, CA
- Department of Pathology, Vanderbilt School of Medicine, Nashville, TN
- Suburban Hospital, Bethesda, MD
- Department of Medicine, Columbia-Presbyterian Medical Center, New York City, NY
- Gordon Conference on Cancer, Newport, RI
- Current Topics in Breast Cancer Research III: Cell Death in Breast Cancer, Cambridge,
UK
- Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
- 2nd Annual Advances in Cancer Therapy, VCU/MCV, Richmond, VA
- Kent and Queen Anne's Hospital, Chestertown, MD
- Breast Cancer Awareness Month, The White House Washington, DC
- Medical Oncology Board Review, George Washington University School of Medicine,
Washington, DC
- 21st Annual San Antonio Breast Cancer Symposium, San Antonio, TX
- 1999 Breast Cancer Think Tank 9, St. Thomas, Virgin Islands
- Joint Cancer Conference of the Florida Universities, Orlando, FL
- Grand Rounds, Department of Medicine, Johns Hopkins Medical Institutions, Baltimore,
MD
- Congressionally Directed Medical Research Programs, Frederick, MD
- Topics in Internal Medicine, Department of Medicine, Johns Hopkins, Baltimore, MD
- American Society of Clinical Oncology, Atlanta, GA
- 1st Milan Breast Cancer Conference, Milan, Italy
- Johns Hopkins Singapore, Singapore
- Grand Rounds, Department of Surgery, Northwest Hospital, Baltimore, MD

- 6th Nottingham International Breast Cancer Conference, Nottingham, England
 Seeking Excellence in Breast Cancer Care: Best Practices in Diagnosis and Treatment,
 Johns Hopkins University School of Medicine, Baltimore, MD
 First Annual Lynn Sage Breast Cancer Symposium, Robert H. Lurie Comprehensive
 Cancer Center of Northwestern University, Chicago, IL
 Chemotherapy Symposium, Berlex Oncology Foundation, Leesburg, VA
 Cancer Medicine, Harvard Medical School, Boston, MA
 41st Annual Meeting of the American Society of Therapeutic and Radiation Oncology,
 San Antonio, TX
 SERMs - Implication for Prevention and Treatment of Cancer, Philadelphia, PA
 American Society of Clinical Oncology Fall Education Conference, San Francisco, CA
 Genetics Program, University of Missouri, Columbia, MO
 22nd Annual San Antonio Breast Cancer Symposium, San Antonio, TX
- 2000 Sibley Hospital, Washington, DC
 Franklin Square Hospital, Baltimore, MD
 Molecular Biology of Breast Cancer, Lillehammer, Norway
 Keystone Symposium in Advances in Human Breast and Prostate Cancer, Lake Tahoe,
 NV
 NIH Workshop on Selective Estrogen Receptor Modulators (SERMs), Bethesda, MD
 Topics in Internal Medicine, Johns Hopkins University School of Medicine, Baltimore,
 MD
 National Breast Cancer Coalition Eighteenth Annual Advocacy Training Conference
 2nd Milan Breast Cancer Conference, Milan, Italy
 Australia - New Zealand Breast Cancer Trials Group, Queenstown, New Zealand
 Suburban Hospital, Bethesda, MD
 15th Annual Excalibur Round Table, American Cancer Society, Baltimore, MD
 Susan G. Komen Breast Cancer Foundation National Symposium - Reaching for the
 Cure..... Making a Difference, Washington, DC
 WellStar Kennestone Hospital, Marietta, GA
 WellStar Cobb Hospital, Marietta, GA
 Hematology-Oncology Board Review, George Washington University School of
 Medicine, Arlington, VA
 Berlex Oncology Foundation Clinical Pharmacology of Anticancer Drugs, Leesburg, VA
 42nd Annual Meeting of the American Society of Therapeutic and Radiation Oncology,
 Boston, MA
 National Institutes of Health Consensus Development Conference on Adjuvant Therapy
 of Breast Cancer, Bethesda, MD
 Seeking Excellence in Breast Cancer Care, Johns Hopkins University School of Nursing
 and School of Medicine, Baltimore, MD
- 2001 Breast Cancer Think Tank 11, Punta Cana, Dominican Republic Potential Clinical
 Applications for GnRH Agonists, National Institutes of Health, Bethesda, MD

- 7th International Conference on Adjuvant Therapy of Primary Breast Cancer, St. Gallen, Switzerland
- 8th Annual Miami Breast Cancer Conference, Miami, FL
- Central Pennsylvania Oncology Group, Harrisburg, PA
- Mary E. Humphreys Biology Lecture, Mary Baldwin College, Staunton, VA
- Department of Medicine Grand Rounds, Johns Hopkins Bayview, Baltimore, MD
- Discussant, American Society of Clinical Oncology, San Francisco, CA
- Anne Arundel Medical Center, Annapolis, MD
- Lombardi Comprehensive Cancer Center, Georgetown University, Washington, DC
- Women's Malignancy Group, MD Anderson Cancer Center, Houston, TX
- 3rd Milan Breast Conference, Milan, Italy
- Gordon Conference on Polyamines, New London, CT
- Australian Society for Breast Diseases, Surfers Paradise, Australia (by video conference)
- White House/Komen Breast Cancer Summit, Washington, DC
- 3rd Annual Lynn Sage Breast Cancer Symposium, Northwestern University, Chicago, IL
- Hematology-Oncology Board Review, George Washington University School of Medicine, Arlington, VA
- Berlex Oncology Foundation Clinical Pharmacology of Anticancer Drugs, Leesburg, VA
- Tumor Board, Greater Baltimore Medical Center, Baltimore, MD
- Hematology Grand Rounds, Johns Hopkins, Baltimore, MD
- William L. McGuire Memorial Lecture, 24th Annual San Antonio Breast Cancer Symposium, San Antonio, TX
- 2002 Breast Cancer Symposium Think Tank 12, St. Maarten, The Netherlands Antilles
- Grand Rounds Department of Medicine, Johns Hopkins University, Baltimore, MD
- Current Trends in Breast Cancer, Philadelphia, PA
- 3rd European Breast Cancer Conference, Barcelona, Spain
- The Third North American Symposium on Skeletal Complications of Malignancy, National Institutes of Health, Bethesda, MD
- Educational Symposium, American Society for Clinical Oncology, Orlando, FL
- 4th Milan Breast Cancer Conference, Milan, Italy
- Second International Conference on Recent Advances and Future Directions in Endocrine Manipulation of Breast Cancer. Cambridge, MA
- Breast Cancer: Current Controversies and New Horizons, Dana Farber Cancer Institute, Boston, MA
- Center for Cancer Research Grand Rounds, National Cancer Institute, Bethesda, MD
- 2nd Annual Karmanos Cancer Institute Breast Cancer Symposium, Detroit, MI
- Era of Hope, Department of Defense Breast Cancer Research Program, Orlando, FL
- Fox Chase Cancer Center, Philadelphia, PA
- IX Congresso Nacional de Oncologia, Lisbon, Portugal
- 2003 NCI – Hopkins Workshop on Clinical Translation of Gene Re-expression in Cancer, Baltimore, MD

Breast Cancer Think Tank 13, Aruba
20th Annual Miami Breast Cancer Conference, Miami, FL
8th International Conference on Primary Therapy of Early Breast Cancer, St. Gallen,
Switzerland
American Society for Breast Disease, Dallas, TX
Upper Chesapeake Medical Center, Fallston, MD
American Society of Clinical Oncology, Chicago, IL
Gordon Conference on Cancer Chemotherapy, Oxford, UK
National Cancer Institute Workshop on Ductal Lavage, Bethesda, MD
9th Annual Perspectives in Breast Cancer, Boston, MA
Cancer Education Consortium Clinical Pharmacology of Anticancer Agents, Leesburg,
VA
Indiana University Cancer Center, Indianapolis, IN
4th Annual Hampton Roads Fall Cancer Conference, Portsmouth, VA
Friends of Cancer Research, Woodrow Wilson International Center for Scholars,
Washington, DC
Astrazeneca Breast Cancer Symposium, Waltham, MA

2004 Breast Cancer Think Tank 14, St Kitts
Translational Conference, Johns Hopkins Oncology Center, Baltimore, MD
Current Trends in Breast Cancer: Updates from the 2003 San Antonio Breast Cancer
Symposium, Washington, DC
Breast Cancer—Bench to Bedside, Loyola University, Chicago, IL
Massachusetts General Hospital, Boston, MA
4th European Breast Cancer Conference, Hamburg, Germany
American Association for Cancer Research, Orlando, FL
The Philip A. Tumulty Topics in Clinical Medicine at Johns Hopkins, Baltimore, MD
Medical Grand Rounds, University of Florida—Shands Medical School, Gainesville, FL
Henry Lemon Memorial Lecture, University of Nebraska—Eppley Cancer Center,
Omaha, NE
Discussant, Best of Oncology Symposium, American Society of Clinical Oncology,
New Orleans, LA
6th Milan Breast Cancer Symposium, Milan, Italy
Gordon Conference on Molecular Therapeutics of Cancer, New London, NH
7th Annual Mission Conference of the Susan G. Komen Breast Cancer Foundation,
Washington, DC
George Washington University Hematology-Oncology Board Review Course,
Alexandria, VA
Cancer Education Consortium Clinical Pharmacology of Anticancer Agents, Leesburg,
VA
6th Lynn Sage Breast Cancer Symposium of Northwestern University, Chicago, IL
Alta Bates Summit Medical Center, Berkeley, CA
Association of Northern California Oncologists, San Francisco, CA

- 4th American Association for Cancer Research Prevention Meeting, Seattle, WA
 Project LEAD, National Breast Cancer Coalition, Washington, DC
 Mayo Clinic Oncology Society, Rochester, MN
 Department of Molecular Pharmacology and Experimental Therapeutics, Mayo Clinic,
 Rochester, MN
 Career Day, Baltimore Polytechnic Institute, Baltimore, MD
 2nd Breast Cancer Inter-SPORE Meeting, Chapel Hill, NC
 27th Annual San Antonio Breast Cancer Symposium, San Antonio, TX
- 2005 Greenebaum Cancer Center, University of Maryland Medical School, Baltimore, MD
 Breast Cancer Think Tank 15, Curacao
 22nd Miami Breast Cancer Symposium, Miami, FL
 Lorne Cancer Conference, Phillip Island, Australia
 Delaware Oncology Society, Wilmington, DE
 New Strategies in Breast Cancer Conference, Philadelphia, PA
 Educational Symposium, American Society of Clinical Oncology, Orlando, FL
 Highlights of the Day Symposium, American Society of Clinical Oncology, Orlando, FL
 National Breast Cancer Coalition Fund Annual Advocacy Conference, Washington, DC
 Third International Symposium on the Molecular Biology of Breast Cancer, Molde,
 Norway
 Breast Cancer: Current Controversies and New Horizons, Harvard Medical School,
 Boston, MA
 New England Journal of Medicine Clinical Pathologic Conference, Harvard Medical
 School, Boston, MA
 Hematology-Oncology Board Review, George Washington University Medical Center,
 Washington, DC
 Frances Bull Lecture, University of Michigan, Ann Arbor, MI
 University of Minnesota Cancer Center, Minneapolis, MN
 50th Anniversary Avon Foundation Symposium, New York City, NY
 Cancer Education Consortium Clinical Pharmacology of Anticancer Agents, Leesburg,
 VA
 100 Women Professors Symposium, Johns Hopkins, Baltimore, MD
 Working Group on Translational Epigenetics in Cancer, National Cancer Institute,
 Bethesda, MD
- 2006 Mayo Clinic, Rochester, MD
 Helen Padykula Lecture, Wellesley College, Wellesley, MA
 Lynne Abraham Symposium, Susan G. Komen Foundation, New York City, NY
 Third Current Concepts in the Multidisciplinary Management of Breast Cancer, Johns
 Hopkins, Baltimore, DC
 Forum on Breast Cancer Prevention. American Association of Cancer Research,
 Washington, DC
 Vth Santiago Breast Cancer Symposium, Santiago, Chile

- 8th Milan Breast Cancer Symposium, Milan, Italy
 International Union Against Cancer (UICC) World Cancer Congress, Washington, DC
 8th Lynn Sage Breast Cancer Symposium, Chicago, IL
 Hematology-Oncology Board Review, George Washington University Medical Center,
 Washington, DC
 Cancer Education Consortium Clinical Pharmacology of Anti-Cancer Agents, Leesburg,
 VA
 44th Meeting of the Japan Society of Clinical Oncology, Tokyo, Japan
 National Comprehensive Cancer Network Adjuvant Therapy in Breast Cancer
 Symposium, Baltimore, MD
 Women's Board, Johns Hopkins Hospital, Baltimore, MD
 National Cancer Institute-Ft. Detrick Distinguished Scientist Seminar, Frederick, MD
 Science Lecture Series 2006-7 Radcliffe Institute for Advanced Study, Cambridge, MA
- 2007 Johns Hopkins Workshop on Clinical Targeting of Epigenetic Changes in Cancer
 Treatment, Phoenix, Arizona
 24th Annual Miami Breast Cancer Conference, Miami, FL
 6th Annual Mid-Atlantic Oncology Update, St Agnes Hospital, Baltimore, MD
 10th International Conference on Primary Therapy of Early Breast Cancer, St. Gallen,
 Switzerland
 Breast Cancer Think Tank 17, Playa del Carmen, Mexico
 Annual Advances in Basic Science Symposium, Northwestern University Cancer Center,
 Chicago, IL
 American Society of Clinical Oncology Education Symposium, Chicago, IL
 10th Komen Mission Conference, Washington, DC
 St Joseph's Hospital, Baltimore, MD
 Australia-New Zealand Breast Cancer Clinical Trials Annual Meeting, Alice Springs,
 Australia
 National Cancer Advisory Board, Bethesda, MD
 Hematology-Oncology Board Review, George Washington University Medical Center,
 Washington, DC
 CR-UK Cambridge Research Institute Plenary Lecture, 3rd National Cancer Research
 Institute Cancer Conference, Birmingham, UK
 President's Cancer Panel, San Diego, CA
 Scientific Symposium, Breast Cancer Research Foundation, New York City, NY
 Florida Oncology Society, Orlando, FL
 Collaborative Summit on Breast Cancer Research, Foundation for the NIH, Lansdowne,
 VA
 American Association of Cancer Research Prevention Symposium, Philadelphia, PA
- 2008 7th Rosalind E. Franklin Award for Women in Science, National Cancer Institute,
 Bethesda, MD
 Breast Cancer Think Tank 18, Waikaloa, HI

Cancer Institute of New Jersey, New Brunswick, NJ
 5th Early Detection Research Network Scientific Workshop, National Cancer Institute,
 Bethesda, MD
 Vanderbilt-Ingram Comprehensive Cancer Center, Nashville, TN
 11th American Association for Cancer Research-Women in Cancer Research Charlotte
 Friend Award, San Diego, CA
 14th Annual Educational Symposium, Susan G. Komen for the Cure Maryland,
 Baltimore, MD
 4th Current Concepts in the Multidisciplinary Management of Breast Cancer, Johns
 Hopkins University, Baltimore, MD
 Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia,
 PA
 Best of ASCO, Boston, MA
 Annual Meeting of the American Association for Clinical Chemistry, Washington, DC
 Seventh International Congress on the Future of Breast Cancer, Kauai, HI
 Nuclear Hormone Receptors, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY
 Hematology-Oncology Board Review, George Washington University, Washington, DC
 Fourth Annual Oncology Congress, San Francisco, CA
 Oberstar Lecture, George Washington University, Washington, DC

2009 Breast Cancer Think Tank 19, Costa Rica
 Bernard Fisher Lecture, University of Pittsburgh, Pittsburgh PA
 11th International Congress Oncology Conference on Primary Therapy of Early Breast
 Cancer, Saint Gallen, Switzerland
 Grand Rounds, MD Anderson Cancer Center – Houston TX
 Women Leading the Way, MD Anderson Cancer Center, Houston, TX
 Jean Sindab Lecture, Emory Winship Cancer Institute, Atlanta, GA
 Oncology Grand Rounds, Ohio State University, Columbus, OH
 16th Annual Pennsylvania Bar Association Women in the Profession, Pittsburgh, PA
 American Society of Clinical Oncology Educational Symposium, Orlando, FL
 24th Annual Aspen Cancer Conference, Aspen, CO
 Harvard Breast Cancer Conference, Boston, MA
 Medical Grand Rounds, UPMC Shadyside Hospital, Pittsburgh, PA
 University of Pittsburgh Postdoctoral Association Data and Dine Lecture, Pittsburgh, PA
 Women's Studies and the Provost's Advisory Committee on Women's Concerns New
 Faculty Lecture, University of Pittsburgh, Pittsburgh, PA
 Pancreasfest 2009, University of Pittsburgh, Pittsburgh, PA
 AACR Advances in Breast Cancer Research, San Diego, CA
 Cincinnati Cancer Symposium, Jensen Symposium on Nuclear Receptors, Cincinnati,
 Ohio
 Translating Scientific Advances into Clinical Care Cancer, Lineberger Comprehensive
 Cancer Center, Chapel Hill, NC
 New Options in Breast Cancer Treatment, UPMC Cancer Centers, Johnstown, PA

- 2010 University of Pittsburgh Winter Academy, Naples, FL
Achievement Rewards for College Scientists, Pittsburgh, PA
Medical Grand Rounds, UPMC Montefiore University Hospital, Pittsburgh, PA
Katz Lecture, Magee Womens Hospital of Pittsburgh, Pittsburgh, PA
NYU Cancer Institute Seminar Series, New York, NY
The Regional Cancer Center, Erie, PA
Lesses Visiting Professor, Medical Grand Rounds, Beth Israel Deaconess Medical Center, Boston, MA
Hematology-Oncology Grand Rounds, Beth Israel Deaconess Medical Center, Boston, MA
University of Maryland Marlene and Stewart Greenebaum Cancer Center, Hormone Responsive Cancer Program Retreat, Baltimore, MD
Lois O'Grady Breast Cancer Lecture, University of California Davis Cancer Center, Sacramento, CA
11th Annual Advances in Oncology, University of California Davis Cancer Center, Sacramento, CA
American Society of Clinical Oncology Breast Cancer Symposium - Gianni Bonadonna Award, Washington, DC
Advances in Oncology, Keynote speaker, UPMC Beacon Hospital, Ireland
Oncology Grand Rounds, Thomas Jefferson University Kimmel Cancer Center, Philadelphia, PA
- 2011 Dept of Environmental & Occupational Health, University of Pittsburgh, Pittsburgh, PA
Department of Pharmaceutical Sciences, University of Pittsburgh, Pittsburgh, PA
Breast Cancer Program Retreat, UCSF Cancer Center, San Francisco, CA
Lineberger Cancer Center, UNC Chapel Hill, Chapel Hill, NC
XI Michelangelo Foundation Seminar, Milan Italy
Georgetown University, Undergraduate Research Conference Keynote Speaker, Washington, DC
City of Hope Cancer Center Grand Rounds, Duarte, CA
Cleveland Clinic Grand Rounds, Taussig Cancer Center, Cleveland, Ohio
McArdle Laboratory Seminar, University of Wisconsin, Madison, WI
13th Milan Breast Cancer Conference, Milan, Italy
Annual Meeting, American Society of Clinical Oncology, Chicago, IL
International Cancer Conference, Trinity Medical School, Dublin, Ireland
Fifth Annual Ri.MED Scientific Symposium, Palermo, Italy
Medical Oncology Board Review, George Washington University, Washington, DC
Department of Epidemiology, University of Pittsburgh, Pittsburgh, PA
Department of Pharmacology and Chemical Biology, University of Pittsburgh, Pgh, PA
San Antonio Breast Cancer Symposium, San Antonio, TX

- 2012 Breast Cancer Think Tank 22, Mexico
 Siteman Cancer Center at Washington University, Saint Louis, MO
 Miami Breast Cancer Conference, Miami, FL
 University of Pittsburgh Department of Pathology, Pittsburgh, PA
 American Society of Preventive Oncology, Washington, DC
 Tsinghua University, Beijing, China
 University of Pittsburgh, Chancellors Inaugural Lecture - Hillman Professor of Oncology,
 Pittsburgh, PA
 University of Chicago Cancer Biology Seminar Series, Chicago, IL
 Johns Hopkins University School of Medicine, Baltimore, MD
 American Society of Clinical Oncology, Chicago, IL
 34th Annual Scientific Meeting, Australia-New Zealand Breast Cancer Trials Group,
 Hobart, Australia
 Medical Oncology Board Review, George Washington University, Washington, DC
 University of Texas Southwestern, Pamela Hearn Isom Lecture, Medicine Grand
 Rounds, Dallas Texas
 Potamkin Lecture, PA Breast Cancer Coalition Conference, Harrisburg, PA
 Northwestern University Feinberg School of Medicine's 16th Annual Department of
 Pathology Joseph C. Calandra Lecture, Chicago, IL
 The Shanghai Breast Cancer Symposium, Shanghai, China
- 2013 Bay City Capital Scientific Advisory Board Meeting
 13th International Congress Oncology Conference on Primary Therapy of Early
 Breast Cancer, St. Gallen, Switzerland
 Annual Meeting, American Association of Cancer Research, Washington, DC
 Case Western Reserve Comprehensive Cancer Center, Cleveland, Ohio
 Medical Oncology Board Review, George Washington University, Washington, DC
 The Hong Kong University of Science and Technology, Tetralateral Symposium,
 Hong Kong
 PA Cancer Planning Summit, Pittsburgh, PA
 Breast Cancer Symposium, San Francisco, CA
 Cancer Caucus, House of Representatives, Harrisburg, PA
 Science 2013, Pittsburgh, PA
 Global Breast Cancer Conference, Seoul, South Korea
- 2014 Annual Meeting, American Association for Cancer Research, San Diego, CA
 American Society of Clinical Oncology, Chicago, IL
 German Cancer Research Center (DKFZ), Heidelberg, Germany
 Medical Oncology Board Review, George Washington University, Washington, DC
 National Cancer Advisory Board, Bethesda, MD
 International Oncology Symposium, Astana, Kazakhstan
 University of Chicago Simon M. Shubitz Lecture, Chicago, IL
 Congressional Briefing, Alliance for Health Reform, Washington, DC

San Antonio Breast Cancer Conference, San Antonio, TX

- 2015 14th St. Gallen International Breast Cancer Conference, Primary Therapy of Early Breast Cancer, Vienna, Austria
Pediatric Hematology/Oncology Pediatric Hematology/Oncology BMT & CT Conference, Childrens Hospital of Pittsburgh, Pittsburgh, PA
University of Pittsburgh, Winter Academy, Palm Beach, Florida
The Wistar Institute, Distinguished Lecture, Philadelphia, PA
Annual Meeting, American Association for Cancer Research, Philadelphia, PA
Inaugural Lecture as Distinguished Professor of Medicine, University of Pittsburgh, Pittsburgh PA
Stephen D Williams, MD Lectureship, Indiana University Simon Cancer Center, Indianapolis, IN
Medical Oncology Board Review, George Washington University, Washington, DC
ASCO 2015 Breast Cancer Symposium, San Francisco, CA
Taipei Medical University, Taipei, Taiwan
Eighth Annual Robert B. Dickson Memorial Lectureship, Georgetown University Lombardi Cancer Center, Washington DC
First Gabriel Hortobagyi Lecture, MD Anderson Cancer Center, Houston, TX

3. Other research related activities

PATENTS GRANTED:

US Patent 7,858,317 B2 Aberrantly methylated genes as markers of breast malignancy (Sukumar S, Evron E, Dooley WC, Sacchi N, Davidson N, Fackler MJ). Issued December 28, 2010

EDITORIAL BOARDS:

1993-1995, 2006-9	Journal of Clinical Oncology
1995-2005	Cancer Research
1995-2009	The Breast Journal
1996-2011	The Breast
1997-2005	American Journal of Medicine
1999-2005	Clinical Cancer Research
2007-2014	Hem/Onc Today
2008-present	Oncology
2008-present	Cancer Prevention Research
2012-present	Journal of the National Cancer Institute
2012-present	Breast Cancer Research and Treatment

STUDY SECTION MEMBERSHIPS:

1988	Member, Ad Hoc Technical Review Section, National Cancer Institute, Bethesda, MD
1990, 1991, 1992	Ad Hoc Member, Reproductive Endocrinology Study Section, National Institutes of Health, Bethesda, MD
1992-1993	Member, Awards Committee, Susan G. Komen Foundation, Dallas, TX
1993-1997	Member, Reproductive Endocrinology Study Section, National Institutes of Health, Bethesda, MD
1994	Member, Walt Disney – American Cancer Society Breast Cancer Professorship Selection Committee, Atlanta, GA
1997-1998	Co-Chair, Progress Review Group for Breast Cancer Research, National Cancer Institute, Bethesda, MD
1996-1998	Chair, Pre-clinical and Clinical Studies Study Section, California Breast Cancer Research Program, San Francisco, CA
1999-present	Medical Advisory Board, Breast Cancer Research Foundation, New York City, NY
2001	Member, Breast and Prostate SPORE Review Group, National Cancer Institute
2002	Co-chair, Breast Cancer SPORE Review Group, National Cancer Institute
2003-2008	Vice-Chair, National Cancer Institute Breast Cancer Intergroup Correlative Science Committee
2002-2005	Member, Charles Kettering Prize Selection Committee, General Motors Cancer Research Foundation, Chair, 2005
2003	Chair, Innovator Award Review Committee, Department of Defense Breast Cancer Program
2005	Member, Lung and Bladder Cancer SPORE Review Group, National Cancer Institute
2005-2006	Ad hoc member, Kimmel Scholars Award Committee
2006-present	Member, Kimmel Scholars Award Committee
2006-2010	Member, Subcommittee A – Cancer Centers, National Cancer Institute
2008	Co-chair, Lung Cancer and Lymphoma SPORE Review Group, National Cancer Institute
2008-present	Member, Scientific Advisory Board, V Foundation for Cancer Research
2008	Chair, Therapeutic Targets I Review Committee, Susan G Komen for the Cure
2012-present	Member, Damon Runyon Cancer Research Foundation Clinical Investigator Award Committee
2012-2013	Chair of the Cancer Program Review, Helmholtz Senate Commission, Helmholtz Association of German Research Centers, Berlin, Germany
2014	Member, Scientific Advisory Committee, Breakthrough Breast Cancer, London, UK
2014-	Chair, CTAC SPORE Program Evaluation Working Group, NCI
2015	Chair, Stand Up To Cancer Canada-Canadian Breast Cancer Foundation Breast Cancer Dream Review Team Committee

EXTRA-MURAL GRANT REVIEWING

Ad hoc grant reviewer for: National Institutes of Health, American Cancer Society, Veterans Administration, Manitoba (Canada) Health Council, Health Research Council of New Zealand, National Cancer Institute - Canada, Medical Research Council - Canada, Department of Defense Breast Cancer Program, many others

ADVISORY BOARD MEMBERSHIPS:

2000-present	Member, External Advisory Board, Vanderbilt-Ingram Cancer Center, Nashville, TN
2001-2006	Member, External Advisory Board, Fox Chase Cancer Center, Philadelphia, PA
2001-2011	Member, External Advisory Board, Bay Area UCSF Breast Cancer SPORE, San Francisco, SF
2003-present	Member, External Advisory Board, Karmanos Cancer Center, Detroit, MI
2003-2008	Member, External Advisory Board, Indiana University Cancer Center, Indianapolis, IN
2005-present	Member, External Advisory Board, University of Maryland Cancer Center, Baltimore, MD
2008-present	Member, Board of Scientific Consultants, Memorial Sloan Kettering Cancer Center, New York City, NY
2008-present	Member, External Advisory Board, Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, Chair 2014-
2009-present	Member, External Advisory Board, MD Anderson Cancer Center, Houston, TX Chair 2014-
2010-present	Member, External Advisory Board, University of Michigan Comprehensive Cancer Center
2010-present	Member, External Advisory Board, Washington University Siteman Cancer Center, St. Louis, MO
2010-present	Member, External Advisory Board Breast Cancer SPORE, Mayo Clinic, Rochester, MN
2010-present	Member, External Advisory Board, Institut National du Cancer, Paris, France
2012-present	Member, Scientific Advisory Board, CTSA, Case Western Reserve University School of Medicine, Cleveland, Ohio
2012-present	Member, Scientific Advisory Board, Cologne Center for Integrated Oncology, Cologne, Germany
2012-present	Member, External Advisory Board, Fred Hutchinson Cancer Research Center University of Washington Cancer Consortium, Seattle, Washington
2013-present	Member, External Advisory Board, Baylor College of Medicine Breast Cancer SPORE
2014-present	Member, External Advisory Board, University of Chicago Comprehensive Cancer Center, Chicago, IL
2014-2015	Member, Scientific Advisory Board, A. Alfred Taubman Medical Research Institute, University of Michigan, Ann Arbor, MI

LIST OF CURRENT RESEARCH INTERESTS:

Cancer biology and treatment, especially breast cancer

SERVICE

1. UNIVERSITY AND MEDICAL SCHOOL:

Committees - Johns Hopkins

1987 Co-Director, Oncology Multidisciplinary Conference
1987-1997 Member, Oncology Fellowship Selection Committee
1993-1995 Department Representative, Medical School Council
1999-2003 Departmental Appointments and Promotions Committee
2000-2005 Member, School of Medicine Professorial Promotion Committee
2001-2009 Member, MD-PhD Admissions Committee
2003-2005 Member, Search Committee for Director of Biophysics and Biophysical Chemistry

Committees – University of Pittsburgh, University of Pittsburgh Physicians (UPP), UPMC

2009-present Member, Chair Management Committee
2009-present Member, UPP Clinical Chairs Committee
2009-present Member, Breast Cancer Steering Committee
2009-present Member, Clinical Research Oversight Committee
2009-2012 Member, ReSet Steering Committee
2009-present Member, Adolescent and Young Adult Cancer Committee
2010-2011 Member, Search Committee for Department of Medicine Chairman
2011-2012 Member, Search Committee for the Institute of Personalized Medicine
2012-present Member, UPMC Presbyterian Shadyside Hillman Cancer Committee
2012-present Member, School of Medicine Financial Oversight Committee
2014-present Member, Internal Advisory Board Gynecologic SPORE
2015-present Member, Internal Advisory Board for the Center for Causal Discovery
2015-present Member, Internal Advisory Board of the Center for Medical Counter Measures Against Radiation (CMCR)

2. EXTERNAL ORGANIZATIONS:

1993-1995 Member, Medical Advisory Committee, Maryland Cancer Consortium
1994-1996 Executive Committee, American Cancer Society – Maryland Division
Chair, Research Committee
1995-1998 Member, Medical Knowledge Self Assessment Program 11-Oncology, American College of Physicians
1999-2000 Planning Committee, National Institutes of Health Consensus Development Conference on Adjuvant Therapy for Breast Cancer, Bethesda, MD
1998-2001 Data Monitoring Committee, Southwest Oncology Group
1999-2006 Data Monitoring Committee, RUTH Trial, Lilly

2000-2006	Data Monitoring Committee, Breast Cancer International Research Group (BCIRG)
2003, 2005, 2007, 2009, 2011, 2013, 2015	Member, St. Gallen Consensus Panel, St. Gallen, Switzerland
2006-2011	Member, Data and Safety Monitoring Committee, TEACH Trial, Glaxo Smith Kline
2009-2012	NMR Center Advisory Committee, Carnegie Mellon University
2010-present	Co-Chair, Breast Cancer Steering Committee, National Cancer Institute
2011-present	Member, Clinical Trials and Translational Research Advisory Committee (CTAC), National Cancer Institute, Chair 2015-present
2013-present	Board of Trustees, Phipps Conservatory, Pittsburgh, PA
2015-	Member, Search Committee for the Scientific Director (SD), Center for Cancer Research (CCR), National Cancer Institute
2015-	Member, Breast Cancer Now's Science Strategy Committee