UNIVERSITY OF CALIFORNIA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

1111 Franklin Street
Oakland, California 94607-5200
Phone: (510) 987-9074
Fax:(510) 987-9086
http://www.ucop.edu

December 14, 2010

The Honorable Denise Moreno Ducheny
Chair, Joint Legislative Budget Committee
State Capitol, Room 5035
Sacramento, California 95814

Dear Senator Ducheny:

Pursuant to the California Health and Safety Code Section 104145 and Revenue and Taxation Code Sections 18791-18796 and 30461.6-30462, I am pleased to enclose the University of California's annual report to the Legislature on the *2010 California Breast Cancer Research Program*.

If you have any questions regarding this report, Associate Vice President Debora Obley would be pleased to speak with you. She can be reached by telephone at (510) 987-9112, or by e-mail at Debora.Obley@ucop.edu.

Sincerely yours,

Mark G. Yudof
President

Enclosure

cc: The Honorable Gloria Romero, Chair
Senate Budget and Fiscal Review Subcommittee #1
(Attn: Ms. Seija Virtanen)
(Attn: Ms. Cheryl Black)
The Honorable Wilmer Amina Carter, Chair
Assembly Budget Subcommittee #2
(Attn: Ms. Sara Bachez)
(Attn: Ms. Amy Rutschow)
Ms. Ana J. Matosantos, Director of Finance
Mr. E. Dotson Wilson, Chief Clerk of the Assembly
Mr. Gregory Schmidt, Secretary of the Senate
Ms. Diane Boyer-Vine, Legislative Counsel
Ms. Sara Swan, Department of Finance
Joint Legislative Budget Committee (18)
Provost and Executive Vice President Lawrence Pitts
Executive Vice President Nathan Brostrom
Vice President Steven Beckwith
Vice President Patrick Lenz
Associate Vice President and Director Steve Juarez
Associate Vice President Debora Obley
Executive Director Jenny Kao
Executive Director Mary Croughan
Director Marion Kavanaugh-Lynch

Report on the 2010 California Breast Cancer Research Program

December 2010

Legislative Report

An investment in UC pays dividends far beyond what can be measured in dollars. An educated, high-achieving citizenry is priceless.

UNIVERSITY *of* CALIFORNIA

UNIVERSITY OF CALIFORNIA

Report on the 2010 California Breast Cancer Research Program

Annual Report

Executive Summary

During 2010, the California Breast Cancer Research Program (CBCRP) funded 37 new single- and multiple year research projects that will advance scientific knowledge about breast cancer. With these new awards, we are investing almost $17 million at 18 California institutions. This annual report summarizes the studies that were completed during 2010 and lists the newly funded and ongoing studies.

Table 1. Research Projects Funded in 2010 by Subject Area

	Number of Projects	Amount	Percentage of Dollars Funded
Community Impact of Breast Cancer	**5**	**$4,319,815**	**26%**
Etiology and Prevention	**4**	**$6,373,430**	**38%**
Detection, Prognosis and Treatment	**18**	**$4,507,438**	**27%**
Biology of the Breast Cell	**10**	**$1,671,431**	**10%**
Totals	**37**	**$16,872,114**	**100%**

Designed to push breast cancer research in new, creative directions, the CBCRP is funded primarily by a California state tax on tobacco. Breast cancer activists have played a leading role in the CBCRP from the beginning. They helped write and pass the statewide legislation that created the Program in 1993. Since then, the CBCRP has provided over $215 million for research in California to prevent, treat, and cure breast cancer.

Women with breast cancer and survivors of the disease are involved in all levels of the CBCRP's decision making, including decisions about which projects get funded. With input from these advocates, the CBCRP has established a record for funding cutting-edge studies and jump-starting new areas of research. The Program's goal is to fund the projects that will lead most rapidly to the end of the breast cancer epidemic.

The need is urgent. Every two hours, on average, a California woman dies of breast cancer. More than 277,000 Californians are living with the disease, and over 21,000 more will be diagnosed this year. Over the past three decades, some progress has been made. The rate at which California women got breast cancer climbed steeply from 1973-1988 and stayed near the 1988 rate for more than a decade. Since then, the breast cancer incidence rate has dropped by eight percent. Between 1988 and 2005, the breast cancer death rate in California dropped by 29 percent.

In April 2010, the U.S. President's Cancer Panel released a ground-breaking report, *Reducing Environmental Cancer Risk: What We Can Do Now.* The federal panel acknowledged that environmental exposures have a substantial impact on increased cancer risk, and they issued a comprehensive call to action to reduce those risks. This landmark report indicates a rising national awareness of the health risks in environmental contaminants and the need for action at the federal, industrial, scientific, local, and individual levels. It underscores the need for the leadership the CBCRP has taken in this area for years. Prior to the release of this report, the CBCRP embarked on an undertaking to develop innovative methods to uncover the environmental causes of breast cancer, with the goal of using the findings to help shape environmental policy to protect Californians.

This report has been prepared by the University of California pursuant to California Health and Safety Code, Section 104145; and the Revenue and Taxation Code Sections 18791-18796 and 30461-30462.1. The following required reporting elements will be addressed in this report:

1. **The number and dollar amounts of research grants, including the amount allocated to indirect costs.** The CBCRP awarded almost $17 million for 37 single- and multiple-year research projects, funded in the form of 43 grants to 18 California institutions in 2010. A complete list of newly funded grants can be found in Table 2.
2. **The institutions and campuses receiving grant awards.** All funded grants are listed with the recipient institutions in Table 2 and in the Research Progress and Results section of this report.
3. **The subject of research projects.** All of the investigator-initiated projects funded by the CBCRP involve key questions in one or more of the following research areas:
    - Community Impact of Breast Cancer (sociocultural behavioral studies and health policy)
    - Breast Cancer Causes and Prevention
    - Earlier Detection, Diagnosis, and Treatment of Breast Cancer
    - Basic Biology of the Breast (normal breast biology and breast cancer pathogenesis)

In 2004, the CBCRP launched the Special Research Initiatives, which involved devoting 30% of annual research funding to program-initiated research into critical but understudied questions in breast cancer. In 2010, the CBCRP decided to build on the success of this approach and is now devoting 50 percent of funding to program-initiated research in three of the most challenging and under-researched areas in breast cancer: the role of the environment in the disease; the reasons why some groups of women—based on characteristics such as ethnicity or race—bear a greater burden of breast cancer; and breast cancer prevention.

4. **The relationship between federal and state funding for breast cancer research.** The CBCRP takes several steps to avoid duplication of funding at the individual research project level and in the Program's research priorities. We identify and attempt to fill important gaps in knowledge about breast cancer. We review priorities yearly in light of changes in the research field, successes and failures of previous funding initiatives, and the results of previous funding. Additionally, as founding members of the International Cancer Research Portfolio and participating members of the Collaborative Summit on Breast Cancer Research, we are able to ensure that CBCRP funding complements, rather than duplicates, grants bestowed by other funding organizations.

The CBCRP's Breast Cancer Research Council sets the Program's funding priorities, taking into account:

- Opinions from national breast cancer experts
- Opinions from California advocates and activists, healthcare providers, public health practitioners, community leaders, biotechnology scientists, and academic researchers
- Current literature on breast cancer and current gaps in knowledge
- Comparisons with portfolios and programmatic goals of other funding agencies
- In-house evaluations of the efficacy of CBCRP grant mechanisms and topic areas in fulfilling program goals

5. **The relationship between each project and the overall strategy of the research program**. The following ten goals are used to set overall programmatic research priorities and calls for applications.

- ***California Specific:*** Fund research that utilizes resources particular to California and/or addresses a breast cancer need that is specific, but not necessarily unique, to the burden of breast cancer in California.
- ***Career Development:*** Fund research that helps recruit, retain, and develop high-quality California-based investigators who engage in breast cancer research.
- ***Collaboration:*** Fund research that uses multidisciplinary approaches and helps foster collaboration among California scientists, clinicians, advocates, community members, patients, survivors, and others.
- ***Disparities:*** Fund research that addresses disparities, inequalities and/or underserved populations in California.
- ***Innovation:*** Fund innovative research (i.e., new drugs, new strategies, new paradigms, new applications of tested strategies in new populations and contexts).

- ***Non-duplicative:*** Fund research that complements, builds on, and/or feeds into, but does not duplicate, other research programs.
- ***Outcome Driven:*** Fund research that will improve public health outcomes (e.g., preventing breast cancer, detecting breast cancer, effective treatments, and quality of life).
- ***Policy:*** Fund research and evaluation that will have policy implications for breast cancer in California.
- ***Responsive:*** Fund research that is responsive to the perceived breast cancer research needs, opportunities, and expectations of the CBCRP as identified by scientists and the public in California.
- ***Translation:*** Fund research that is on a critical path for practical application and leads to more effective products, technologies, interventions, or policies and their application/ delivery to Californians.

The review of each individual grant application is also designed to ensure that the research projects funded by the CBCRP have both high scientific merit and programmatic interest. Each individual application is evaluated by external scientific review committees for specific aspects of scientific merit including, but not limited to, impact on breast cancer, innovation, feasibility, and approach. All applications of sufficient scientific merit undergo a programmatic review by our Breast Cancer Research Council for responsiveness to program priorities, including whether it fits the goals of the award type, integrates advocacy issues, and is an under-funded research question.

6. **A summary of research findings including discussion of promising new areas.** Summaries of all of the research projects completed in 2010 are included in the body of this report. Listed below are just a few of the findings:

- **Megan Schwarzman, M.D., M.P.H.**, at the **University of California, Berkeley**, and **Sarah Janssen, M.D., Ph.D., M.P.H.,** at the **Natural Resources Defense Council**, developed a testing scheme for identifying chemicals that could contribute to the development or progression of breast cancer. This approach is useful for informing California's Green Chemistry Initiative and for reforming the national policy to include toxicity tests that are relevant to the mammary gland. See page 34.
- **Jessica Gorman, M.P.H.**, at the **University of California, San Diego**, evaluated whether concerns about reproduction after breast cancer treatment were associated with long-term depression in women diagnosed with early stage breast cancer at age 40 or younger. Her findings suggest that reproductive concerns are associated with depression, and that young survivors would benefit from additional information and support related to reproductive issues. See page 36.
- **Lawrence Kushi, Sc.D.,** at the **Kaiser Foundation Research Institute** held a Mammary Gland Evaluation and Risk Assessment Workshop to develop a standard protocol for using mammary gland morphology in chemical risk assessment. This protocol will help to advance our understanding of the impact that early life exposure to chemicals that affect hormone systems can have on mammary gland development and susceptibility to cancer, and provide the scientific basis public policy experts need to develop and implement regulations that limit chemical exposures that are associated with breast cancer. See page 40.
- **Gaurav Sharma, Ph.D.,** at **Sanford-Burnham Medical Research Institute** developed a nanoparticle therapy that targets and delivers drugs to the tumor associated macrophages, the type of cells the comprise up to 80% of the cells in a breast tumor. These studies provide the proof-of-concept that could lead to the development of a new breast cancer treatment. See page 46.
- Magnetic resonance imaging (MRI) is increasingly being used for early breast cancer detection. However, MRI is associated with many false-positive findings, leading to unnecessary biopsies. It also requires intravenous injection of a contrast agent, such as gadolinium. **Rebecca Rakow-Penner, M.S.,** and colleagues at **Stanford University** have completed a pilot study determining that it is feasible to use blood oxygen level dependent (BOLD) contrast to make magnetic resonance imaging more accurate and to dispense with intravenous injections of contrast agents. See page 47.
- **Shannon Sirk, Ph.D.,** and colleagues at the **University of California, Los Angeles,** investigated whether whole body breast imaging would aid in earlier and more accurate detection and diagnosis of HER2-positive tumors than the current biopsy and immuhistochemistry methods. This work has the potential to improve non-invasive detection, diagnosis, and treatment of HER2-positive breast cancer. See page 47.
- Studies suggest that disruption of day-night cycles (circadian rhythms) can increase breast cancer risk and that these cycles are controlled by defined molecular pathways. **Kuang-Yu Jen, M.D., Ph.D.,** and colleagues at the **University of California, San Francisco**, have demonstrated that breast cancers that have low levels of one of the circadian rhythm genes, known as Period3 (Per3), are more likely to stop responding to anti-hormone treatment than those with higher Per3. See page 55.

7. **Inclusion of women and minorities in research studies**. The CBCRP funded 37 research projects in 2010. Forty-three percent (16 of 37) of the research projects that the CBCRP funded in 2010 study either women or tissues from women. The remaining 57% are laboratory studies that do not directly involve women or human tissues.

One of the 16 research projects involve tissues from women, while 15 (94%) have women as participants in the study.

Out of the 15 studies that include women:

- One hundred percent (15) include minority women in the study.
- Twenty-six percent (4) are focused on minority women.
- Thirty-three percent (3) are focused on underserved women.

The CBCRP's activities, goals, and progress during 2010 are described in this report, along with the challenges that must be confronted in order to decrease the economic burden and human suffering caused by breast cancer in California.

Table 2: Summary of New Research Funded in 2010

Beckman Research Institute of the City of Hope						
Bernstein	Leslie	3	California Breast Cancer Survivorship Consortium - City of Hope	$262,515	$173,260	$435,775
Petrossian	Karineh	2	A Novel Mediator of AI Resistance in Breast Cancer	$76,000	$0	$76,000
Wang	Shizhen Emily	1.5	Breast Cancer Neoadjuvant Chemotherapy Response with miRNA	$150,000	$99,000	$249,000
Cancer Prevention Institute of California						
Gomez	Scarlett	3	California Breast Cancer Survivorship Consortium - CPIC	$472,465	$208,120	$680,585
Reynolds	Peggy	5	Persistent Organic Pollutants & Breast Cancer Risk	$4,090,115	$759,913	$4,850,028
T* Reynolds	Peggy	1.5	Light at Night and Breast Cancer Risk in California Teachers	$149,993	$49,087	$199,080
Wang	Wei	1.5	Vitamin D and Breast Cancer Survival	$149,997	$70,498	$220,495
John Wayne Cancer Institute						
Hoon	David	1.5	Multimarker miR Blood Assay for Breast Cancer Detection	$150,000	$132,900	$282,900
Kaiser Foundation Research Institute						
Kwan	Marilyn	3	California Breast Cancer Survivorship Consortium-Kaiser	$314,397	$176,688	$491,085
Latinas Contra Cancer						
Duron	Ysabel	1	2010 National Latino Cancer Summit	$25,000	$0	$25,000
Mendocino Cancer Resource Center						
O'Donnell	Sara	3	Recording medical visits for people with breast cancer	*$0*	*$0*	*$0*
			collaborative award with Jeffrey Belkora of University of California, San Francisco			
Proteomics Research Institute for Systems Medicine						
Latterich	Martin	1.5	p97 as a Therapeutic Target in Breast Cancer Metastasis	$150,000	$142,500	$292,500
Scripps Research Institute						
Bachovchin	Daniel	2	Pharmacological Modulation of PP2A Activity in Breast Cancer	$76,000	$0	$76,000

Felding-Habermann	Brunhilde	1.5	Inhibiting Breast Cancer Brain Metastasis with Cilengitide	$150,000	$134,850	$284,850
T* Lorger	Mihaela	1.5	Targeting Brain Metastasis with a Cell-based Approach	$150,000	$134,850	$284,850
Romesberg	Floyd	1.5	Inhibiting Mutation to Prevent and Treat Breast Cancer	$99,887	$87,551	$187,438
Stanford University						
Bitton	Rachel	2	MRI Guided Focused Ultrasound in Breast Cancer Treatment	$88,467	$0	$88,467
T* Kurian	Allison	3	Measuring Real-World Breast Cancer Outcomes	$749,809	$316,416	$1,066,225
Lau	Frances	2	Electronics for High Resolution Breast-Dedicated PET	$76,000	$0	$76,000
Levy	Ronald	1	Enhancing Trastuzumab Therapy with an NK Activating Antibody	$150,000	$75,389	$225,389
The Burnham Institute for Medical Research						
Reynolds	Wanda	1.5	Myeloperoxidase Mediated Protection in Breast Cancer	$150,000	$136,500	$286,500
Torrey Pines Institute for Molecular Studies						
Mueller	Barbara	1.5	Local Adipocyte Function in Breast Cancer	$150,000	$123,000	$273,000
Schraufstatter	Ingrid	1	Complement-mediated Stem Cell Recruitment to Breast Cancer	$75,000	$61,500	$136,500
Turtle Health Foundation						
Navarro	Linda	3	IncreasingMammography Screening Among Native Women	*$0*	*$0*	*$0*
		collaborative award with Marlene von Friederichs-Fitzwater of University of California, Davis				
University of California, Davis						
Andrews	Nicolas	2	The Role of ANCCA in Tamoxifen Resistant Breast Cancer	$90,000	$0	$90,000
von Friederichs-Fitzwater	Marlene	3	Increasing Mammography Screening Among Native Women	$591,281	$0	$591,281
		collaborative award with Linda Navarro of Turtle Health Foundation				
University of California, Irvine						
Lin	Muqing	2	MRI Registration for Therapy Evaluation and Annual Screening	$76,000	$0	$76,000
Verma	Suman	2	The Role of Clim Proteins in Breast Cancer	$90,000	$0	$90,000

University of California, Los Angeles						
Carpenter	Ellen	1.5	Reelin Signaling Involvement in Breast Cancer Cell Migration	$149,493	$0	$149,493
Hu	Hailiang	1.5	Targeting Drug Resistant Breast Cancer by microRNAs	$100,000	$0	$100,000
Pietras	Richard	1.5	New Estrogen Receptor Downregulators for Breast Cancer	$150,000	$0	$150,000
T* Zhang	Lei	1.5	Salivary Biomarkers for Early Detection of Breast Cancer	$150,000	$0	$150,000
University of California, San Diego						
Tsai	Jeff	2	The Role of Twist1 in Epithelial-mesenchymal Transition	$90,000	$0	$90,000
University of California, San Francisco						
Belkora	Jeffrey	3	Recording medical visits for people with breast cancer	$637,500	$0	$637,500
			collaborative award with Sara O'Donnell of Mendocino Cancer Resource Center			
Goldman	Lauren	2	Quality of Mammography Facilities Serving Vulnerable Women	$239,673	$0	$239,673
Huskey	Noelle	2	Targeting Breast Tumor Stem Cells with Cell Cycle Inhibitors	$76,000	$0	$76,000
Kusdra	Leonard	2	The Role of microRNAs in Triple-Negative Breast Cancer	$90,000	$0	$90,000
Moasser	Mark	3	Towards Highly Effective Inactivation of HER2-HER3 Signaling	$745,757	$0	$745,757
Woodruff	Tracey	4	Partnership to Advance Breast Cancer Research	$1,103,827	$0	$1,103,827
University of Southern California						
Holmes	Dennis	1.5	Receptor Re-expression in ER and PR Negative Breast Cancer	$150,000	$93,000	$243,000
Monroe	Kristine	3	California Breast Cancer Survivorship Consortium - USC MEC	$151,367	$65,322	$216,689
Press	Michael	1.5	HER2 Co-Amplified Genes and Treatment Response	$150,000	$93,000	$243,000
Wu	Anna	3	California Breast Cancer Survivorship Consortium - USC AABCS	$618,659	$383,568	$1,002,227
TOTALS				**$13,355,202**	**$3,516,912**	**$16,872,114**

T Funded in part by Tax Check-off voluntary contributions from individual taxpayer's income tax forms.*

Fiscal Overview of the CBCRP (2004-2010)

Table 3: CBCRP Income 2004-2010

FISCAL YEAR	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
CYCLE	XI	XII	XIII	XIV	XV	XVI
STATE FUNDS ALLOCATED	$15,847,000	$13,249,000	$13,249,000	$13,554,000	$13,554,000	$13,554,000
EXTERNAL FUNDING*	$91,770	$97,925		$40,000	$500,000	
PRIVATE DONATIONS	$25,019	$14,972	$19,877	$34,385	$77,033	$40,931
TOTAL FUNDS	$15,963,789	$13,361,897	$13,268,877	$13,628,385	$14,131,033	$13,594,931

*2004-2005, California Endowment; 2007-2008 California Community Foundation ; 2008-2009 Avon Foundation for Women

Table 4: Grant and Contract Funding

FISCAL YEAR	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
CYCLE	XI	XII	XIII	XIV	XV	XVI
CORE GRANTS AWARDED	53 projects	53 projects	35 projects	42 projects	44 projects	34 projects
Direct Cost Total	$6,177,885	$7,288,931	$5,873,318	$6,854,984	$6,693,999	$6,341,857
Indirect Cost Total	$1,562,957	$2,540,198	$1,240,833	$1,232,410	$1,904,740	$1,750,041
Total Grant Costs	$7,740,842	$9,829,129	$7,114,351	$8,087,394	$8,598,739	$8,091,898
SRI GRANT/CONTRACTS AWARDED					9 projects	3 projects
Direct Cost Total					$6,323,325	$7,013,345
Indirect Cost Total					$1,021,524	$1,766,871
Total Grant Costs					$7,344,849	$8,780,216
Pending Grants (cyrrent RFP's)						$6,200,000
Reserve	$4,106,045	$3,168,495	$2,967,701	$3,376,296	$4,115,088	$3,526,147
Balance	$4,106,045	$7,274,540	$10,242,241	$13,618,537	$10,384,988	-$ 1069081
TOTAL GRANT FUNDS	$7,740,842	$9,829,129	$7,114,351	$8,087,394	$15,943,588	$16,872,114

Table 5: Non-Grant Expenditures

FISCAL YEAR	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
CYCLE	XI	XII	XIII	XIV	XV	XVI
Administration	$566,449	$684,795	$745,043	$702,079	$420,612	$433,375
% Total Funds	3.5%	5.1%	5.6%	5.2%	3.0%	3.3%
Research Support and Evaluation	$1,587,075	$2,463,055	$2,378,164	$2,259,317	$1,397,751	$974,093
% Total Funds	16%	19%	23%	20%	8%	5%

Table of Contents

California Breast Cancer Research Program
Annual Report to the State of California Legislature 2009

Report prepared by the University of California, Office of the President pursuant to California Health and Safety Code, Section 104145; and the Revenue and Taxation Code Sections 18791-18796 and 30461-30462.1.

Marion H. E. Kavanaugh-Lynch, M.D., M.P.H.
Director, California Breast Cancer Research Program

Mary Croughan, Ph.D.
Executive Director, Research Grants Program Office

Steven Beckwith, Ph.D.
Vice President for Research and Graduate Studies
California Breast Cancer Research Program
University of California, Office of the President
300 Lakeside Drive, 6th Floor
Oakland, CA 94612-3550

Phone: (510) 987-9884
Toll-free: (888) 313-BCRP
Fax: (510) 587-6325
Email: getinfo@cabreastcancer.org
Web: www.CABreastCancer.org

About the California Breast Cancer Research Program

California Takes National Breast Cancer Research Leadership

The CBCRP's mission is to eliminate breast cancer by leading innovation in research, communication, and collaboration among California's lay and scientific communities.

Established by the California Legislature with passage of the 1993 Breast Cancer Act, the CBCRP was created because California breast cancer activists were impatient with the slow pace of progress against the disease. Together with scientists, clinicians, state legislators, and University of California officials, they wrote legislation that created a program to fund cutting-edge breast cancer research in California.

Since then, the CBCRP has made California a leader among states for breast cancer research. The Program is the largest, most stable state-funded breast cancer research effort in the nation. Since 1993, the CBCRP has awarded 894 grants to 101 scientific institutions and community entities, totaling more than $215 million for research in California to prevent, treat, and cure breast cancer. In 2010, the CBCRP awarded nearly $17 million for 37 single- and multiple-year research projects at 18 California institutions.

The CBCRP is administered as a public service by the University of California. The CBCRP's staff manages the solicitation, review, award, and oversight of grants and dissemination of research results, working under the administration of the University of California, Office of the President, in Oakland.

Funding for the CBCRP comes primarily from a state tax on tobacco, a steadily declining source of revenue due to decreasing consumption of tobacco products. This funding is supplemented with taxpayer donations contributed through state income tax forms and by private contributions. Ninety-five percent of our revenue goes directly to funding research and education efforts.

Funding Innovative Research

During our sixteen-year history, the CBCRP has established a record for funding innovative research ideas that have led to successes that include a Nobel Prize, and for fostering collaborations between members of California's diverse communities and scientific researchers.

Going forward, the Program is poised to develop the innovative foundations that we have laid. Half of the CBCRP's funding will go toward program initiated research, building on the success of the 2004 Special Research Initiatives (SRI). The program initiated research will be devoted to investigating three interconnected research areas that have long received little attention from traditional private and federal research funding sources:

- The environment's role in breast cancer
- The reasons why some groups of women are more likely to get or die from breast cancer, based on characteristics that include race and ethnicity
- Breast cancer prevention

During 2009 and 2010, the CBCRP funded cutting-edge investigations into the first two of the three research areas listed above. For the future, we are adding breast cancer prevention research that will include population-level interventions, interventions for high-risk women and men, and better methods to assess risk.

The other half of the CBCRP's research funds will be focused on areas where the Program has historically had great impact. These include funding to launch new research on innovative concepts, and collaborations between scientists and community members. For more on the way the CBCRP allocates our research funds, see the section titled "The CBCRP's Strategy for Allocating Research Funds" in this annual report.

Structured to Welcome Public Input

From the beginning, the CBCRP has been structured to welcome and encourage community involvement. Breast cancer advocates, who sparked the creation of the Program, continue to play a critical role in every aspect of the CBCRP's work, from setting research priorities to recommending research projects for funding to getting out the word about research results. The Program's structure has inspired other research funding agencies around the nation to follow the CBCRP's example. Other agencies are now more likely to include community advocates in the review of research proposals and to involve community members in the design and conduct of research.

The CBCRP's 16-member Breast Cancer Research Council is the Program's highest decision-making body. It includes scientists, clinicians, representatives of industry and nonprofit health organizations, and breast cancer advocates serving overlapping three-year terms. The council provides vision, sets research priorities, and determines how the CBCRP invests funds in research. The council also conducts one of the two reviews that every proposal must pass to receive funding. Council members review research proposals for relevance to the CBCRP's goals, while teams of research scientists and breast cancer advocates from outside California review all proposals for scientific merit.

All Californians concerned about breast cancer also have opportunities to help set the research agenda via several avenues of feedback created by the Program. The CBCRP's research symposia bring the scientific and treatment communities into dialog with a broader range of the public than is common at such conferences. Each symposium includes a session for members of the public to provide feedback on the Program's work and suggest research priorities. The development of program initiated research strategies included opportunities for the public to take part in identifying and prioritizing questions to be investigated. During 2010, the CBCRP embarked on a new funding strategy for the coming five years. The planning process to develop this new strategy included collecting feedback from researchers, service providers, and interested members of the public. We also encourage public review of our funded research through our annual reports and the CBCRP Web site (www.CABreastCancer.org) and social media pages, where members of the public can leave written comments.

By bringing the research, advocacy, and treatment communities into closer collaboration, the California Breast Cancer Research Program pushes the boundaries of research, mobilizing greater creativity and resources toward decreasing—and ending—the suffering and death caused by breast cancer.

Sharing Research with Scientists and the Public

Even the biggest breast cancer research breakthrough will have no impact if people don't know about it. The scientific community needs to know about the results of research in order to make progress against breast cancer. The medical community needs to know, in order to improve prevention and treatment. People with breast cancer need the opportunity to learn about new prevention and treatment options. Breast cancer activists and policy makers need information about research results in order to shape their advocacy agenda. Communities affected by breast cancer need to know what's been proven to work in other communities. And the taxpayers of California need to know what their taxes are funding.

For all these reasons, the sponsors of the legislation that established the California Breast Cancer Research Program recognized that funding high quality research is necessary but not sufficient to fulfill the Program's mission. The legislation calls on the Program to disseminate the research results.

The scientists whose projects are funded by the CBCRP publish their results in peer-reviewed scientific journals and present them at scientific conferences. We are committed to going beyond these venues, and to making the results and progress of research it funds available to a much wider audience. The CBCRP publishes and distributes summaries of Program-funded research over the Internet. We are one of the few research funding programs in the world to publish annual summaries of research while the studies are still in progress, so that scientists and other interested people can make use of the information as soon as possible. The Program's research results and research progress are disseminated in a variety of ways:

Research Symposia

The CBCRP periodically holds a research symposium, a statewide conference, free to the public, where researchers present the results of their CBCRP-funded studies. The Program's seventh symposium, "From Research to Action: Tools for Change," was held September 24-25, 2010, in Oakland. The symposium brought together over 450 scientists, health care and social service professionals, and women and men whose lives have been affected by breast cancer. The CBCRP makes a special effort to bring women who have, had, or are at risk of breast cancer to the symposium. Forty women received scholarships that covered their travel and accommodations. The mix of diverse attendees leads to spirited exchanges of ideas between researchers and the people most affected by breast cancer, as well as increased networking opportunities.

Plenary sessions at the seventh symposium included "Tools for Expanding the Research Paradigm," and "Making Chemicals Testing Relevant to Breast Cancer." In these plenary sessions, and in workshops and breakout sessions, researchers presented their latest findings, gave overviews of research fields, and predicted coming trends.

Illustrated posters depicting the results of 59 research projects funded by the CBCRP were on display throughout the symposium. Researchers were on hand for a poster viewing session where they could answer questions and receive comments about their research directly from the public and their scientific colleagues. In addition, the abstracts to all of the research projects presented in posters were available on the Web site prior to the symposium and in the symposium booklet given to all attendees.

The majority of the scientific sessions consisted of presentations of CBCRP-funded research through panel discussion sessions and workshops. This was the first CBCRP symposium in which researchers funded through the Special Research Initiatives were able to present their progress.

At an Advocate/Scientist Collaboration Breakfast, attendees met in small group discussions led by breast cancer advocates. Topics ranged from conducting research that drives environmental policy, to socially responsible drug development, to advantages of including advocates in basic science research. Symposium attendees new to breast cancer could get the basics at a workshop called Breast Cancer 101. Also included was a training workshop for members of community organizations and experienced researchers who wanted to learn more about teaming up to conduct research with funding from the CBCRP's Community Research Collaboration awards.

Representatives from California community organizations staffed over 15 exhibits, sharing practical knowledge about what Symposium attendees can do to confront breast cancer in their own communities.

CBCRP Listens, a town-hall-style meeting, invited feedback on the direction the Program will take over the next five years. Feedback from past CBCRP Listens sessions has helped shape the CBCRP in important ways, including helping to stimulate the creation of our highly-lauded Special Research Initiatives.

An emotionally complex illness like breast cancer requires more than science to bring about meaningful understanding. Deeply-felt understanding is needed for the sustained effort necessary to reduce the impact of the disease. For this reason, powerful works of art were on display, speaking eloquently to the impact of breast cancer on the lives of Californians. The curated art exhibition included painting, photography, sculpture, graphic art, textile art, and mixed media, and the screening of a moving new documentary film, *Dear Talula*. A networking reception featured live music from vocalist William Mininfield.

The symposium was designed to be healthy and environmentally friendly. Free yoga and exercise classes were offered each morning. Organic produce was served when possible. The use of plastic products was reduced, no Styrofoam was used in the symposium food service, and recycling opportunities were provided. All printed symposium materials were produced on recycled chlorine-free paper with soy-based ink, and provided only to attendees who wanted them.

A meeting report, available on the CBCRP Web site with hard copies provided upon request, provides summaries of all presentations made at the 2010 symposium. Audio recordings of symposium presentations are also available on the Program Web site.

Sharing Research over the Internet

Web Site: The CBCRP Web site (www.CABreastCancer.org) has summaries of all completed research projects and annual progress reports for ongoing projects, in language accessible to the general reader. All research on the CBCRP Web site is fully searchable, and visitors who want to keep up with the latest research can search to access the most recently posted findings. A featured researcher section profiles an individual researcher and her or his findings on a rotating basis. Visitors to the Web site can ask questions and receive answers via email. The CBCRP Web site also includes:

- Links between abstracts of research supported by CBCRP funding to the National Institutes of Health's PubMed, a public-access database of biomedical journals;
- A list of each year's grants made by the CBCRP;
- Information on applying for grants;
- Downloadable versions of all CBCRP publications;
- Videos and audio recordings of presentations from past CBCRP symposia;
- Opportunities to join the Program's volunteer team, request specific information from the CBCRP, and make online donations to the CBCRP;
- Reports on progress of the CBCRP's research strategy development.

E-Newsletter: The CBCRP's email newsletter gives subscribers timely announcements of funding opportunities, early notification of new research resources and breast cancer conferences, and avenues to stay involved, informed, and active in the fight against breast cancer. It is distributed to over 2,800 stakeholders each month.

Facebook and Twitter: The CBCRP has a growing number of friends on Facebook and followers on Twitter. Our Facebook page presents up-to-date information about breast cancer research, along with an online space to exchange ideas, ask questions, and follow links to information about CBCRP-funded research studies. Facebook users can also access invitations to events such as the CBCRP symposium, announcements of new CBCRP publications, and links to other breast-cancer-related organizations. The Program's Twitter feed also keeps followers current about breast cancer research and opportunities to take part in CBCRP activities.

Publications

All CBCRP publications are available free to the public and can be downloaded from the CBCRP Web site. Some of our publications are also available free to the public in print, with multiple copies free to organizations. On request, the CBCRP also provides free hard copies of any of our publications from the Program Web site.

Compendium of Awards: To make it easy for scientists and the public to follow CBCRP-funded research from the beginning, a description of newly funded projects is published each year. It is available on the CBCRP Web site, with hard copies on request.

Formal Evaluations of the CBCRP: Formal evaluations let the public understand the CBCRP's successes and efforts to improve our work. The latest evaluation, "New Funding Strategy for the California Breast Cancer Research Program: The Way Forward," describes the evaluation process that led to the CBCRP setting new funding priorities for the coming five years. Evaluations are available on the CBCRP's Web site, many are also available in print, and hard copies of those not available in print are provided on request.

Community Research Collaboration Awards Abstract Booklet: The CBCRP's Community Research Collaboration awards bring together members of community groups and academic scientists to conduct breast cancer research. This booklet, with abstracts of many past community research collaboration projects funded by the CBCRP, is designed to make community groups aware of this opportunity. The booklet is available on the Program Web site and in print.

Newsletter: The CBCRP's newsletters report on new awards, research results, scientific meetings where the CBCRP is presenting an exhibit of Program work, and other Program news. Newsletters are published on the CBCRP Web site, with hard copies provided on request.

Breast Cancer in California: A Closer Look/El Cancer de Seno en California: Una Mirada Mas de Cerca: This 40-page booklet provides a picture of breast cancer's effect on the lives of California women, and it is available in print and on the CBCRP Web site in both English and Spanish.

Identifying Gaps in Breast Cancer Research: This research paper reviews previous research in two areas covered under the CBCRP's Special Research Initiatives: environmental links to breast cancer and the reasons why some groups of women bear a greater burden of the disease. The draft is available on the CBCRP Web site.

Urgent Unanswered Questions about Breast Cancer: A 32-page booklet in language accessible to the general public, it highlights and summarizes previous research into the environmental causes of breast cancer and the reasons why some groups of women bear a greater burden of the disease. The booklet also lists promising ideas for research in these areas, and describes the first projects funded under the CBCRP's ground-breaking Special Research Initiatives. It is available in print and on the CBCRP Web site.

California Breast Cancer Research Program brochure: An overview of the CBCRP, our philosophy, and opportunities to get involved is available in print in English and Spanish.

Further Methods of Sharing Research

Scientific Presentations at Conferences: The CBCRP staff and CBCRP-funded researchers present research results at scientific conferences.

Expressions: The Art of Healing Breast Cancer: The CBCRP owns a collection of wearable breast art created by California artists to reflect on the breast cancer epidemic. The entire collection is on exhibit at CBCRP symposia. During 2010, portions of *Expressions: the Art of Healing Breast Cancer* were displayed, along with the CBCRP's exhibit, at community meetings. An art catalog of this collection is available online at the CBCRP Web site.

Exhibits at Community Meetings: The CBCRP presented displays of the Program's work at a number of community meetings and events during 2010. These included:

- Sister's Network's Young Women's Breast Health Summit, San Francisco
- Cancer Prevention Institute of California's 6th Annual Each One Reach One, Oakland
- Professional Business Women of California's 21st Annual Women's Conference, San Francisco
- Mills-Peninsula African American Community Health Advisory Committee's 9th Annual "Soul Stroll for Health" Resource Fair, San Mateo
- Susan G. Komen San Francisco Chapter's 4th Annual Marketplace, Many Voices One Face, San Francisco
- Latina Contra Cancer's National Latino Cancer Summit, San Francisco
- The North Face's 4th Annual Health and Wellness Fair, San Leandro

Serving the Media: The CBCRP does regular outreach to the media about the Program and about CBCRP-funded research projects that are of interest to the general public. When reporters from TV, newspapers, magazines, or other media need information on breast cancer research, the CBCRP links them with the appropriate experts. During 2010, newspapers nationwide covered CBCRP-funded research that suggests new ways to test chemicals for their ability to cause breast cancer. News about the CBCRP and research funded by the CBCRP also appeared over the past year in local California newspapers, and on a variety of general news, health news, international news, and blog Web sites.

Speakers and Educational Bureau: When community organizations want speakers on breast cancer research for meetings and public events, the CBCRP provides referrals from the Program's network of researchers and advocates. The Program also refers research experts to teach continuing education classes for healthcare professionals.

Collaborating with Breast Cancer Advocates and California Communities

People with breast cancer and survivors of the disease are involved in every level of the California Breast Cancer Research Program, from deciding which research the Program funds to actually carrying out some of the CBCRP's research. The CBCRP has been in the forefront of a nationwide trend among research funding agencies toward a greater voice for the people facing the disease in their day-to-day lives. The CBCRP still sets the standard for including advocates at all levels of all of the phases of research funding.

Breast Cancer Advocates in Leadership

Breast cancer advocates—survivors of the disease and leaders of breast cancer advocacy organizations—play a leadership role in the CBCRP. Breast cancer advocates:

- Comprise one-third of the CBCRP's 16-member council, the group that makes the final selection of research projects the CBCRP funds. An advocate serves as the council's Chair or Vice-Chair
- Serve on review panels, along with scientists, who rate all research proposals submitted to the CBCRP for scientific merit prior to selection of research by the CBCRP's council. Out-of-state advocates are full voting members of the panels and a California advocate observes each one
- Are involved in setting priorities for the CBCRP's research funding
- Serve on advisory groups guiding the CBCRP's program initiated research

Leadership from breast cancer advocates ensures that the CBCRP funds research important to the people most affected by the disease.

Communities Conducting Research

Breast cancer advocates are also investigators on a rising number of the CBCRP's research projects. In 1997, the CBCRP pioneered our Community Research Collaboration awards. These grants allow community groups and breast cancer advocacy organizations to team up with experienced scientists to pursue a research idea of importance to the community in a scientifically rigorous way. Community Research Collaboration (CRC) awards are open to nonprofit organizations or ad-hoc community groups in any California community affected by breast cancer.

Research involving community organizations as active partners is gaining credibility in the United States, and the CBCRP has been a prime mover in extending and supporting the use of this approach to breast cancer research in California. The Community Research Collaboration awards have provided nearly $18 million in funding to 70 collaborative projects conducted by 61 different California institutions and community groups. Projects funded over the years include:

- Determining whether Vietnamese nail salon workers have higher breast cancer rates and whether their workplace exposures to toxic substances exceed health-based standards
- Developing and testing culturally-appropriate breast health care and breast cancer education for women in a number of California communities, including Native American women; immigrant Afghan, South Asian, Hmong, and Slavic women; and Samoan American, Korean American, and older Thai American women
- Educating African American and Hispanic women about the importance of participating in breast cancer clinical trials and developing tools for an educational program entitled *Scientific Literacy and Breast Cancer Clinical Trials Education Program*
- Determining the benefits of peer-led African American support groups to address the unmet needs of African American women with breast cancer in an underserved geographic area
- Assessing the benefits and acceptability of a videoconferencing support group for rural and isolated women
- Evaluating an ethical will intervention for underserved women at end of life
- Identifying barriers to survival in the Latina population
- Exploring breast cancer risk factors of lesbians and heterosexual women
- Testing complementary and alternative medicine approaches to improving the quality of life of breast cancer survivors through mindful movement programs

The CBCRP's Community Research Collaboration awards are designed to have an impact on breast cancer health care:

- We funded the first-ever research into appropriate breast health and breast cancer education for a community that has been left behind in the fight against breast cancer: Deaf and Hard of Hearing women. Deaf/Hard of Hearing are often poor, with, on average, a fifth grade reading level. This community has little awareness of the breast cancer education and services available to hearing women. **Heidi Booth** of the **Greater Los Angeles Council on Deafness** collaborated with **Barbara Berman, Ph.D.,** of **University of California, Los Angeles** to develop, validate, and distribute a tailored breast health educational program for Deaf/Hard of Hearing women. The program includes a workshop, group discussion, a signed/captioned DVD, and written materials. This research can provide other agencies serving Deaf/Hard of Hearing women with a breast cancer education program never before available.
- Women with low incomes who are also ethnic minorities are diagnosed with breast cancer at relatively later stages and have lower rates of survival. But most end-of-life research has focused on white, middle-class patients. **Kendra Stone** of the **Charlotte Maxwell Complementary Clinic** and **Shelley Adler, Ph.D.,** of **University of California, San Francisco** found, in their CBCRP-funded research, that quality of life issues such as meaning and purpose were important to low-income, ethnic minority women at the end of life. The researchers developed and successfully tested an intervention—the construction of an ethical will. An ethical will is an enduring document that expresses an individual's experiences, life lessons, values, hopes, and loves. Ethical wills are typically made by middle- and upper-class people. In this study, women terminally ill with cancer met with a trained interviewer to record material for their ethical will, then edited it jointly with the interviewer. This is one of the first successful interventions shown to address existential suffering at the end of life for underserved women with breast cancer.

Fostering Community-Based Research

The CBCRP has taken major steps to enable diverse populations in California to take part in quality scientific research into breast cancer issues of interest to their communities. These efforts included making the application process for the Program's Community Research Collaboration grants more user-friendly. The CBCRP also conducts technical assistance to community groups and scientists interested in collaborating on scientific research. This assistance includes webinars, where a slide presentation provided over the Internet is combined with a teleconference, and one-on-one training.

During 2010, the National Institutes of Health (NIH) recognized the CBCRP's leadership in community-based participatory research by funding the CBCRP to establish a larger outreach effort and a more in-depth training program in California. In collaboration with the nonprofit organization Commonweal, the CBCRP's Community-Based Research Infrastructure to Better Science (CRIBS) will stimulate California community organizations to collaborate with scientific researchers in two research areas: the environmental causes of breast cancer and the reasons why some groups of women are more likely to get or die from the disease. The CRIBS project will create an infrastructure for community-based participatory research using intensive training, technical assistance, and a Web-supported learning community.

In recognition of her leadership in community breast cancer research, during 2010 the CBCRP's Director, Dr. Marion H.E. Kavanaugh-Lynch, co-chaired the National Institutes of Health, National Cancer Institute, Special Emphasis Panel on Community Networks Program (CNP) – Centers for Reducing Disparities through Outreach, Research and Training (U54) and served on the National Institutes of Health, Center for Scientific Review, Special Emphasis Panel/Scientific Review Group on Building Sustainable Community-Linked Infrastructure to Enable Health Science Research.

During 2011, the CBCRP will continue to facilitate diverse communities in California taking part in quality scientific breast cancer research and to take leadership in community-based participatory research.

The CBCRP's Strategy for Allocating Research Funds

A New Strategy for the Coming Five Years

To accelerate an end to breast cancer, the California Breast Cancer Research Program (CBCRP) has developed a new strategy for funding research over the next five years. In March 2010, after three years of intense analysis, the CBCRP's Breast Cancer Research Council—the program's highest decision-making body—voted for a bold, new funding strategy. Our strategy will generate new discoveries and approaches for preventing, detecting, and curing breast cancer, and for caring for those affected by the disease.

For the next five years, the CBCRP will focus our funding on:

Program Initiated Research: We are dedicating 50% of our annual funds for studies into three critical, under-investigated areas of breast cancer research:

- Identification and elimination of **environmental causes of breast cancer**.
- Identification and elimination of the **reasons why some groups of women bear a greater burden of breast cancer,** based on characteristics such as their race, their ethnicity, or the place where they live.
- **Primary prevention** of breast cancer. Primary prevention measures keep women and men from getting breast cancer, in contrast to secondary prevention, which is early diagnosis and treatment. The CBCRP will fund population-level interventions on known and suspected risk factors and protective measures, and also targeted interventions for high-risk individuals, including new methods for identifying and assessing risk.

For more on the program initiated research, see the section of this report titled, "Answering Urgent, Neglected Questions: Program Initiated Research."

Community Research Collaborations: We are allocating $2 million annually to support community-based participatory research. These research projects are collaborations between community organizations—such as breast cancer advocacy organizations, community clinics, or organizations serving under-represented women—and experienced scientists. Together, these teams investigate breast cancer problems that are important to that community, using culturally-appropriate research methods.

Innovative, Developmental, and Exploratory Awards (IDEAs): We are supporting ground-breaking research that applies novel methods, perspectives, and approaches that may lead to extraordinary outcomes. Applicants must show how their project is part of a step-by-step research process that will lead to practical applications, such as breast cancer diagnosis, treatment, or prevention.

Translational Research Awards: We are funding research that takes basic science findings quickly toward treatment, diagnosis, prevention or another application that can directly impact breast cancer, either in a medical clinic setting or through a public health measure.

Health Policy: We are allocating $150,000 annually to fund research into ways to shape policy to improve breast cancer prevention, diagnosis or treatment.

Conferences: We are supporting up to $50,000 in breast cancer conferences each year.

The new strategy focuses the CBCRP's funding in areas where the Program can have the most impact. Several types of research grants that the CBCRP has made in previous years and during 2010 will be discontinued starting in 2011. These include Postdoctoral Fellowships and Dissertation awards, because our evaluation showed that career development awards are offered by many other funding agencies, and because the CBCRP's IDEA grants can provide new researchers with opportunities to develop careers in breast cancer research. The Program is also discontinuing IDEA competitive renewal grants, which allowed recent recipients of CBCRP IDEA grants to compete for additional funding, because other research funding agencies offer similar grants. The application process for the IDEA grants is being changed to require applicants to submit a letter of intent. This saves applicants whose research ideas are unlikely to be funded from having to submit a full application. It also increases opportunities for success for applicants who are invited to submit a full proposal after submitting a letter of intent.

The CBCRP's Breast Cancer Research Council developed this new funding strategy through a careful, data-driven process of evaluation that included input from researchers and the public. For more on this process, see the "Improving the CBCRP through Evaluation" section of this Annual Report. A more detailed description of both the new strategy and the evaluation process that led up to it are published in "New Funding Strategy for the California Breast Cancer Research Program: The Way Forward," available on the CBCRP Web site.

Our new strategy is designed to meet the challenge of the CBCRP's declining source of funding, which is a statewide tax on tobacco products. By focusing our resources on the areas where the CBCRP has had the greatest impact, we will continue to lead the nation in meaningful advances against breast cancer.

The Grant-Making Process

Each year, the California Breast Cancer Research Program funds California investigators' research into the disease. These research projects may be completed during that year, but typically they run for more than a year.

The CBCRP's 16-member Breast Cancer Research Council recommends which research projects to fund. The members of the council are listed in the “California Breast Cancer Research Program Council (2010)” section of this annual report. The council uses two different processes to select research for CBCRP funding.

For **Program-Initiated Research** projects, the CBCRP selects the topics to be researched through a thoughtful, thorough planning process. This process includes analyzing years of nationwide and CBCRP-funded breast cancer research, and collecting feedback from breast cancer advocates, researchers, healthcare providers, policy makers, other funders, and the public, as well as groups of experts we convene to provide advice . Once the CBCRP selects topics to be studied, California researchers are then invited to participate.

For all **Investigator Initiated Research**—Community Research Collaborations, IDEAs, Translational Research awards, and Conference awards—California scientists select topics to be researched and submit applications.

For all grants, the Breast Cancer Research Council selects research to fund based on recommendations from expert committees who review all research applications for scientific merit. To minimize conflicts of interest, review committees are composed of experts from outside California. These experts include scientists highly knowledgeable about the topics of the applications they consider. Each review committee also has advocate reviewers. These are women and men active in breast cancer advocacy organizations, many of them also living with the disease. The committees use a review process based on established practice at the federal government's National Institutes of Health, but tailored to focus on the assessing the qualities of the applications that are important to the CBCRP (e.g., impact on breast cancer, translation potential). The members of the CBCRP's review committees for 2010 are listed in the Appendix of this annual report.

Research Funded in 2010

The following table presents statistics on the 37 research projects the CBCRP funded in 2010. This is the last year the CBCRP will fund Dissertations, Postdoctoral Fellowships, and IDEA-Competitive Renewal awards.

Table 6. Research Funded in 2010 by Award Type

Grant Type	Number of Projects	Amount	Percentage of Dollars Funded
Program-Initiated Research	3	$6,859,443	45.9%
Dissertation Awards	5	$380,000	2.5%
Postdoctoral Fellowship Awards	5	$448,467	3.0%
Innovative Developmental and Exploratory Awards (IDEA)	18	$3,957,673	26.5%
IDEA-Competitive Renewal Awards	1	$239,673	1.6%
Community Research Collaboration Awards (CRC)	2	$1,228,781	8.2%

Joining Forces Conference Awards	1	$25,000	0.2%
Translational Research Awards	2	$1,811,982	12.1%
Totals	**37**	**$14,951,341**	**100%**

Priority Issues

Each research project funded by the CBCRP must meet a second set of criteria, in addition to those for the awards listed above. The subject of each project must also fall under one of the Program's Priority Issue areas:

- The Community Impact of Breast Cancer
- Etiology and Prevention
- Biology of the Breast Cell
- Detection, Prognosis, and Treatment

The following table presents statistics on the 37 research projects the CBCRP funded in 2010 by Priority Issue:

Table 7. Research funded in 2010 by Priority Issue

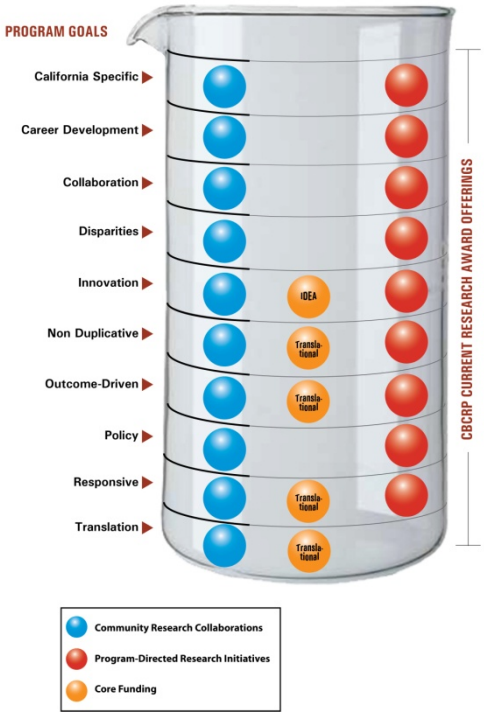
	Number of Projects	Amount	Percentage of Dollars Funded
Community Impact of Breast Cancer	**5**	**$4,319,815**	**26%**
Etiology and Prevention	**4**	**$6,373,430**	**38%**
Detection, Prognosis and Treatment	**18**	**$4,507,438**	**27%**
Biology of the Breast Cell	**10**	**$1,671,431**	**10%**
Totals	**37**	**$16,872,114**	**100%**

Ten Goals for the CBCRP's Funding Strategy

The CBCRP's funding strategy is designed to achieve the following ten goals:

- ***California Specific:*** Fund research that utilizes resources particular to California and/or addresses a breast cancer need that is specific but not necessarily unique to the burden of breast cancer in California.
- ***Career Development:*** Fund research that helps recruit, retain, and develop high-quality California-based investigators who engage in breast cancer research.
- ***Collaboration:*** Fund research that uses multidisciplinary approaches and helps fosters collaboration among California scientists, clinicians, advocates, community members, patients, survivors, and others.
- ***Disparities:*** Fund research that addresses disparities, inequalities and/or underserved populations in California.
- ***Innovation:*** Fund innovative research (i.e., new drugs, new strategies, new paradigms, new applications of tested strategies in new populations and contexts).
- ***Non-duplicative:*** Fund research that complements, builds on, and/or feeds into, but does not duplicate, other research programs.
- ***Outcome Driven:*** Fund research that will improve public health outcomes (e.g., preventing breast cancer, detection of breast cancer, effective treatments and quality of life).
- ***Policy:*** Fund research and evaluation that will have policy implications for breast cancer in California.
- ***Responsive:*** Fund research that is responsive to the perceived breast cancer research needs, opportunities, and expectations of the CBCRP as identified by scientists and the public in California.
- ***Translation:*** Fund research that is on a critical path for practical application and leads to more effective products, technologies, interventions, or policies and their application/ delivery to Californians.

The following figure illustrates how the CBCRP's types of awards address the Program's goals.



Impacting Statewide and National Policy

The CBCRP's research strategy is designed not only to increase knowledge about breast cancer, but also to lead to solutions that will decrease the suffering caused by the disease. For example, the results from the CBCRP's first completed Special Research Initiatives study—on chemicals policy in California—have caught the attention of state and national policy makers. This research has the potential to shape policy to protect residents from chemicals related to breast cancer in California and throughout the country. Due to the extensive work CBCRP has done to evaluate and facilitate research on the environment and breast cancer, the director of the CBCRP, Dr. Marion H.E. Kavanaugh-Lynch, was invited to speak to the Institute of Medicine (IOM) Committee on Breast Cancer and the Environment: The Scientific Evidence, Research Methodology, and Future Directions, on the subject of "The California Breast Cancer Research Program's Special Research Initiatives on Environment and Disparities" to inform their policy recommendations.

Spurring Nationwide Research Progress

One goal underlying the CBCRP's funding strategy is the leveraging of Program funds to spur nationwide progress in breast cancer research. The CBCRP is part of a much larger research system. The federal government funds breast cancer research through agencies like the National Cancer Institute and the U.S. Department of Defense, Congressionally Directed Medical Research Programs. Nonprofit organizations and for-profit corporations also fund breast cancer research. Although the CBCRP is the largest state funding source for breast cancer research , these funds make up only a small part of the funds granted through the larger system. The CBCRP tries to influence this larger research system to move in directions that will lead to research breakthroughs.

An example is the CBCRP's funding of researchers with innovative ideas that have a high potential for scientific payoff—and also a high potential for failure. The CBCRP has taken a chance on many researchers with high risk ideas. When the research succeeds, the researcher is often able to get another research funding agency to fund the next step. One researcher who began her investigations into b reast cancer with CBCRP funding, Elizabeth Blackburn, not only received funding from other agencies to continue her research, she also received the 2009 Nobel Prize for Physiology or Medicine.

A number of researchers who started with CBCRP funding have recently received funding from the NIH to pursue research across a broad range of breast cancer topics:

- Craig Levin, Ph.D., of Stanford University is adapting Positron Emission Tomography (PET) for use in detecting breast cancer.
- Brian Hargreaves, Ph.D., also at Stanford, is modifying magnetic resonance imaging (MRI) technology with the goal of improving early diagnosis of breast tumors.
- Paul Henderson, Ph.D., at Lawrence Livermore National Laboratory is investigating chemical reactions resulting from breast tumor-related DNA damage. Measuring the tiny quantities of substances resulting from these chemical reactions may lead to a "fingerprint" that can be used to diagnose a tumor or predict whether it will respond to treatment.
- Melissa Dix, at Scripps Research Institute is identifying and cataloging enzymes called proteases and determining how they work in the growth of breast tumors and in the spreading of breast cancer to other parts of the body.
- Frank Pajonk, M.D., Ph.D., at the University of California Los Angeles is investigating how stem cells in breast tumors survive radiation therapy that kills other breast tumor cells. Preventing stem cell survival could keep tumors from growing back after radiation therapy.
- Brunhilde Felding-Habermann, Ph.D., at Scripps Research Institute is investigating a way to use normal stem cells as healers. She is working towards a therapy for breast cancer that has spread to the brain, harnessing the brain's own mechanism for healing and regenerating, neural stem cells.
- Robert West, M.D., Ph.D., at the Palo Alto Institute for Research and Education is studying the genes of cells called stromal cells that surround tumors and play a crucial role in tumor growth. Therapy aimed at stromal cells could work against tumors that resist other therapies.

To further spur research progress, the CBCRP uses additional methods. These include the establishment of our program-initiated research program, which stimulates new investigation in under-investigated areas that have a high potential to lead to breakthroughs in breast cancer causes and prevention, and our development of a new scoring system to help reviewers read proposals with a perspective toward rewarding high-risk research.

Enlarging the Pool of Breast Cancer Researchers

Another major goal of the CBCRP is to increase the number of talented scientists engaged in breast cancer research. Some of the Program's grants have allowed investigators to specialize in, or concentrate much of their efforts on, breast cancer research. For example, Lei Zhang, Ph.D., at the University of California, Los Angeles, is using a CBCRP grant to apply an already-developed method—salivary transcriptomics—toward a better way to detect early breast cancer. Dr. Zhang is testing saliva of women with early breast cancer and women who don't have the disease. His team is looking for biomarkers, substances found in saliva (or other body fluids or tissues) that signal the presence or absence of a disease. Salivary transcriptomics allows scientists to find very tiny amounts of these substances. So far, Dr. Zhang's team has found nine biomarkers that vary significantly between women who have breast cancer and those who don't. The research could lead to a saliva test to detect breast cancer, a much less invasive method than a mammogram.

Leveraging Funds for Promising Research

An additional goal of the CBCRP's research strategy is encouraging and inspiring other research funding agencies to support cutting edge research. For example, the Avon Foundation for Women, which funds breast cancer research nationwide, has joined the CBCRP in supporting the Program's ground-breaking Special Research Initiatives. The foundation, long a funder of breast cancer research, agrees that not enough has been done in the areas of environmental links to breast cancer and the reasons why some groups of women bear a greater burden of the disease. The Avon Foundation for Women awarded the CBCRP a $500,000 grant earmarked for the CBCRP Special Research Initiatives.

In addition, receiving a CBCRP grant to conduct breast cancer research also allows scientists to leverage additional funding. For example, for every $1 the CBCRP invested in the Program's Innovative, Developmental and Exploratory awards (IDEAs), investigators have been able to leverage another $5 for breast cancer research.

Answering Urgent, Neglected Questions: Program-Initiated Research

In 2005, the CBCRP's council voted to allocate 30% of the Program's funding to program initiated research endeavors and launched the Special Research Initiatives to investigate two research areas that have not received enough attention, but that hold great promise against breast cancer:

- Why are some groups of women—based on characteristics such as their ethnic group, race, or where they work or live—more likely to get, or die from, breast cancer?
- What is the role of the environment in this disease?

Building on the initial success of these initiatives, during 2010, the council decided to devote 50% of funding to program-initiated research and added a third area of research:

- Breast cancer prevention

Funds are being targeted to research that will most quickly lead to major breakthroughs. The initiatives are designed not only to increase scientific knowledge, but also to create solutions that will move toward the goal of ending the suffering caused by breast cancer.

The CBCRP launched the Special Research Initiatives because the Program's previous efforts to increase research addressing these questions had not led to enough progress. California is an ideal laboratory for these under-researched questions. The state has varied geography and development, which includes heavily industrialized as well as large agricultural areas. It has a mix of urban, suburban, small town, and rural communities. The state's population is very ethnically and racially diverse. California also has communities with some of the highest rates of breast cancer in the nation.

To build on the most current findings, the CBCRP commissioned a review of previous research into the environmental links to breast cancer and the reasons why some groups of women bear a greater burden of the disease. A draft of this extensive scientific review, *Identifying Gaps in Breast Cancer Research*, is posted on the CBCRP web site.

First Completed Initiative Draws Attention from Policy Makers

During 2010, the first study funded under the Program's Special Research Initiatives was completed. This study, the **California Breast Cancer and Chemicals Policy Project,** developed an approach for identifying and prioritizing the testing of chemicals—including those found in the environment, consumer products, or workplaces—to see if they may raise the risk of breast cancer. A multidisciplinary panel of experts identified biological processes relevant to breast cancer and evaluated existing tests to detect if a chemical affects those processes. From this, they developed a framework for prioritizing chemicals to be tested. They also created the Hazard Identification Approach, a structured method for chemicals testing. The California Breast Cancer and Chemicals Policy Project's recommendations are already drawing attention, including from those developing a policy to protect Californians from toxic chemicals through the Green Chemistry Initiative, a key Institute of Medicine working group, and leaders in the U.S. Congress working to reform the decades-old Toxic Substances Control Act.

Three Special Research Initiative Studies Funded in 2010

Three Special Research Initiatives studies were funded this year:

- **California Breast Cancer Survivorship Consortium/Understanding Racial and Ethnic Differences in Stage-Specific Breast Cancer Survival.** Women from some racial and ethnic groups are less likely to survive breast cancer than others, even when they are diagnosed at the same stage and with the same kind of cancer. This study aims to find out why and identify ways to decrease breast cancer deaths among the most affected racial and ethnic groups. The project leverages resources found only in California: diverse ethnic and racial groups, plus expert researchers conducting ongoing investigations of breast cancer among a number of those groups. This study is based on the success of a pilot project the CBCRP funded in 2009 as one of our

first Special Research Initiatives. It gave researchers heading seven different projects the impetus to combine their resources for the first time.

- **Persistent Organic Pollutants and Breast Cancer Risk: Chemicals Old and New.** Persistent organic pollutants are a large group of chemicals that include the banned pesticide DDT and newer compounds still used as flame retardants. This project leverages data already collected about a large population of women over many years through the ongoing California Teachers Study. This is the first large-scale study to investigate whether exposure to common flame retardants and their replacements play a role in breast cancer.
- **Partnership to Advance Breast Cancer Research.** Researchers are working with the CBCRP to plan the coming five years of the CBCRP's program-initiated research. They will assemble a team to build on progress so far and develop further initiatives to study the environmental causes of breast cancer and ways to lift the burden on groups of women who suffer disproportionately from the disease. They will also recommend initiatives to advance primary breast cancer prevention (steps that can be taken to keep women and men from getting breast cancer.

Ongoing Special Research Initiatives

Special Research Initiatives funded previously and underway during 2010 include:

- **Demographic Questions for California Breast Cancer Research.** The state of California, researchers, and clinicians all collect data about who gets breast cancer. This study investigates the best way to improve these data. The goal is to better understand which groups of women suffer disproportionately from breast cancer and work to reduce their burden.
- **Biological/Ecological Models of Breast Cancer Causation and Prevention. S**cientists too often study only one possible cause of breast cancer at a time. A different approach is needed to make progress in uncovering the environment's role in breast cancer and in understanding why some groups of women bear a greater burden of the disease. This project is bringing together experts from many fields to develop better tools to raise awareness of and investigate—collectively—many co-existing and inter-related factors that are likely to affect breast cancer risk.
- **The Environmental Causes of Breast Cancer across Generations.** In the first-ever "womb to breast cancer" study in women, rather than in lab animals, CBCRP-funded researchers are finding out if women exposed to certain chemicals while they were developing in the womb are more likely to get breast cancer. The study is based on growing scientific evidence that women exposed to toxic chemicals at critical periods in their lives are more likely to get breast cancer years later.
- **New Statistical Models to Address Disease Complexity.** It takes complex math—made possible by new, more powerful computers—to evaluate the impact of many complex factors that may affect our risk of breast cancer. The CBCRP is funding research teams to develop new statistical methods that will allow researchers to better measure the many factors that act in combination across a woman's life span, increasing or lowering her risk of getting breast cancer.

Special Research Initiatives Result in the CBCRP Providing Statewide and National Environmental Leadership

As a result of the CBCRP's leadership in research into the role of the environment in breast cancer, the Program's director, Marion H.E. Kavanaugh-Lynch, serves on the nine-member California Environmental Contaminant Biomonitoring Program Scientific Guidance Panel. The panel assists the Department of Health Services and California Environmental Protection Agency by providing scientific peer reviews and making recommendations regarding the design and implementation of the California Environmental Contaminant Biomonitoring Program. Dr. Kavanaugh-Lynch also serves on the oversight committee of the Breast Cancer and Environment Research Centers (BCERC). BCERC is a network of four national centers, created by the National Institute of Environmental Health Sciences and the National Cancer Institute. The network supports research into the impact of prenatal-to-adult environmental exposures that may predispose a woman to breast cancer.

Research Progress and Results

The Research Progress and Results section is organized by the CBCRP's four major Priority Issues:

The Community Impact of Breast Cancer
Etiology and Prevention
Detection, Prognosis, and Treatment
Biology of the Breast Cell

The Community Impact of Breast Cancer

California is comprised of diverse communities differing by interwoven characteristics such as ethnicity, culture, language, sexual identity, immigration history, and socioeconomic status. This diversity offers the unique opportunity to investigate disparities and the unequal burden of breast cancer among underserved groups. Critical questions to be addressed include:

- How do poverty, race/ethnicity, and social factors impact incidence and mortality for breast cancer?
- What are the sociocultural, behavioral, and psychological issues faced by women at risk for or diagnosed with breast cancer?
- What services are needed to improve access to care in order to improve quality of life and reduce suffering?

The CBCRP addresses these issues through program-initiated research in addition to the research conducted by community academic partnerships and individual investigators.

Three research topics are represented in this section:

- Health Policy and Health Services: Better Serving Women's Needs
- Disparities: Eliminating the Unequal Burden of Breast Cancer
- Sociocultural, Behavioral, and Psychological Issues Relevant to Breast Cancer: The Human Side

Research Completed in 2010

California Chemicals Policy & Breast Cancer

A major challenge to investigating the relationship between chemical exposures and breast cancer is a lack of toxicity information for tens of thousands of commonly used chemicals. California's Green Chemistry Initiative seeks to eliminate or reduce the creation and use of hazardous chemicals. **Megan Schwarzman, M.D., M.P.H.**, at the **University of California, Berkeley**, and **Sarah Janssen, M.D., Ph.D., M.P.H.**, at the **Natural Resources Defense Council**, implemented a Breast Cancer and Chemicals Policy project that brought together a panel of biologists, chemical policy experts, toxicologists, epidemiologists, and advocates to develop an approach for identifying which chemicals might contribute to the development or progression of breast cancer. The testing scheme the panel developed, called the Hazard Identification Approach (HIA), evaluates a chemical's effect on a variety of endpoints in biological processes that could affect breast cancer risk. Drs. Janssen and Schwarzman are currently working with panel members to conduct a virtual pilot test of the HIA. This work has the potential to lead to new environmental and public health policies that could reduce breast cancer risk by identifying and limiting the manufacture and use of implicated chemicals. The report can be downloaded at http://coeh.berkeley.edu/greenchemistry/cbcrpdocs/pathways_report.pdf .

Race & Ethnicity in Stage-specific Breast Cancer Survival

Breast cancer deaths have been steadily decreasing in the U.S. since 1990. However, this decline has not been the same among all racial/ethnic groups—and it is not clear why. To investigate the reasons for this disparity, **Anna Wu, Ph.D.**, and **Kristine Monroe, Ph.D.**, at the **University of Southern California**, in Los Angeles; **Marilyn Kwan, Ph.D.,** at the **Kaiser Foundation Research Institute** in Oakland; **Leslie Bernstein, Ph.D.,** and **Katherine DeLellis Henderson, Ph.D.**, at the **Beckman Research Institute of the City of Hope**, in Duarte, and **Esther John, Ph.D.**, at the **Cancer Prevention Institute of California**, in Berkeley, worked together to explore the possibility of pooling data from their seven breast cancer case-control and cohort studies. Together they would have more than16,000 breast cancer cases in California, including 2603 African Americans, 2113 Asian Americans, 2582 Latinas, and 9306 non-Latina Whites to analyze for differences that could not be identified in the individual studies. Together, they

successfully produced a proposal that was recently funded by the CBCRP to conduct four studies to investigate factors that may impact racial/ethnic disparities in breast cancer survival as the California Breast Cancer Survivorship Consortium. The findings could lead to programs or initiatives that can reduce these disparities.

Breast Cancer Education for Deaf and Hard-of-Hearing Women
Deaf and hard-of-hearing women are invisible in the research that has shaped breast health and breast cancer educational interventions. Cultural, social, and communication barriers often prevent deaf and hard-of-hearing women from accessing public information about breast health and breast cancer, yet there currently are no breast health and breast cancer programs that have been developed specifically for this community. To address this problem, **Barbara Berman, Ph.D.**, at the **University of California, Los Angeles**, and **Heidi Booth, B.S.**, at the **Greater Los Angeles Council on Deafness, Inc.**, developed a comprehensive, multi-media breast cancer program tailored to meet the needs of deaf and hard-of-hearing women and then tested the program's effectiveness in a randomized controlled trial that enrolled 200 women 40 years of age and older. Dr. Berman and Ms. Booth have disseminated their findings to the deaf and hard-of-hearing community, health care providers, and others serving these women at meetings and workshops locally, regionally, and nationally. Their work has the potential to improve breast health among deaf and hard-of-hearing women.

Mindful Movement Program for Breast Cancer Survivors
Many breast cancer survivors continue to experience psychosocial and physical problems, such as anxiety, depression, fear of recurrence, and pain, long after their treatment is completed. Mindfulness training and movement-dance therapy has the potential to reduce these problems and improve breast cancer survivors' quality of life, but little if any research has been done in this area. **Rebecca Crane-Okada, Ph.D., R.N.,** at the **Beckman Research Institute of the City of Hope**, in Duarte, and **Holly Kiger, R.N., M.N.,** at the **YWCA Santa Monica/Westside**, conducted a randomized controlled trial that investigated the impact of a new and innovative 12-week Mindful Movement Program (MMP) that combined movement and mindfulness techniques on the quality of life of breast cancer survivors who were 50 years of age or older and were 12 months or more past completion of treatment. Their study found that the MMP had a positive effect on both mindfulness and quality of life (reducing fear of recurrence). Dr. Crane-Okada and Ms. Kiger now intend to study the MMP in a larger group of women. This work could result in an MMP becoming widely used to improve quality of life in breast cancer survivors.

Latina Breast Cancer Survivors…Our Experience
Survivorship is a distinct and important phase of the cancer experience, but it has been relatively neglected in education and clinical practice. Research is needed to understand patterns of delivery of survivorship care and to identify areas in need of intervention, particularly for Latinas and other populations at risk for disparities. **Diana Tisnado, M.P.A., Ph.D.,** at the **University of California, Los Angeles**, and **Brian Montano, M.P.H.,** at **Partnered for Progress** in Los Angeles, developed and implemented a Community Research Collaboration pilot project to examine issues of breast cancer survivorship care among Latinas in Los Angeles County. Focus groups they conducted with Latinas identified concerns including: quality of care, health insurance coverage, emergency MediCal, provider choice, fatigue, depression, cognitive problems, and family stress. Participant recommendations included support services for family members and caregivers. Dr. Tisnado and Mr. Montano will now develop and assess an intervention that will address the concerns they have identified. This work has the potential to improve the survivorship experience of Latinas with breast cancer.

Breast Cancer Risk Reduction in American Indian Women
Breast cancer incidence and mortality rates have been increasing among American Indian women over the past 20 years, and breast cancer is now their second leading cause of cancer death. American Indians currently have the poorest cancer screening rates of any ethnic group, and those with breast cancer have the lowest five-year survival rate. **Marlene von Friederichs-Fitzwater, Ph.D.,** at the **University of California, Davis**, and **Linda Navarro**, at the **Turtle Health Foundation,** in Sacramento, received a one-year planning grant that allowed their team of academic and community investigators to address weaknesses in the research plan and submit a revised CBCRP grant application. This work allowed them to strengthen their research and obtain a 2010 CBCRP grant for their study, "Increasing Mammography Screening among Native Women." Results from a CBCRP pilot project leading up to this grant was published in the *Journal of Cancer Education*. 2010 [E-pub, DOI 10.1007/s13187-010-0111-0]

Reproductive Concerns and Depression among Younger Survivors
Breast cancer can negatively impact a woman's fertility. **Jessica Gorman, M.P.H.**, at the **University of California, San Diego**, evaluated whether concerns about reproduction after breast cancer treatment were associated with long-

term depression in women diagnosed with early stage breast cancer at age 40 or younger. Her study showed that greater reproductive concerns independently predicted consistent depressive symptoms after taking into account both social support and physical health. In addition, both not having a child at the time of diagnosis and reporting treatment-related ovarian damage were strongly associated with higher reproductive concerns and with depression. These findings suggest that reproductive concerns are associated with depression, and that young survivors would benefit from additional information and support related to reproductive issues. This work provides additional evidence of a need for interventions to improve patient-provider discussions about reproductive issues prior to treatment and later in survivorship. Findings from this research were published in *Psycho-oncology* 19(2010)517.

Provider Communication and Health in Breast Cancer Survivors
Breast cancer survivors' perceptions of their communication with health care providers may be associated with their health habits and their physical health. **Sara Fernandes-Taylor, B.A**., at the **University of California, Berkeley**, interviewed breast cancer survivors in the San Francisco Bay Area to investigate how they perceived their communication with their doctors. Her study found that patients' perceptions of their communication with providers were not consistently associated with their sense of control over their health, their health behaviors, or health outcomes, and that problems with provider communication were associated with self-esteem and emotional support, rather than with socio-demographic characteristics, such as age, race, and education. In addition, women who were anxious about the future or had problems communicating with physicians during treatment were more likely to express regret five years later. This research suggests that breast cancer treatment could be improved by addressing the psychosocial aspects of cancer care in the survivorship phase; improving study design in physician-patient communication research; and addressing the unique emotional needs of women with recurrent cancers, who may experience an undue burden of regret. Findings from this research were published in *Psycho-oncology* 2010 Apr 23. [Epub ahead of print]

Research Initiated in 2010
2010 National Latino Cancer Summit
Ysabel Duron
Latinas Contra Cancer

California Breast Cancer Survivorship Consortium
Leslie Bernstein, Scarlett Gomez, Marilyn Kwan, Kristine Monroe, and Anna Wu
Beckman Research Institute of the City of Hope, Cancer Prevention Institute of California, Kaiser Foundation Research Institute, and University of Southern California

Increasing Mammography Screening Among Native Women
Linda Navarro and Marlene von Friederichs-Fitzwater
Turtle Health Foundation and University of California, Davis

Recording Medical Visits for People with Breast Cancer
Sara O'Donnell and Jeffrey Belkora
Mendocino Cancer Resource Center and University of California, San Francisco

Quality of Mammography Facilities Serving Vulnerable Women
Lauren Goldman
University of California, San Francisco

Research in Progress
Adapting a Breast Cancer Education Program for South Asians
Zul Surani, Roshan Bastani, and Beth Glenn
South Asian Cancer Foundation and University of California, Los Angeles

Breast Cancer Clinical Trials Education Program
Natasha Riley, Vanessa Malcarne, and Georgia Sadler
Vista Community Clinic, San Diego State University Research Foundation, and University of California, San Diego

Demographic Questions for California Breast Cancer Research
Scarlet Lin Gomez

Northern California Cancer Center

Expanding Rural Access: Distance Delivery of Support Groups
Mary Anne Kreshka, Suzanne Ferrier and Cheryl Koopman
The Sierra Fund and Stanford University

Health Anxiety as a Risk for Insomnia in Breast Cancer
Michelle Rissling
University of California, San Diego

Health Literacy in Older Patient's Breast Cancer Treatment
Arash Naeim
University of California, Los Angeles

Increasing Mammography Screening in Latinas with Diabetes
Christine Noguera and Steve Roussos
Golden Valley Health Centers and San Diego State Research Foundation

Macrophages in Breast Cancer Patients of African Descent
Rita Mukhtar
University of California, San Francisco

Neighborhoods and Obesity in Pre-Adolescent Girls: Part II
Irene Yen
University of California, San Francisco

New Methods for Genomic Studies in African American Women
Daniel Stram
University of Southern California
$442,631

Nuevo Amanecer: Promoting the Psychosocial Health of Latinas
Carmen Ortiz and Anna Napoles-Springer
Circulo de Vida Cancer Support and Resource Center and University of California, San Francisco

Patient and Clinician Knowledge of Breast Cancer Lymphedema
Marilyn Kwan
Kaiser Foundation Research Institute

Quality of Mammography Facilities Serving Vulnerable Women
Lauren Goldman
University of California, San Francisco

Risk Factors and Breast Cancer Survival in Black/White Women
Yani Lu
Beckman Research Institute of the City of Hope

Telephone-Based Decision Support for Rural Patients
Sara O'Donnell and Jeff Belkora
Mendocino Cancer Resource Center and University of California, San Francisco

Underserved Women with Breast Cancer at End of Life
Kendra Stone and Shelley Adler
Charlotte Maxwell Complementary Clinic and University of California, San Francisco

Etiology and Prevention

Although our foundation of knowledge for the basic science aspects of breast cancer (tumor biology) has expanded greatly over the past decade, there still remains a gap in our strategies for large-scale prevention due to uncertainties over the underlying causes of the disease and their relative importance. There is an extensive list of factors associated with increased or decreased risk for breast cancer. However, some of these factors (such as exposure to light at night) remain controversial; how others affect breast cancer (such as socioeconomic status) remains a mystery, and true causes are yet to be discovered.

The two research topics represented in this section are:

- Etiology: The Role of the Environment and Lifestyle
- Prevention and Risk Reduction: Ending the Danger of Breast Cancer

Research Concluded in 2010

Exploring Disparities, Environmental Risk Factors in Teachers
Breast cancer is more common in urban and industrial areas than in rural areas, fueling speculation that environmental pollutants may play a causal role in its development. **Peggy Reynolds, Ph.D.**, and **Susan Hurley, M.P.H.**, at the **Cancer Prevention Institute of California**, in Berkeley, and their team of researchers worked with a CBCRP-appointed Scientific Advisory Committee to determine how questions related to environmental risk factors could be integrated into the California Teachers Study, a large on-going breast cancer study. This work resulted in a detailed research proposal funded by CBCRP to investigate the risk of breast cancer associated with both older and newer persistent organic pollutants of human health concern, including polybrominated diphenyl ethers (PBDEs) and their replacement brominated flame retardants, polychlorinated biphenyls (PCBs), , and some organochlorine pesticides (e.g., DDT). This research will look for disparities in, and predictors of, body burden levels of these compounds and explore potentially important windows of susceptibility—times in a woman's life when exposure may be especially significant. This study offers an important opportunity to investigate how exposure to flame retardants and other persistent organic pollutants impacts breast cancer risk in different racial and ethnic groups.

Mammary Gland Evaluation and Risk Assessment
Human studies suggest that conditions that affect the hormonal environment of the developing fetus may affect breast cancer risk in adulthood. These findings support the hypothesis that fetal exposure to chemicals that affect hormone systems can also affect breast cancer risk. Because the effects of fetal exposures to these chemicals are difficult to study in humans, they are typically studied in animals. However, this area of research is new, and many questions remain about how to evaluate changes in an animal mammary gland structure that occur due to chemical exposure, and how to link findings in animals to potential breast cancer risk in humans. To advance this area of research, **Lawrence Kushi, Sc.D.,** at the **Kaiser Foundation Research Institute,** in Oakland, and colleagues, held a Mammary Gland Evaluation and Risk Assessment Workshop in Oakland in November 2009 that focused on developing a standard protocol for evaluating mammary gland morphology and chemical risk assessment. This protocol is necessary to advance our understanding of the impact early life exposure to chemicals that affect hormone systems can have on mammary gland development and susceptibility to cancer. It will also provide the scientific basis public policy experts need to develop and implement regulations that limit chemical exposures that are associated with breast cancer.

Circuit Training to Lower Breast Cancer Risk in Latina Teens
Obesity is rapidly rising in children, especially among Latinos. Girls who are overweight often start their menstrual cycles early in life and have an increased frequency of ovulatory cycles, which has been widely linked with increased post-menoapusal breast cancer risk. It is not known whether an exercise intervention can decrease breast cancer risk factors in youth, especially in a high-risk overweight minority population. **Jaimie Davis, Ph.D.,** at the **University of Southern California,** in Los Angeles, is investigating whether a 16-week circuit training (aerobic and strength training) program can impact breast cancer risk factors, such as age of menarche, frequency of ovulatory cycles, obesity, and insulin resistance in overweight, adolescent Latinas. This is one of the first studies to assess whether a physical activity intervention, particularly a circuit training approach, can lower breast cancer risk in youth. It also is one of the first studies to examine the relationship of physical activity, fat distribution (i.e., fat around the abdominal organs) and insulin resistance on breast cancer biomarkers in youth. This research will expand our understanding of

the feasibility of introducing exercise interventions to adolescent girls that may decrease their breast cancer risk as adults.

Grapefruit, Hormones, and Postmenopausal Breast Cancer Risk
Scientists have shown that grapefruit juice can interact with many prescription drugs, including estrogen and progesterone. Researchers have also found that postmenopausal women who consume very modest amounts of grapefruit have higher estrogen levels. Since estrogen is a well-established risk factor for breast cancer, it is biologically plausible that regular intake of grapefruit might increase breast cancer risk. To further investigate this interaction, **Kristine Monroe, Ph.D.**, and colleagues at the **University of Southern California**, in Los Angeles, studied the effects that consumption of different grapefruit products has on endogenous hormone levels in healthy, postmenopausal women. In their first analyses, Dr. Monroe and her colleagues found considerable inter-individual variability between baseline hormone values and the hormone values seen while consuming grapefruit. Additional analyses are now underway. Findings from this research will help determine whether grapefruit consumption may be a breast cancer risk factor in postmenopausal women. This grant was supported in part by a grant from the California Community Foundation

Folate, DNA Methylation, and Breast Cancer Metastasis
Folate is a B vitamin that is essential for making DNA and controlling gene expression. Both normal cells and cancer cells need folate for these purposes. DNA undergoes a chemical modification, called methylation, which regulates the expression of genes. The methyl groups available for DNA methylation are manufactured by folate. In 1998, the U.S. government mandated that cereals and grains be fortified with folate (folic acid) to reduce the number of birth defects. It is not known if the high levels of folate people are now consuming could have negative consequences, such as causing cancers to grow or spread more quickly. **Teresa Marple, Ph.D.,** at the **University of California, Davis**, initiated an investigation into how dietary intake of folic acid affects breast tumor metastasis. She resigned the project prior to completion.

FGFR2 Signaling in human Breast Cancer Cells
FGFR2 is a receptor tyrosine kinase belonging to the fibroblast growth factor receptor (FGFR) family. Recently, two large studies independently suggested that FGFR2 might play a role in postmenopausal invasive breast cancer. **Daniel Donoghue, Ph.D.,** and colleagues at the **University of California, San Diego**, investigated whether the single nucleotide polymorphisms (SNPs) within Intron 2 of FGFR2 that were identified in these studies alter FGFR2 expression in an estradiol-dependent manner. Dr. Donoghue's studies demonstrated qualitative changes in FGFR2 expression in response to estradiol and FGF, suggesting future avenues of research. These findings have the potential to open up a new line of study for breast cancer, since there is currently no published data confirming estradiol-dependent FGFR2 expression and any disease-associated polymorphisms. Findings from this research were published in *Cell Cycle* 8(2009)66.

Research Initiated in 2010

Light at Night and Breast Cancer Risk in California Teachers
Peggy Reynolds
Cancer Prevention Institute of California

Partnership to Advance Breast Cancer Research
Tracey Woodruff
University of California, San Francisco

Persistent Organic Pollutants & Breast Cancer Risk
Peggy Reynolds
Cancer Prevention Institute of California

Vitamin D and Breast Cancer Survival
Wei Wang
Cancer Prevention Institute of California

Research in Progress

Antidepressant and Breast Cancer Drug Interactions
Reina Haque
Kaiser Foundation Research Institute

Breast Cancer Risk Reduction: A Patient-Doctor Intervention
Celia Kaplan
University of California, San Francisco

Breast Cancer Risks in California Nail Salon Workers
Peggy Reynolds and Linda Okahara
Northern California Cancer Center and Asian Health Services

Cancer Mapping: Making Spatial Models Work for Communities
Eric Roberts
Public Health Institute

Environmental Causes of Breast Cancer Across Generations
Barbara Cohn
Public Health Institute

Genes in Hormone Metabolism Pathway and Breast Cancer
Eunjung Lee
University of Southern California

Model-building with Complex, High-dimensional Exposures
David Nelson
Northern California Cancer Center

New Paradigm of Breast Cancer Causation and Prevention
Robert Hiatt
University of California, San Francisco

Pesticide and Gene Interactions in Latina Farm Workers
Paul Mills
University of California, San Francisco

Prognostic Implications of DNA Glycation in Breast Cancer
Daniel Tamae
Beckman Research Institute of the City of Hope

Soy Treatment for High-risk Women and DCIS Patients
Anna Wu
University of Southern California

Detection, Prognosis, and Treatment

Until we learn how to prevent all breast cancers, detection, prognosis and treatment are research areas that need to be pursued. The detection, prognosis, and treatment topics funded by the CBCRP continue to change as novel technologies and approaches come under investigation. Breast cancer detection technology is moving past traditional mammography; diagnosis is depending on understanding the genetic profile of tumors rather than the anatomy; and treatment is moving toward more tailored and personalized approaches. Alternative therapies and drugs, especially those derived from plants, engender intriguing areas of investigation. Taken together these advances are leading to patient care that treats women appropriately and spares them unnecessary side effects.

Two research topics are represented in this section:

- Imaging, Biomarkers, and Molecular Pathology: Improving Detection and Diagnosis
- Innovative Treatment Modalities: Search for a Cure

Research Concluded in 2010

6th Symposium on the Intraductal Approach to Breast Cancer
The Dr. Susan Love Research Foundation works to eradicate breast cancer by advancing research and developing resources that explore the intraductal approach to the breast. As part of this effort, and with principal support from the CBCRP, **Dixie Mills, M.D.**, and her colleagues at the **Dr. Susan Love Research Foundation** in Santa Monica, hosted the 6th International Symposium on the Intraductal Approach to Breast Cancer in February 2009. The Symposium included the mini-Symposium "A Novel Etiology for Breast Cancer: Inflammation;" live demonstrations of ductoscopy, ductosonography, and methods of collecting nipple aspirate fluid; and a Public Panel that provided the local community with an opportunity to learn more about the intraductal approach to breast cancer. At the close of the Symposium, the Foundation awarded $84,000 in pilot grants to eight new investigators for their unique studies in the intraductal field.

Chemical Inhibitors of Hsp70 for Breast Cancer
Heat shock protein 70 (Hsp70) is a molecule that protects cells. In normal cells it is found in only small amounts. However, in cancer cells the level of Hsp70 is hundreds of times higher, which helps to protect it from the toxic effects of chemotherapy. **Chung-Wai Shiau, Ph.D.,** at **Sanford-Burnham Medical Research Institute** in La Jolla, attempted to create chemicals that could inhibit Hsp70 and that might eventually be used as new breast cancer treatments. Dr. Shiau and his colleagues screened 60,000 compounds, and a number of potential compounds were identified before Dr. Shiau was required to return to his home country, Taiwan.

Real-Time 3D Ultrasound Image-Guidance for Breast Surgery
The surgeon's goal during breast cancer surgery is to remove the entire tumor as well as a small margin of healthy tissue surrounding the tumor. If a sufficient margin is not removed during the initial surgery, cancer cells may be left behind, substantially increasing the risk of a cancer recurrence. **Michael Bax, M.S.,** at **Stanford University** in Palo Alto, is developing an advanced ultrasound-based, three-dimensional (3D) visualization and navigation tool that doctors can use prior to, during, and after surgery to ensure successful removal of the cancer. The system is now ready to be evaluated in a clinical environment, where it will be further refined and improved for use in the surgical setting.

Inhibition of Brain Metastases in Breast Cancer
New and better approaches are desperately needed to treat brain metastases. **Brunhilde Felding-Habermann, Ph.D.,** and colleagues at the **Scripps Research Institute** in La Jolla, developed unique new human breast cancer cell models and analytical systems that allowed them to follow the development of breast cancer brain metastases step-by-step and to evaluate how these lesions respond to treatment. Using these models they showed that integrin avß3 (a receptor important in tumor growth and spread) very strongly promotes breast cancer cell survival in the brain and central nervous system. Next, they isolated antibodies that can keep avß3 from functioning. Lastly, they showed that treatment with these antibodies could interfere with early metastatic disease and reach breast cancer metastasis in the brain. This work overcomes a major hurdle that has been a stumbling block for research on brain metastases, and it will allow Dr. Felding-Habermann to investigate new treatments for brain metastases. If successful, this approach could lead to the development of a new therapy for brain metastases in breast cancer patients. Findings from this research appeared in *Cancer Research* 67(2007)1472 and *Clinical Cancer Research* 13(2007)1656.

Mechanism of HSP90 Inhibitor Action in Breast Cancer
Aromatase is an enzyme that converts androgen into estrogen. Breast cancer tumors that are hormone sensitive are often treated with anti-estrogen therapies called aromatase inhibitors. However, over time, tumors can become resistant to these drugs. **Cynthie Wong, B.S., B.A.,** and colleagues at the **Beckman Research Institute of the City of Hope,** in Duarte, are investigating whether HSP90 inhibitors, such as 17-DMAG, might be an effective therapy for breast cancer tumors that have stopped responding to aromatase inhibitors. Their studies demonstrated that at low doses 17-DMAG kills cancer cells, but not normal cells, which is crucial for a targeted therapy. The team is continuing to investigate how aromatase inhibitor- and tamoxifen-resistant breast tumors respond to HSP90 inhibitors. This work could lead to new treatments for hormone-sensitive breast cancer tumors that have stopped responding to aromatase inhibitors.

Polyamide Inhibitors to Block Estrogen Receptor Function
A low level of oxygen, or hypoxia, causes a cell to increase its levels of a DNA-binding protein called hypoxia inducible factor (HIF). In addition to activating genes involved in blood vessel formation, HIF also activates genes directly implicated in invasion and metastasis that allow the cell to detach from its neighbors and move through the extracellular matrix. This suggests that HIF plays a role in breast cancer progression. **John Phillips, M.S.**, and colleagues at the **California Institute of Technology**, in Pasadena, attempted to design a small molecule called a DNA-binding polyamide that could inhibit the estrogen receptor, a key gene that controls the progression of many breast cancers. Although the compound performed well in cell-free systems, it was not successful in inhibiting ER function in breast cancer cells. Dr. Phillips and his colleagues are now studying other small molecules that may have the potential to become effective breast cancer treatments.

Engineering EGFR Antagonists for Breast Tumor Targeting
Epidermal growth factor receptor (EGFR) protein is found on up to 90% of breast cancer cells, and its presence correlates with tumor aggressiveness and poor clinical prognosis. EGFR must be activated before it can transmit extracellular signals. This activation occurs when specific binding partners attach to the protein. **Jennifer Lahti, M.S.**, and colleagues at **Stanford University** in Palo Alto are using an experimental technique known as directed evolution to engineer EGFR inhibitors that will prevent receptor activation and, in turn, inhibit breast cancer growth. Ms. Lahti and her colleagues were unable to identify molecules sufficient for further development. However, they did explore and publish alternative protein engineering approaches to develop EGFR inhibitors, which will be useful in the development of new breast cancer therapies. Findings from this research were published in the *Journal of Molecular Biology* 385(2009)1064 and *PLoS Computational Biology* 5(2009) e1000499.

Molecular Imaging of Metastatic Lymph Nodes in Breast Cancer
Breast cancer surgery typically includes a sentinel node biopsy or axillary node dissection. These procedures are used to assess whether the cancer has spread to the lymph nodes, which helps determine both the cancer's stage and treatment options. **Ella Jones, Ph.D.,** and colleagues at the **University of California, San Francisco** are trying to develop a non-invasive imaging probe that could be used as an alternative to lymph node surgery. The probe would characterize lymph nodes and breast cancer metastases at a molecular level by looking for the presence of a protease called Cathepsin B, which is produced in large quantities on the surface of malignant cancer cells. If successful, the molecular imaging probe could provide quantifiable information about tumor invasion. Its use could also reduce or eliminate side effects, like lymphedema, that are associated with lymph node removal.

Breast Cancer Treatment Monitoring Combining MRI and Optics
Chemotherapy given before surgery (neoadjuvant treatment) is used to reduce the size of a large tumor prior to surgery. However, not all tumors will respond to chemotherapy. Having an early way to identify these tumors could help patients avoid a toxic and ineffective treatment as well as expedite the use of an alternative therapy. **Catherine Klifa, Ph.D.,** and colleagues at the **University of California, San Francisco** are developing a way to use magnetic resonance imaging (MRI) along with diffuse optical spectroscopy to quantify changes in the breast tissue of patients undergoing neoadjuvant chemotherapy. Their goal is to identify new markers of treatment response that could be evaluated after treatment begins. If successful, this work could lead to a safe, fast, and inexpensive test that could be used to monitor the tumor's response during cancer treatment.

Neural Stem Cell Therapy for Breast Cancer Brain Metastases
Few therapies exist for treating breast cancer brain metastases, and those that are available prolong survival for only a few weeks or months. **Brunhilde Felding-Habermann, Ph.D.,** and colleagues at the **Scripps Research Institute** in La Jolla are exploring whether brain metastases can be treated with neural stem cells (NSCs), which have a natural

ability to seek out diseased areas in the brain and regenerate damaged brain tissue. Dr. Felding-Habermann and her team have developed new models of breast cancer brain metastasis that faithfully reflect the spectrum of cell types seen in the clinic. This has allowed them to identify the earliest cellular events that occur when breast cancer brain metastasis develop, document how the brain responds to incoming cancer cells, and identify a mechanism by which breast cancer cells thrive within the brain tissue. If successful, this work could lead to the development of new therapies for treating breast cancer brain metastases. Findings from this research appeared in *Clinical & Experimental Metastasis* 27(2010)217; *American Journal of Pathology* 176(2010)2958; *Methods in Molecular Biology* 568(2009)249; and the *Proceedings of the National Academy of Sciences of the United States of America* 106(2009)10666.

Nanotherapy for Breast Cancer Targeting Tumor Macrophages
Tumor associated macrophages (TAMs) comprise up to 80% of the cells in a breast tumor. Studies have shown that TAMs can promote tumor cell proliferation, angiogenesis, and metastasis, suggesting that a drug that can target TAMs could be an effective breast cancer treatment. **Gaurav Sharma, Ph.D.,** at **Sanford-Burnham Medical Research Institute** in La Jolla, developed a nanoparticle therapy that targets and delivers drugs to TAMs. Dr. Sharma's nanoparticles are fabricated from polylactic-co-glycolic acid (PLGA) polymer, which is approved by the FDA for a variety of drug delivery applications; encapsulate clodronate (a bisphosphonate originally used to treat osteoporosis) as an anti-macrophage drug; and are "decorated" with a peptide called Lyp-1 that can selectively target TAMs. To further boost drug-delivery, Dr. Sharma changed the shape of the nanoparticle to stimulate internalization by macrophages. These studies provide the proof-of-concept for targeting TAMs and could lead the development of a new breast cancer treatment.

Functional Breast MRI with BOLD Contrast
Magnetic resonance imaging (MRI) is increasingly being used for early breast cancer detection. However, MRI is associated with many false-positive findings, leading to unnecessary biopsies. It also requires intravenous injection of a contrast agent, such as gadolinium. **Rebecca Rakow-Penner, M.S.,** and colleagues at **Stanford University** in Palo Alto are investigating whether it is feasible to use blood oxygen level dependent (BOLD) contrast to help characterize tumors, predict susceptibility to treatment, and monitor chemotherapeutic response. This technique has traditionally been used to study the brain, but it has the potential to evaluate tumor metabolism and angiogenesis. Ms. Rakow-Penner and her team developed a robust methodology for detecting BOLD contrast on healthy volunteers and evaluated the method on three breast cancer patients. They now intend to test the protocol on a larger population. Findings from this research appeared in the *Journal of Magnetic Resonance Imaging* 32(2010)120.

Novel Anti-HER2 Fragments for Better Detection and Therapy
A breast tumor's treatment is determined by its HER2 status. Currently, immunohistochemistry of a tumor biopsy is used to assess HER2 status; however, this method is both invasive and time-consuming. **Shannon Sirk, Ph.D.,** and colleagues at the **University of California, Los Angeles**, investigated whether whole body breast imaging would aid in earlier and more accurate detection and diagnosis of HER2-positive tumors. Dr. Sirk and her team created a novel HER2-targeting biomolecule that can carry cargo to HER2-positive tumors in vivo, and developed a streamlined method for radiolabeling biomolecules for same-day, high-contrast imaging applications. This work has the potential to improve non-invasive detection, diagnosis, and treatment of HER2-positive breast cancer. Findings from this research appeared in *Bioconjugate Chemistry* 20(2009)1474 and 19(2008)2527.

Inhibition of TF Signaling as a Novel Breast Cancer Therapy
Blood clotting is often seen in cancer patients. Tissue factor (TF), the initiator of blood clotting, is expressed on the surface of many cell types, including cancer cells. In addition to initiating blood clotting, TF also initiates internal cell signaling by turning on the protease-activated receptor 2 (PAR2). This suggests that TF-PAR2 signaling plays a role in tumor growth, tumor angiogenesis, and metastasis. **Wolfram Ruf, M.D.,** and colleagues at the **Scripps Research Institute** in La Jolla evaluated the effects of an antibody they identified that can block direct TF signaling without altering TF-induced clotting. Using mouse models and human breast cancer cell lines, they showed that blocking TF signaling with this antibody in an aggressive breast cancer model reduced tumor growth. They also showed that the antibody worked well when used along with other cancer drugs that block angiogenesis. This work has the potential to lead to the development of a new breast cancer drug that works by blocking TF signaling.

Imaging Novel Stem Cell Therapy Targeting Breast Cancer
Chemotherapy kills cancer cells but it also kills normal cells, resulting in significant side effects. Targeted therapies that only kill cancer cells have the potential to be more effective, and less toxic. **Joseph Wu, M.D., Ph.D,** and

colleagues at **Stanford University** in Palo Alto have significant expertise in the cultivation, differentiation, and transplantation of human embryonic stem cells (ESCs). Their goal is to develop a stem cell-based cancer therapy that will target both angiogenesis (the growth of new blood vessels) and the breast tumor itself. This work could lead to the development of a novel stem cell therapy for breast cancer. Findings from this research appeared in *Cancer Research* 69(2009)2709, *Experimental Biology Annual Meeting* 4(2009)e7040, and *PLOS One* 4(2009)e8443.

Treating BC Brain Metastases with Cytotoxic Lymphocytes
As women with metastatic breast cancer live longer, brain metastases is becoming more common. However, the currently available treatments for brain metastases are ineffective. **Barbara Mueller, Ph.D.,** and colleagues at the **Sidney Kimmel Cancer Center** in San Diego are investigating whether allo-reactive cytotoxic lymphocytes (alloCTL) are an effective therapy for brain metastases. Dr. Mueller has established a protocol to generate alloCTL from unrelated blood donors directed against human breast cancer cells, and she has demonstrated that this therapy can specifically kill breast cancer cells. Her team has now shown that this therapy suppresses brain metastases in a mouse model. This work could lead to the development of an effective, non-toxic therapy for breast cancer that has metastasized to the brain.

Novel Small Proteins for PET Imaging of Breast Cancer
HER2 is an important breast cancer biomarker that helps determine treatment options. A technology that can accurately test HER2 status would advance clinical management of breast cancer patients. **Zhen Cheng, Ph.D.,** and colleagues at **Stanford University** in Palo Alto are developing a positron emission tomography (PET) probe that uses a new class of scaffold proteins, called Affibody molecules, to non-invasively image HER2 status in breast cancer. If successful, this new PET imaging agent could be used in the clinic to provide a real-time, non-invasive assay of HER2 expression in patients. Findings from this research were published in *ChemBioChem* 10(2009)1293 and *Journal of Nuclear Medicine* 50(2009)1492.

Diffusion-Weighted MRI in Monitoring Breast Cancer Treatment
Chemotherapy given prior to surgery (neoadjuvant treatment) is used to shrink the breast tumor, allowing for less extensive surgery. Giving chemotherapy before surgery also provides information about whether the tumor will later respond to chemotherapy. **Lisa Singer, B.S.,** and colleagues at the **University of California, San Francisco** are investigating whether the apparent diffusion coefficient (ADC) obtained from diffusion-weighted magnetic resonance imaging (DW-MRI)—a non-invasive, non-contrast, and non-ionizing way to detect microscopic changes in cell density and cell content—can improve the ability to predict tumor response to neoadjuvant chemotherapy. Their results suggest that ADC measurement can be improved and made more time-effective, but these technical advances must be compared to standard methods. Large, prospective studies are now needed to determine whether ADC is valuable in predicting treatment response and should have a place in the clinical setting.

Research Initiated in 2010

A Novel Mediator of AI Resistance in Breast Cancer
Karineh Petrossian
Beckman Research Institute of the City of Hope

Breast Cancer Neoadjuvant Chemotherapy Response with miRNA
Shizhen Emily Wang
Beckman Research Institute of the City of Hope

Electronics for High Resolution Breast-Dedicated PET
Frances Lau
Stanford University

Enhancing Trastuzumab Therapy with an NK Activating Antibody
Ronald Levy
Stanford University

HER2 Co-Amplified Genes and Treatment Response
Michael Press
University of Southern California

Inhibiting Breast Cancer Brain Metastasis with Cilengitide
Brunhilde Felding-Habermann
Scripps Research Institute

Measuring Real-World Breast Cancer Outcomes
Allison Kurian
Stanford University

MRI Guided Focused Ultrasound in Breast Cancer Treatment
Rachel Bitton
Stanford University

MRI Registration for Therapy Evaluation and Annual Screening
Muqing Lin
University of California, Irvine

Multimarker miR Blood Assay for Breast Cancer Detection
Dave Hoon
John Wayne Cancer Institute

New Estrogen Receptor Downregulators for Breast Cancer
Richard Pietras
University of California, Los Angeles

Receptor Re-expression in ER and PR Negative Breast Cancer
Dennis Holmes
University of Southern California

The Role of ANCCA in Tamoxifen Resistant Breast Cancer
Nicolas Andrews
University of California, Davis

Salivary Biomarkers for Early Detection of Breast Cancer
Lei Zhang
University of California, Los Angeles

Targeting Brain Metastasis with a Cell-based Approach
Mihaela Lorger
Scripps Research Institute

Targeting breast tumor stem cells with cell cycle inhibitors
Noelle Huskey
University of California, San Francisco

Targeting Drug Resistant Breast Cancer by microRNAs
Hailiang Hu
University of California, Los Angeles

Towards Highly Effective Inactivation of HER2-HER3 Signaling
Mark Moasser
University of California, San Francisco

Research in Progress

Antibody-based Targeting of Breast Cancer Stem Cells
Claudia Gottstein
University of California, Santa Barbara

Chemerin as an Immunotherapeutic Agent in Breast Cancer
Russell Pachynski
Palo Alto Institute for Research & Education

Combating Breast Cancer with the Wellderly Immune Repertoire
Brunhilde Felding-Habermann
Scripps Research Institute

Compounds Blocking Assembly of LRH-1 in Breast Cancer
Cindy Benod
University of California, San Francisco

Development of a Breast MRI Computer-Aided Diagnosis System
Ke Nie
University of California, Irvine

Genetics of Tamoxifen Response
Elad Ziv
University of California, San Francisco

ID4: A Prognostic Factor of Breast Cancer Metastasis
Dave Hoon
John Wayne Cancer Institute

Inhibitors of Condensin I as Chemotherapy for Breast Cancer
Kyoko Yokomori
University of California, Irvine

Intraductal Therapy of DCIS: a Presurgery Study
Susan Love
Dr. Susan Love Research Foundation

Membrane-associated Estrogen Receptors in Breast Cancer
Richard Pietras
University of California, Los Angeles

Metabolite Imaging to Identify Drug Resistant Breast Cancer
Trent Northen
Lawrence Berkeley National Laboratory

Modulation of Breast Cancer Stem Cell Response to Radiation
Frank Pajonk
University of California, Los Angeles

A Predictive Factor for Eribulin Treatment of Breast Cancer
Jennifer Smith
University of California, San Francisco

Sound Speed Tomography for Early Breast Cancer Detection
Jakob Nebeker
University of California, San Diego

Stratifying DCIS Biopsies for Risk of Future Tumor Formation
Thea Tlsty
University of California, San Francisco

Survival in de novo and recurrent metastatic breast cancer
Sumanta Pal
Beckman Research Institute of the City of Hope

Targeting DNA Repair Function of Breast Cancer Stem Cells
Xiaohua Wu
Scripps Research Institute

Topoisomerase-IIa as a Predictor of Anthracycline Response
Michael Press
University of Southern California

Reducing Surgical Morbidity of Breast Cancer Staging
Steven Chen
University of California, Davis

The Biology of the Breast Cell

To understand the origin of breast cancers, more research is needed on the pre-cancerous, causative events in the normal breast. In breast development, cell populations must coordinate migration, proliferation, and apoptosis (cell death) over space and time. In cancer progression these processes become deregulated, initially at the genetic level that leads to the physiological changes associated with malignancy. An inability to recognize and properly repair damage to DNA that occurs in normal cell physiology and enhanced by environmental factors is recognized as driving force of cancer progression.

An emerging paradigm identifies progenitor stem cells as the key to the origin of tumors. Stem cell populations reside in body organs to provide the raw material for tissue regeneration, repair, and for the cyclic proliferation of breast cells in response to hormones and pregnancy. If this paradigm proves correct, then only a small fraction (1-2%) of cells in a tumor mass retain stem/progenitor cell properties, and these "cancer stem cells" must be selectively targeted to achieve an effective eradication of the disease.

Important basic science topics represented in CBCRP's portfolio include: exploring the role of stem cells in normal and tumor breast; cell proliferation control mechanisms through the estrogen receptor and growth factor receptors (e.g., Her-2); alterations in DNA repair processes that permit genetic damage to accumulate in cancer cells; cell cycle changes that permit division under conditions where normal cells would undergo programmed cell death (apoptosis); novel biomarkers to distinguish pre-cancerous and cancerous cells from normal breast epithelium and their validation as potential new detection and therapy targets, and developing methods for accounting for the complexity of the interplay of all of these factors in breast cancer.

Two of the CBCRP's research areas are presented in this section.

- Biology of the Normal Breast: The Starting Point
- Pathogenesis: Understanding the Disease

Research Concluded in 2010

The Role of Podosomes in Breast Cancer Metastasis
Early detection has greatly reduced breast cancer mortality. However, once breast cancer has metastasized treatment options are limited. Studies suggest that cancer cells use specialized structures called podosomes to help them invade surrounding tissue. These podosomes, which are located on the front of the cellular membrane, are composed of a number of different proteins. One of these proteins is called Tks5, and studies have found that its presence in human breast cancer correlates with tumor progression. **Barbara Blouw, Ph.D.,** at **Sanford-Burnham Medical Research Institute** in La Jolla used a mouse model of breast cancer to investigate whether Tks5 and podosomes play a role in breast cancer tumor growth and progression. Preliminary data suggest that when the levels of Tks5 are reduced, growth of the primary cancer is decreased. Dr. Blouw is conducting experiments to verify these findings and to further analyze the role Tks5 and podosomes may play in metastasis. This work could lead to new treatments for metastatic breast cancer. Findings from this research were published in the *European Journal of Cell Biology* 87(2008)555.

Novel Regulation of the Rb Pathway in Breast Epithelium
For a normal cell to transform into a breast cancer cell multiple mutations must occur in the cell's genes. Some of the genes that are often lost in breast cancer are called tumor suppressors. Their job is to keep breast cells from abnormally multiplying. **Deborah Burkhart** and colleagues at **Stanford University** in Palo Alto are studying the pRB family of tumor suppressors, which is comprised of pRB (a retinoblastoma protein), and its associated proteins p107 and p130. Normally pRB prevents the cell from replicating damaged DNA by blocking its progression through the cell cycle. This project focused on learning more about p107, and how it can block cancer in pRB-deficient breast cells. The team successfully developed and published a novel p107-GFP reporter transgenic mouse line. Their studies using this mouse line showed that in wild-type animals p107 levels appear to decrease over the course of development, even during mid-pregnancy when the ducts are expanding. They also showed that in some cells in the mammary gland p107 expression could increase in the absence of Rb. This research could lead to new insights into how breast cancer develops. Findings from this research were published in *Cell Cycle* 7(2008)2544 and *Nature Reviews Cancer* 8(2008)671.

Indole (I3C) Control of Breast Cancer by ER Downregulation
Studies have found that indole-3-carbinol (I3C), a phytochemical found in cruciferous vegetables, such as broccoli, can slow the growth of human breast cancer cells because it has an effect on cell cycle regulators like estrogen receptor-alpha (ERα). **Crystal Marconett, B.A.,** and colleagues at the **University of California, Berkeley** conducted studies that would illuminate how I3C affects ERα. Their work established the molecular mechanism I3C elicits to ablate ERα expression in hormone sensitive breast cancer cells, and demonstrated that ERα-dependent loss of other downstream gene targets—IGF1R and IRS1, critical regulators of growth factor signaling in breast cancer—accounted for the loss of proliferation. These research findings suggest that I3C could be pursued as a potential new breast cancer treatment. Findings from this research appeared in *Molecular and Cellular Biology* 21(2010)1166.

Tumor Suppressor 14-3-3sigma in Breast Cancer Progression
There are at least five breast cancer subtypes, with distinct genetics, response to chemotherapy, clinical outcome, and biology. Developing effective targeted cancer therapies requires learning more about the molecular basis of tumor progression of each breast cancer subtype. **Aaron Boudreau, B.Sc.,** and colleagues at the **Lawrence Berkeley National Laboratory** recently identified a protein called 14-3-3sigma that becomes highly expressed during malignancy in a culture model of breast cancer progression. Mr. Boudreau's research characterized a novel mechanism by which 14-3-3sigma regulates cell migration and invasion by regulating the homeostasis of the cell's cytoskeleton. Their research also found that there are high levels of 14-3-3sigma in a specific subset of breast tumors that are associated with a poor clinical outcome. These findings suggest that targeting 14-3-3sigma may be an effective therapeutic strategy in a subset of breast tumors. Findings from this research were published in *Cancer Metastasis Reviews* 28(2009)167.

Dietary Metabolite Inhibition of Breast Cancer Cell Survival
Indole-3-carbinol (I3C), a phytochemical found in cruciferous vegetables, such as broccoli, can slow the growth of human breast cancer cells. 3,3'-Diindolylmethane (DIM), the major acid condensation product of I3C, has been shown to have anticancer effects in breast cancer. DIM also inhibits Akt, a kinase whose signaling promotes proliferation, survival, and motility in breast cancer cells in vitro. **Holly Nicastro, B.S.,** and colleagues at the **University of California, Berkeley** investigated whether DIM's inhibition of Akt is partly responsible for DIM's anti-proliferative/pro-apoptotic effects. They found that DIM inhibits proliferation, cell cycle progression and motility, and induces apoptosis in MDA-MB-231 breast cancer cells, which is consistent with Akt inhibition. They also showed that DIM inhibits Akt downstream of hepatocyte growth factor (HGF). And they found that DIM decreases activation of c-Met at several tyrosine residues, indicating decreased activation of the receptor. These findings suggest that DIM is a promising potential therapeutic option for breast cancers with aberrant HGF/c-Met/Akt signaling.

Dissecting the Role of Twist in Breast Cancer Metastasis
Several changes that occur in metastatic cancer cells resemble an evolutionarily conserved process in embryonic development called epithelial-mesenchymal transition (EMT). Recently, a gene-regulatory transcription factor called Twist was shown to play a prominent role in promoting EMT in mammalian breast cancer cells. **Janine Low-Marchelli, B.S.,** and colleagues at the **University of California, San Diego** are investigating whether the Twist protein promotes breast cancer metastasis. Using a new technology called ChIP-Sequencing, they are trying to identify the genes that are under the direct control of Twist during angiogenesis (the growth of a tumor's blood vessels). They found that a gene called semaphoring appears to be required for angiogenesis, but that it cannot promote angiogenesis on its own. They now intend to conduct additional research into semaphorin's role in angiogenesis. This work could help lead to the development of prognostic tools and drugs that can more accurately predict and treat breast cancer metastasis.

Chemokine Receptor Signaling in Breast Cancer
Chemokines and their receptors play an important role in the immune system by guiding the migration of cells involved in routine immune surveillance and inflammatory responses. However, cancer cells also can use these proteins to facilitate metastasis and enhance tumor growth. **Morgan O'Hayre, B.S.**, and colleagues at the **University of California, San Diego** are studying the role the chemokine CXCL12 and its receptors, CXCR4 and CXCR7, play in breast cancer progression. (CXCR4 and CXCR7 receptors are not normally found in breast tissue, but they are often found in breast cancer.) Their studies demonstrated that while both CXCR4 and CXCR7 could accelerate primary tumor growth, CXCR4 appeared to have a stronger effect. They also demonstrated that presence of CXCR4 but not CXCR7 enhanced rates of metastasis to the lungs and lymph nodes. In addition, the research team identified a tumor suppressor protein, programmed cell death factor 4, as a novel target of CXCL12 signaling that may contribute to

breast cancer cell growth. Ms. O'Hayre and her colleagues are continuing to conduct experiments on CXCR4 and CXCR7 and their role in breast cancer growth and metastasis. These findings could lead to the identification of new targets for new breast cancer treatments. Findings from this research appeared in *Cell and Molecular Life Sciences* 66(2009)1370, *Methods and Enzymology* 460(2009)331, and *PLOS One* 5(2010)e11716.

Maternal Embryonic Leucine Zipper Kinase in Mammary Tumors
The maternal leucine zipper kinase (Melk) gene is a potential marker of proliferating mammary epithelial progenitor cells that are highly expressed in multiple human cancers, including breast cancer. **Robert Oshima, Ph.D.,** and colleagues at **Sanford-Burnham Medical Research Institute** in La Jolla used a genetically engineered mouse model to determine whether Melk played a role in breast cancer. They found that in their model Melk kinase activity was not required for mammary tumors. However, additional experiments using shRNA (short hairpin RNA) knockdown of Melk decreased the ability of cultured mammary tumors to form both tumors in vivo and tumorspheroid colonies in cell culture. Specifically, Melk shRNA decreased tumor frequency by six fold. This research suggests that Melk protein, but not kinase activity, may be important for mammary tumor formation. These findings could lead to a new target for new breast cancer therapies.

The Regulation of SATB1 in Metastatic Breast Cancer
Metastasis occurs when cancer cells travel through the body and create new tumors in other organs. **Laurie Friesenhahn, Ph.D.,** and colleagues at the **Lawrence Berkeley National Laboratory** are studying a protein called SATB1 (Special AT Sequence Binding Protein 1), which regulates the tumor-initiating and metastatic potential of breast cancer cells. Not every cancer cell in a primary breast tumor has the SATB1 protein, and Dr. Friesenhahn and her team explored their hypothesis that cells with SATB1 are an aggressive, metastatic, sub-population of tumor-initiating cells. Their studies showed that cells with SATB1 are resistant to the widely used breast cancer chemotherapy drug fluorouracil. This finding supports the hypothesis that breast cancer cells that express SATB1 pose a greater risk of relapse to the patient. Dr. Friesenhahn and her team intend to continue to investigate the link between SATB1 expressing cells and chemo-resistance, using different chemotherapy drugs and different breast cancer cell lines. They also intend to investigate how cells initiate and sustain SATB1 expression. Their findings could lead to the development of new breast cancer therapies that target SATB1.

Role of Circadian Rhythm Gene Homolog PER3 in Breast Cancer
Studies suggest that disruption of day-night cycles—which occurs, for example, during night-shift work—can increase breast cancer risk. These day-night cycles, called circadian rhythms, are controlled by defined molecular pathways. Circadian rhythm genes show daily cycles in their gene expression and protein activity. **Kuang-Yu Jen, M.D., Ph.D.,** and colleagues at the **University of California, San Francisco** previously discovered that mice deficient in one of the circadian rhythm genes, known as Period3 (Per3), are more susceptible to developing breast tumors following exposure to carcinogens. They have now demonstrated that the cancer susceptibility in Per3-deficient mice is likely not attributed to their acute ability to repair DNA damage. They also have shown that breast cancer tumors that express low amounts of PER3 are more likely to stop responding to anti-hormone treatment. Dr. Jen's team intends to pursue additional research on PER3 levels in breast cancer. Findings from this research were published in the *Journal of Clinical Oncology* 28(2010)3770.

Understanding the Role of GATA3 in Breast Cancer
Despite recent advances in our understanding of breast cancer, patients who do not respond to treatment or who develop metastatic disease have a poor prognosis. Currently, the molecular basis for the metastases process remains largely unknown**. Jonathan Chou, B.S.,** at the **University of California, San Francisco**, studied GATA3, a master regulatory transcription factor that specifies mammary cell differentiation. Because GATA3 is lost in breast cancer progression, Mr. Chou and his team were interested in investigating how it functions at the molecular and cellular level to prevent metastasis. Their studies found that GATA3 induces the expression of miR29b, a miRNA that has recently been shown to be a tumor suppressor, and they showed that miR29 family members regulate key factors involved in blood vessel recruitment and permeability, including vascular endothelial growth factor. They also showed that miR29b is lost during tumor progression in a mouse model of breast cancer, concomitant with the loss of GATA3. The laboratory is now investigating whether miR29b targets are important regulators of tumor metastasis, and whether miR29b expression promotes mammary cell differentiation. This research could lead to the development of new breast cancer treatments. Findings from this research appeared in the *Journal of Cellular Physiology* 222(2010)42.

Research Initiated in 2010

Complement-mediated Stem Cell Recruitment to Breast Cancer
Ingrid Schraufstatter
Torrey Pines Institute for Molecular Studies

Inhibiting Mutation to Prevent and Treat Breast Cancer
Floyd Romesberg
Scripps Research Institute

Local Adipocyte Function in Breast Cancer
Barbara Mueller
Torrey Pines Institute for Molecular Studies

Myeloperoxidase Mediated Protection in Breast Cancer
Wanda Reynolds
Sanford-Burnham Medical Research Institute

p97 as a Therapeutic Target in Breast Cancer Metastasis
Martin Latterich
Proteomics Research Institute for Systems Medicine

Pharmacological Modulation of PP2A Activity in Breast Cancer
Daniel Bachovchin
Scripps Research Institute

Reelin Signaling Involvement in Breast Cancer Cell Migration
Ellen Carpenter
University of California, Los Angeles

The Role of Clim Proteins in Breast Cancer
Suman Verma
University of California, Irvine

The Role of microRNAs in Triple-Negative Breast Cancer
Leonard Kusdra
University of California, San Francisco

The Role of Twist1 in Epithelial-mesenchymal Transition
Jeff Tsai
University of California, San Diego

Research in Progress

Breast Cancer Tumor-Stroma Interactions in an In Vivo Model
Per Borgstrom
Vaccine Research Institute of San Diego

Control of BRCA2-mediated Homologous Recombination
Damon Meyer
University of California, Davis

Discovery of Fusion Genes in Breast Cancer
Jonathan Pollack
Stanford University

Finding BRCA1 Ubiquitinated Substrates in Breast Cancer
Charles Spruck
Sanford-Burnham Medical Research Institute

A Genetic System for Identification of Mammary Stem Cells
Dannielle Engle
Salk Institute for Biological Studies

Global Analysis of Protein Ubiquitination in Breast Cancer
Stefan Grotegut
Sidney Kimmel Cancer Center

Mechanisms of Daxx-Mediated Apoptosis in Breast Cancer
Lorena Puto
Sanford-Burnham Medical Research Institute

A Molecular Strategy to Inhibit Breast Cancer Metastasis
Frances Brodsky
University of California, San Francisco

Nanolipoproteins to Study Breast Cancer Growth Receptors
Paul Henderson
University of California, Davis

Novel Tumor Suppressors in Breast Development and Cancer
Margaret Fuller
Stanford University

P32: New Functional Target in Breast Cancer Brain Metastasis
Karin Staflin
Scripps Research Institute

Podocalyxin as a Basal-like Breast Cancer Stem Cell Marker
Graham Casey
University of Southern California

Proline Metabolism in Metastatic Breast Cancer
Adam Richardson
Sanford-Burnham Medical Research Institute

Regulation of Breast Stem-Progenitor Cell Chromatin by Pygo2
Bingnan Gu
University of California, Irvine

The Role of EGF Variant mLEEK and Grp78 in Breast Cancer
Albert Wong
Stanford University

The Role of Estrogen Receptor in Endocrine Resistance
Hei Chan
Beckman Research Institute of the City of Hope

Role of Estrogen-modulated Protein AGR2 in Breast Cancer
Mikhail Geyfman
University of California, Irvine

Role of p68 in Breast Cancer
Daojing Wang
Lawrence Berkeley National Laboratory

Stem Cells in Breast Cancer Metastasis
Brunhilde Felding-Habermann, John Yates & Evan Snyder
Scripps Research Institute and The Burnham Institute of Medical Research

Stroma Expression Patterns in Breast Cancer
Robert West
Palo Alto Institute for Research & Education

Substrate Profiling of Breast Cancer Related Proteases
Melissa Dix
Scripps Research Institute

Targeting MYC in Human Breast Cancer
Dai Horiuchi
University of California, San Francisco

Improving the CBCRP through Evaluation

California taxpayers deserve to have the funds they provide for breast cancer research spent wisely. That's why the California Breast Cancer Research Program continually evaluates our work. Evaluation helps the Program target research dollars where they will do the most to reduce and end the suffering caused by breast cancer.

Evaluating the CBCRP's Funding Strategy

During 2010, the CBCRP completed a multi-year, formal evaluation of the entire program that led to a new funding strategy for the coming five years. This evaluation began with the CBCRP's highest decision-making body, the Breast Cancer Research Council, asking the question, "How can we best leverage California resources to make an impact on breast cancer?"

The council engaged in an intensive data collection and evaluation process that included:

- Conducting literature searches and interviews with scientists the CBCRP has funded to identify the impact that CBCRP-funded research has had on breast cancer research;
- Analyzing the ways in which CBCRP-funded research has leveraged funding for breast cancer research from other sources and increased breast cancer research expertise;
- Comparing the CBCRP's research portfolio with those of other breast cancer research funding agencies, nationwide and around the world, to determine where there may be overlap;
- Conducting surveys with breast cancer advocates, breast cancer researchers, breast cancer health professionals and policy makers, and combining the survey results with analysis of California breast cancer statistics to identify opportunities for the CBCRP to fill critical gaps in research.

The evaluation revealed that the CBCRP has been highly effective. The Program has succeeded in funding California-specific research, including research that involves the state's diverse communities. The CBCRP has also made strides in probing areas of breast cancer research that have not been well-studied. In addition, the CBCRP has funded research that has improved access and services for populations of California women who have lacked access and services. The

Program has stimulated innovation in breast cancer research, leveraged funds from other sources, and impacted policy around health education, health information, and the environment-breast cancer connection.

The evaluation also showed that the CBCRP was falling short in meeting some Program goals. Despite strong support for research into breast cancer prevention by advocates, scientists, and the public, the CBCRP has not been able to fund much research in this area. A second shortcoming was that some of the grants that the CBCRP has been making duplicate those offered by other research funding agencies.

The context for this evaluation included the CBCRP's declining source of revenue. In 2011, the Program's revenue is expected to drop 15% from the average revenue of the past five years.

The Breast Cancer Research Council used this evaluation to develop a bold new strategy for putting breast cancer research in California in the forefront of the field. The strategy, which will guide the next five years of grant-making, focus CBCRP resources in areas where the program has had the most impact, and increase research in the crucial and under-studied area of breast cancer prevention. For more on the new funding strategy, see the sections of this annual report titled "The CBCRP's Strategy for Allocating Research Funds" and "Answering Urgent, Neglected Questions: Program Initiated Research." For a fuller explanation of both the evaluation process and the new funding strategy, see "New Funding Strategy for the California Breast Cancer Research Program: The Way Forward," a publication available on the CBCRP Web site.

Evaluating the Special Research Initiatives Process

During 2010, the CBCRP evaluated the process used to select research for the first ten Special Research Initiatives. This process involved an in-depth literature review of previous research, guidance from committees of national experts in the breast cancer field, a survey of California resources that might be used to conduct breast cancer research, and opportunities for the public to submit research ideas. The goal of this process was to select research projects that would push forward progress in two areas:

- The environmental causes of breast cancer;
- The reasons why some groups of women are more likely to get breast cancer, or die from the disease, based on characteristics such as their race, ethnicity, or where they live.

The evaluation revealed that the Special Research Initiatives research project development process had worked quite well to fund critical, neglected areas. Still, there is room for improvement in developing future program initiated research. Recommendations included:

- Continue a process to identify crucial, under-researched questions;
- Clarify the roles of committees of experts in the breast cancer research field;
- Consider alternative methods for involving breast cancer advocates and the public in the process
- Allow more time for the CBCRP's Breast Cancer Research Council members to review and consider recommendations for research projects.

One immediate result of the evaluation is that the CBCRP designed and funded the Partnership to Advance Breast Cancer Research grant to carry out an intensive, but streamlined process for developing future program-initiated research. The CBCRP is continuing to evaluate the Special Research Initiatives priority setting process and will find additional ways to optimize it.

Additional CBCRP Evaluations

In the past several years, the CBCRP has conducted evaluations on components of the Program. Results from these evaluations have been used to improve the CBCRP. For example, three evaluations of the CBCRP's Community Research Collaborations have led to changes in the way we make these grants. These changes have increased the number of community organizations collaborating with scientists to research questions of interest to communities of California women. Results of past CBCRP evaluations are available in print and on the CBCRP Web site.

Relationship between Federal and State Funding for Breast Cancer Research

The California Breast Cancer Research Program is distinct from research programs funded by the federal government in both the CBCRP's sources of funding and in the types of research funded.

The CBCRP's Source of Funding: Unique Among the Nation's Breast Cancer Research Agencies

The primary source of funding for the CBCRP is a 45 percent share of revenue from a two-cent State tax on cigarettes. This source of funding is unique among agencies that fund breast cancer research across the nation.

In contrast, funding for breast cancer research at other programs in the U.S. comes from a variety of different sources:

- **Federal Agencies** (National Institutes of Health, Department of Defense) receive funding through Congress from the national budget and from the public's voluntary purchase of more expensive postage stamps.
- **National Voluntary Health Organizations** (such as the American Cancer Society, Komen Foundation, Breast Cancer Research Foundation, Avon Foundation for Women) receive funding through charitable contributions from individuals, corporations, and foundations.
- **Regional Nonprofit Organizations** (such as the Entertainment Industry Foundation, The Wellness Foundation) also receive funding through charitable contributions.
- **State Agencies** (such as the New Jersey Breast Cancer Research Fund, Illinois Ticket for the Cure State Lottery, and the Cancer Prevention and Research Institute of Texas, the latter of which includes breast cancer) receive funding from state general funds, auto license fees, lottery ticket sales and voluntary donations on individual state income tax returns.

The California Breast Cancer Research Program's primary source of funds, a State cigarette tax, is declining and temporary. Measures were proposed in the California State Legislature that would have directly or indirectly decreased funding for the CBCRP. Similar measures may be proposed, and may pass, in the future.

The CBCRP also receives funding from the income tax checkoff program, which allows individuals to make voluntary donations on state income tax returns. This was a result of legislation passed by the California State Legislature that authorized donations for five years. In 2007, AB28, a bill authored by Assembly Member Jared Huffman, became law, providing individuals the opportunity to make donations to the CBCRP via voluntary tax contributions through 2012.

To increase these sources of revenue, the CBCRP conducts a public outreach and fundraising effort, the Community Partners Program. This effort, begun in 2002, has led to an increase in donations to the CBCRP from individuals, businesses, and foundations. The CBCRP's Community Partners Program is discussed more fully in the section of this report titled "Increasing Funding for and Awareness of Breast Cancer Research."

Types of Research Funded by the CBCRP: Complementing, Not Duplicating, Federal Efforts

The CBCRP has a deep commitment to using the funds provided by the State of California in the most efficient and cost-effective manner, and to adhering to the Program's mandate as defined by the California Legislature. One of the CBCRP's mandates is to "fund innovative and creative research, with a special emphasis on research that complements, rather than duplicates, the research funded by the federal government." The CBCRP fulfills this mandate in four ways:

1. By funding breast cancer research areas that could have a major impact on breast cancer—including leading to prevention and cure—that are not getting sufficient attention from the federal government;
2. By having expert reviewers from across the U.S. review grant applications for their innovation and impact;
3. Before funding a grant application, reviewing it for overlap with current and pending funding from other agencies;
4. By taking leadership in reducing barriers and waste in state, federal, and international breast cancer research funding.

These four ways of assuring that CBCRP-funded research does not duplicate federally-funded research are each discussed in more detail below.

Funding Promising Areas of Research That Have Not Received Sufficient Attention

The federal government's method for funding research has led to some promising areas of breast cancer research being under-funded. The federal government funds most health-related research through the National Institutes of Health (NIH). The primary basis on which the NIH chooses grants for funding is their scientific merit, not their relevance to a particular disease. As a result, most research proposals submitted to the NIH address scientific questions in which the investigators have theoretical and empirical interest, even though there may be no clear relevance to particular diseases.

Only a small percentage of NIH funds go to research in issues the NIH has identified as particularly important to specified diseases (i.e., Requests for Applications). The majority of NIH funds support the most scientifically meritorious research, regardless of the applicability of the research to breast cancer or any other disease.

In contrast, a fundamental priority for the CBCRP is to fund scientifically meritorious research that will speed progress in preventing and curing breast cancer specifically. The CBCRP's Breast Cancer Research Council sets the Program's funding priorities, taking into account:

- Opinions from national breast cancer experts;
- Opinions from California advocates and activists, healthcare providers, public health practitioners, community leaders, biotechnology scientists, and academic researchers; and
- Current literature on breast cancer and current gaps in knowledge

The council attempts to identify important research questions that could lead to breakthroughs and that have not received sufficient attention. The CBCRP is conducting program-initiated research to fill a significant gap in breast cancer research. The CBCRP will address three overlapping research questions that California is uniquely positioned to address through program initiated research. They are the environment's role in breast cancer, the reasons for the unequal burden of breast cancer among various populations of women, and breast cancer prevention. More information on these projects may be found in two previous sections of this report, "The CBCRP's Strategy for Allocating Research Funds," and "Answering Urgent, Neglected Questions: Program Initiated Research."

Choosing Research for Innovation and Impact

To allow the Program's expert reviewers to differentiate applications that are especially innovative and that have the most potential impact on breast cancer, the CBCRP created its own scoring system. The scoring system has improved the Program's ability to choose the most innovative and creative research for funding.

In the past, the majority of research funding agencies, including the NIH, scored funding proposals with a single score based solely on scientific merit. With this method, an application with an excellent research plan to test an idea that wasn't particularly novel could receive the same score as an application with a flawed research plan to test a novel idea. The CBCRP's scoring method, based on the recommendations of an NIH Advisory Committee, can distinguish these two applications. The CBCRP scores applications separately for innovation, impact, approach, and feasibility. The separate scores are then used to inform funding decisions. For example, under the CBCRP's "impact" criterion, researchers are required to describe the steps necessary to turn their research into products, technologies, or interventions that will have an impact on breast cancer, and describe where their study fits into this critical path. Since the CBCRP developed its pioneering scoring system, the NIH has also abandoned the single scientific merit score and developed a system that rates specific application qualities such as innovation and significance.

Reviewing Grant Proposals for Overlap with Federal Funding

As a final step to ensure that CBCRP-funded research doesn't duplicate federally-funded research, breast cancer science experts in other states and Program staff scientists review all grants recommended for funding for overlap with

current and pending federal grants. If overlap with federal funding is found, the overlapping grant (or portion of the grant) is not funded.

Taking Leadership to Reduce Duplication and Waste In Federal, State, and International Funding

The CBCRP is part of an international effort to reduce duplication and waste in research toward the goal of ending breast cancer. This effort, the International Cancer Research Portfolio (ICRP), includes 50 of the largest government and charitable research funding agencies in the U.S., United Kingdom, Canada, and the Netherlands. The organizations that make up the ICRP are working to speed progress by increasing communication and avoiding duplication among agencies that fund breast cancer research.

One way the ICRP pursues these goals is through a research classification system to encourage agencies to report their funding in an accessible and meaningful way. The ICRP Web site (www.cancerportfolio.org) includes research abstracts from more than 15,000 current and past research projects. The online database is searchable by cancer type, scientific area, funding organization, and other criteria. The Web site allows scientists to identify possible collaborators, plan their research based on current research, and facilitates dialogues among cancer researchers. Access to information about ongoing research also aids research funding organizations in strategic planning. In addition, the Web site is a useful tool for other groups. Policy makers may use the database during the formulation of new health care and service delivery policies. Healthcare professionals, patients, survivors, and advocates may review the current status of funded research.

The CBCRP and the Program's ICRP partners further coordinate efforts by inviting representatives from the other organizations to attend their scientific meetings and review in person their funded research.

The ICRP has also taken international coordination to a higher level. It published the results of an evaluation of the career development funding trends in the U.S., U.K., and Canada. The evaluation found that providing funds for recent Ph.D. or M.D. graduates to conduct breast cancer research enabled a large majority of these researchers to stay in breast cancer research and to leverage additional funding for their investigations. The ICRP also conducted and published the results of an online survey of its member organizations on strategies for peer review. Peer review is the process of a funding agency having research proposals reviewed by scientific experts, with the goal of selecting the best research to be funded. The survey identified several successful methods for costs savings in the peer review process, In the future, the ICRP will publish a review of cancer research funding patterns in the U.S., U.K., and Canada that will point to gaps in research and make recommendations for research priorities to fill those gaps.

Increasing Funding for and Awareness of Breast Cancer Research

Funding for the California Breast Cancer Research Program (CBCRP) from the State tobacco tax decreases every year. Moreover, current funds are not sufficient to do all that needs to be done. During 2010, the CBCRP turned down grant applications requesting a total of $13,855,061 that were rated by expert reviewers as having sufficient scientific merit for funding. Commitment and action are needed to ensure the CBCRP's present funding sources and increase funds from new sources. To address this pressing need, the CBCRP's Community Partners Program pursues two goals:

- Increasing donations to the CBCRP through the California income tax voluntary contribution program and new sources;
- Increasing public awareness of breast cancer, breast cancer research, and the California Breast Cancer Research Program.

Community Partners: Increasing Voluntary Donations to the CBCRP

The Community Partners Program has led to growth and diversification in donations to the CBCRP. During 2010, the CBCRP received major funding from the California state income tax checkoff program, a private foundation, and from the public.

California State Income Tax Checkoff Program

More than 36,000 individuals donated over $485,000 to the CBCRP during 2010 through the state income tax checkoff program. This made the CBCRP one of the checkoff program's top beneficiary organizations for the year.

Four grants made in 2010 were funded in part through voluntary tax contributions:

- **Measuring Real-World Breast Cancer Outcomes,** Allison Kurian, M.D., Stanford University School of Medicine
- **Light at Night and Breast Cancer Risk,** Peggy Reynolds, Ph.D., Cancer Prevention Institute of California
- **Targeting Brain Metastasis with a Cell-based Approach,** Mihaela Lorger, Ph.D., Scripps Research Institute
- **Salivary Biomarkers for Early Detection of Breast Cancer,** Lei Zhang, Ph.D., University of California, Los Angeles

Foundation Funding

The Avon Foundation for Women has contributed $500,000 to support the CBCRP's groundbreaking Special Research Initiatives. The funds help support a study examining long-term environmental exposures and breast cancer in a large, diverse population group and a study investigating why women from some minority groups, once they are diagnosed with breast cancer, are less likely than others to be successfully treated.

Donations from the Public

Californians continue to demonstrate enthusiasm for the CBCRP's research. We thank the many generous individuals who made $40,000 in donations to the CBCRP during 2010. The following organizations and businesses raised fund for the CBCRP through events and campaigns and businesses: United Way of the Bay Area; California Breast Cancer Research Program Community Partners; San Francisco Marathon Cause to Run; Wells Fargo Community Support Campaign; AT&T Employee Giving Campaign; Kaiser Permanente Community Giving Campaign; Spectrum Clubs, Inc.; Lighthouse Quilters Guild; Positively Negative Clothing; Chevron Humankind Matching Gift Campaign; Amgen Matching Gift Campaign; and Microsoft Matching Gift Campaign.

Web-based Giving

The public has also responded to the opportunity to make donations via the Program's Web site, www.CABreastCancer.org.

Community Partners: Increasing Awareness of Breast Cancer Research and of the CBCRP's Work

During 2010, the CBCRP conducted an outreach campaign focused on raising awareness of breast cancer research results and the Program's work. As part of this campaign, on April 12, 2010, CBCRP Director Marion H.E. Kavanaugh-Lynch appeared in a newscast on San Francisco television station KPIX, speaking about the increased risk of breast cancer in young women.

The CBCRP outreach campaign also encouraged donations to the Program through state tax return contributions. A special CBCRP Web site, www.endbreastcancer.org, informs stakeholders about fundraising progress. It also summarizes progress researchers achieved with the grants funded via contributions made on state income tax returns.

To further increase state tax return contributions, the CBCRP conducted a combined outreach effort in 2010, named Checkoff California, with other California nonprofit organizations who receive these contributions. Together, the CBCRP and these nonprofit organizations created a radio and Internet marketing campaign to alert the public to the income tax checkoff program. The campaign was conducted in partnership with the California Society of Certified Public Accountants (CalCPA) and over 140 California radio stations, member stations of the Northern California Broadcasters Association, Southern California Broadcasters Association, and San Diego Radio Broadcasters

Association. Campaign activities included radio public service announcements in English and Spanish, a presence on Facebook and Twitter, and a Web site highlighting all nonprofit organizations included in the income tax checkoff program.

Governor Arnold Schwarzenegger further boosted California's awareness of the opportunity to make donations through the tax checkoff by issuing an official proclamation declaring March 2010 as Checkoff California Month.

Honoring a Pioneer in CBCRP Visibility and Fundraising: The Faith Fancher Research Award

Faith Fancher was a long-time television news anchor and personality with KTVU (Oakland) who waged a very public battle against breast cancer. She also was the founding member of the CBCRP Executive Team, which formed in 2001 to help raise the visibility and fundraising profile of the Program. Faith passed away in October 2003 after a six-year struggle with breast cancer. In Faith's honor, the CBCRP has created the annual Faith Fancher Research Award. The award is presented each year to a researcher or research team embarking on a CBCRP-funded breast cancer study that reflects the values that Faith held most closely and extends the work that Faith did for all women facing breast cancer. The recipients of the 2010 Faith Fancher Research Award are **Jeffrey Belkora**, University of California, San Francisco, and **Sara O'Donnell**, Mendocino Cancer Resource Center, for their community collaborative research project, **Recording Medical Visits for People with Breast Cancer.**

Research on Women and Minorities

Forty-three percent (16 of 37) of the research projects that the CBCRP funded in 2010 study either women or tissues from women. The remaining 57 percent are laboratory studies that do not directly involve women or tissues from women.

One of the 16 grants that involve tissues from women, while 15 (94%) have women as participants in the study.

Out of the 15 studies that include women:

- One hundred percent, (15) grants include minority women in the study.
- Twenty-six percent, (4) are focused on minority women.
- Thirty-three percent, (5) are focused on underserved women.

A total of 6 grants were funded with a primary emphasis on minority and/or underserved women:

Recording Medical Visits for People with Breast Cancer
Jeffrey Belkora, Ph.D., University of California, San Francisco
Sara O'Donnell, Mendocino Cancer Resource Center

Increasing Mammography Screening Among Native Women
Marlene von Friederichs-Fitzwater, Ph.D., University of California, Davis
Linda Navarro, Turtle Health Foundation

Vitamin D and Breast Cancer Survival
Wei Wang, M.D., Cancer Prevention Institute of California

Quality of Mammography Facilities Serving Vulnerable Women
Lauren Goldman, M.D., University of California, San Francisco

California Breast Cancer Survivorship Consortium
Anna Wu, Ph.D., University Southern California
Scarlett Gomez, Ph.D., Cancer Prevention Institute of California
Leslie Bernstein, Ph.D., Beckman Research Institute – City of Hope
Marilyn Kwan, Ph.D., Kaiser Foundation Research Institute
Kristine Monroe, Ph.D., University Southern California

Persistent Organic Pollutants & Breast Cancer Risk
Peggy Reynolds, Ph.D., Cancer Prevention Institute of California

California Breast Cancer Research Program Council (2010)

Chair
Jeanne Rizzo (2010-2011)
Jim Ford (2009-2010)

Vice-Chairs
Teresa Burgess (2010-2011)
Barbara Brenner (2009-2010)

Advocates
Susan Braun, Commonweal (2009-2012)
Barbara Brenner, J.D., Breast Cancer Action (2008-2010)
Ysabel Duron, Latinas Contra Cancer (2010-2013)
Karren Ganstwig, Los Angeles Breast Cancer Alliance (2007-2010)

Cacilia Kim, J.D., Ph.D., California Women's Law Center (2010-2013)
Jeanne Rizzo, Breast Cancer Fund (2008-2011)
Donna Sanderson, Susan G. Komen Foundation (2009-2012)

Scientists/Clinicians
Lisa Barcellos, Ph.D., University of California, Berkeley (2009-2012)
Moon Chen, Ph.D., University of California, Davis (2008-2011)
Laura Fenster, Ph.D., California Department of Public Health (2007-2010)
Jim Ford, M.D., Stanford University (2008-2011)
Shelley Hwang, M.D., University of California, San Francisco Comprehensive Cancer Center (2007-2010)
Sora Park Tanjasiri, Dr.P.H., M.P.H., California State University, Fullerton
(2010-2013)
Mary Alice Yund, Ph.D., University of California, Berkeley Extension (2007-2010)

Industry Representatives
Chris Bowden , Ph.D., Genentech (2007-2010)
Teresa Burgess, Ph.D., Amgen, Inc. (2008-2011)
Kathy Kamath, Ph.D., Cytom X Therapeutics, LLC (2010-2013)

Non-Profit Health Representatives
Roxanna Bautista, M.P.H, Asian & Pacific Islander American Health Forum (2007-2010)
Carlina Hansen, San Francisco's Women's Community Clinic (2009-2012)
Naz Sykes, Dr. Susan Love Research Foundation (2010-2013)

Medical Specialist
Klaus Porzig, M.D., South Bay Oncology Hematology (2006-2010)
Michael Moffett, M.D., Cancer Care Associate (2010-2013)

Ex Officio Member
Sherie Smalley, M.D., California Department of Public Health (2005-2010)

California Breast Cancer Research Program Staff (2010)

Marion H. E. Kavanaugh-Lynch M.D., M.P.H. – Director

Senaida Fernandez, Ph.D. – Manager: Community Research Initiatives
Laurence Fitzgerald, Ph.D. – Manager: Core Funding; Biomedical Research Administrator
Katherine McKenzie, Ph.D. – Manager: External Relations; Biomedical Research Administrator
Catherine Thomsen, M.P.H. – Project Lead, Special Research Initiatives

Sharon Cooper, M.P.A. – Research Analyst
Mary Daughtry – Core Funding Assistant
Brenda Dixon-Coby – Community Outreach & Special Events Coordinator
Lyn Dunagan – Communications Project Coordinator
Lisa Minniefield – Assistant to the Director
Eric Noguchi – Senior Designer

Appendix: CBCRP 2010 Research Review Committees

Expert committees review for scientific merit all research applications submitted to the CBCRP. To minimize conflicts of interest, review committees are composed of experts from outside California. These experts include scientists highly knowledgeable about the broad topic of the applications they consider. Each review committee also has advocate reviewers. These are women and men active in breast cancer advocacy organizations, many of them also living with the disease. The review committees for 2010 are listed below.

Community Impact Review Committee

►Chair:
Shiraz Mishra, M.B.B.S., Ph.D.
Associate Professor
Dept. Epidemiology & Preventive Medicine
University of Maryland, Baltimore - School of Medicine
Baltimore, MD

►Scientific Reviewers:

Deborah Bowen, Ph.D.
Member and Professor
Social and Behavioral Sciences
Boston University
Boston, MA

Alecia Fair, Dr.PH
Assistant Professor
Meharry Medical College
Nashville, TN

Carolyn Gotay, Ph.D.
Professor. & Chair in Cancer Primary Prevention
School of Population and Public Health
University of British Columbia
Vancouver, BC

Mel Haberman, Ph.D.
Professor
College of Nursing
Washington State University
Spokane, WA

Alicia Matthews, Ph.D.
Associate Professor
University of Illinois at Chicago
College of Nursing
Chicago, IL

Margo Michaels, M.P.H
Executive Director
Education Network Access to Advance Clinical Trials
Bethesda, MD

Nalini Visvanathan, Ph.D.
Research Contractor, Editor
The Fenway Institute
Washington, DC

►Advocate Reviewers:

Beverly Canin
Breast Cancer Option, Inc
Rhinebeck, NY

Christine Carpenter
Iowa Breast Cancer Edu-action
Cedar Falls, IA

►California Advocate Observer:
Ernesta Wright
The Green Foundation
Brea, CA

►Ad-Hoc Reviewers:

Dawn Hershman, M.D., M.S.
Assistant Professor
Columbia University Medical Center
New York, NY

Karen Meneses, Ph.D.
Professor & Associate Dean for Research
School of Nursing
University of Alabama at Birmingham
Birmingham, AL

George Wright, Ph.D.
Associate Professor
University of Washington
Seattle, WA

Detection and Prognosis Review Committee

►Chair:
Peggy Porter, M.D.
Head, Breast Cancer Research Program
Divisions of Human Biology and Public Health Sciences
Fred Hutchinson Cancer Research Center
Seattle, WA

►Scientific Reviewers:

Eldon Jupe, Ph.D.
Vice President, Research
InterGenetics, Incorporated
Oklahoma City, OK

Andrew Karellas, Ph.D.
Director of Radiologic Physics
University of Massachusetts Medical School
Worcester, MA

Paul Kinahan, Ph.D.
Professor of Radiology
Department of Radiology
University of Washington
Seattle, WA

University of North Dakota
Grand Forks, ND

Ratna Vadlamudi, Ph.D.
Associate Professor
UTHSCSA Department of Obstetrics & Gynecology
Division of Reproductive Research
San Antonio, TX

Martin Woodle, Ph.D.
Scientist
Aparna Biosciences Corp.
Bethesda, MD

Julie Lang, M.D.
Assistant Professor of Surgery
Arizona Health Sciences Center
University of Arizona
Tucson, AZ

Stefan Posse, Ph.D.
Associate Professor
Department of Neurology
University of New Mexico School of Medicine
Albuquerque, NM

Edward Sauter, M.D., Ph.D.
Professor of Surgery, Associate Dean for Research
School of Medicine and Health Sciences

►Advocate Reviewers:

Roberta Gelb
SHARE
New York, NY
Kimberly Newman-McCown
Susan G. Komen Foundation
Melrose Park, PA

Beverly Parker, Ph.D.
Breast Cancer Network of Strength
Naperville, IL

► California Advocate Observer:
Sherrie Fasola Wilkins, Ph.D.

Breast Cancer Connections — Palo Alto, CA

Etiology and Prevention Review Committee

►Chair:
Christine Ambrosone, Ph.D.
Professor of Oncology and Chair
Roswell Park Cancer Institute
Department of Cancer Prevention & Control
Buffalo, NY

► Scientific Reviewers:

Stefan Ambs, Ph.D.
Principal Investigator
Laboratory of Human Carcinogenesis
National Cancer Institute
Bethesda, MD

Abenaa Brewster, M.D., M.H.S.
Associate Professor of Medicine
The University of Texas MD Anderson Cancer Center
Department of Clinical Cancer Prevention
Houston, TX

Scott Davis, Ph.D.
Professor and Chairman
Department of Epidemiology, School of Public Health
University of Washington
Seattle, WA

Chi-Chen Hong, Ph.D.
Assistant Professor
Department of Cancer Prevention and Control
Roswell Park Cancer Institute
Buffalo, NY

Eva Schernhammer, M.D., Dr.P.H.
Assistant Professor of Medicine and Epidemiology
Department of Epidemiology
Harvard School of Public Health
Boston, MA

Rulla Tamimi, Sc.D.
Assistant Professor of Medicine and Epidemiology
Department of Medicine
Harvard Medical School
Boston, MA

►Advocate Reviewers:

Ann Fonfa
The Annie Appleseed Project
Delray Beach, FL

Sara Williams
The Carolina Breast Cancer Study (UNC)
Mebane, NC

►California Advocate Observer:
Cindy Love
Albie Aware, Inc.
Sacramento, CA

Innovative Treatments Review Committee

►Chair:
Patricia LoRusso, D.O.
Professor of Medicine
Karmanos Cancer Institute
Wayne State University
Detroit, MI

►Scientific Reviewers:

Stephen Barnes, Ph.D.
Professor
Department of Pharmacology & Toxicology
University of Alabama School of Medicine
Birmingham, AL

Ralph Bernacki, Ph.D.
Professor; Cancer Research Scientist
Department of Pharmacology & Therapeutics
Roswell Park Cancer Institute
Buffalo, NY

Ulrich Bierbach, Ph.D.
Associate Professor
Wake Forest University
Chemistry Department
Winston-Salem, NC

Sandra Demaria, M.D.
Assistant Professor
Department of Pathology
NYU School of Medicine
New York, NY

Shawn Holt, Ph.D.
Associate Professor
Massey Cancer Center, Department of Pathology
Medical College of Virginia
Richmond, VA

Kathie-Ann Joseph, M.D., M.P.H.
Medical Director, Women at Risk
Department of Surgery, Breast Service
Columbia University Medical Center
New York, NY

Keith Knutson, Ph.D.
Assistant Professor of Immunology
Mayo Clinic College of Medicine
Department of Immunology
Rochester, MN

Mark Pegram, M.D.
Professor of Medicine
Division of Hematology/Oncology
University of Miami
Miami, FL

William Redmond, Ph.D.
Scientist
Robert W. Franz Cancer Research Center
Providence Portland Medical Center
Portland, OR

Tumor Biology Review Committee

►Chair:
Danny Welch, Ph.D.
Leonard H. Robinson Professor of Pathology
Department of Pathology

Fredika Robertson, Ph.D.
Professor
Department of Experimental Therapeutics
M.D. Anderson Cancer Center
Houston, TX

Lily Yang, M.D., Ph.D.
Nancy Panoz Chair of Surgery in Cancer Research
Department of Surgery and Winship Cancer Institute
Emory University School of Medicine
Atlanta, GA

►Advocate Reviewers:

David Baker
National Breast Cancer Coalition
Houston, TX

Marjorie Gallece
Breast Cancer Resource Centers of Texas
Austin, TX

Nancy Singleton
SHARE
Hoboken, NJ
Maria Wetzel
Michigan Breast Cancer Coalition
Baldwin, MI

►California Advocate Observer:
Carol Rose Schultz
Breast Cancer Connections
Palo Alto, CA

►Ad-Hoc Reviewers:

Silvia Formenti, M.D.
Professor of Medicine
NYU School of Medicine
New York, NY

Eva Sevick-Muraca, Ph.D.
Professor and Director
The University of Texas
Brown Institute of Molecular Medicine
Houston, TX

University of Alabama - Birmingham
Birmingham, AL

►Scientific Reviewers:

Hava Avraham, Ph.D.
Associate Professor of Medicine
Beth Israel Deaconess Medical Center
Harvard Medical School
Boston, MA

David Boothman, Ph.D.
Professor
Department of Oncology, Pharmacology and Radiation
University of Texas, Southwestern Medical Center
Dallas, TX

James DiRenzo, Ph.D.
Associate Professor of Pharmacology
Department of Pharmacology
Dartmouth Medical School
Hanover, NH

Stephen Grant, Ph.D.
Associate Professor
Department of Environmental and Occupational Health
University of Pittsburgh Cancer Institute
Pittsburgh, PA

Cheryl Jorcyk, Ph.D.
Associate Professor
Department of Biology
Boise State University
Boise, ID

Joan Lewis-Wambi, Ph.D.
Assistant Professor
Fox Chase Cancer Center
Philadelphia, PA

Thomas Ludwig, Ph.D.
Associate Professor
Columbia University, Institute for Cancer Genetics
Department of Pathology
New York, NY

Cindy K. Miranti, Ph.D.
Scientific Investigator
Van Andel Research Institute
Grand Rapids, MI

Harikrishna Nakshatri, Ph.D.
Associate Professor
Walther Oncology Center
Indiana University School of Medicine
Indianapolis, IN

Weston Porter, Ph.D.
Associate Professor
Texas A&M University
Department of Veterinary Integrative Biosciences
College Station, TX

Patricia Schoenlein, Ph.D.
Associate Professor
Cellular Biology & Anatomy
Medical College of Georgia
Augusta, GA

Joyce Schroeder, Ph.D.
Associate Professor
University of Arizona, Arizona Cancer Center
Department of Molecular & Cellular Biology
Tucson, AZ

►Advocate Reviewers:

Valerie Fraser
Inflammatory Breast Cancer Research Foundation
Huntington Woods, MI

Nancy Key
Susan G. Komen Foundation
Camano Island, WA

Theresa Martyka
Breast Cancer Network of Strength
Chicago Ridge, IL

Diane Roth
Breast Cancer Network of Strength
Oak Lawn, IL

Sandra Stanford
Alamo Breast Cancer Foundation
San Antonio, TX

►California Advocate Observer:
Dikla Benzeevi

Young Survival Coalition
Studio City, CA

►**Ad-Hoc Reviewer:**
Zhen Zhang, Ph.D.
Associate Professor, Associate Director
Center for Biomarker Discovery, Dept. of Pathology
Johns Hopkins Medical Institutes
Baltimore, MD

Silent Spring Institute
Newton, MA

SRI Environmental Exposure Cohort Review

►**Chair:**
Suzanne E. Fenton, Ph.D
Reproductive Endocrinologist
NIEHS, Division of Intramural Research
Ntl.Toxicology Program, Cellular & Molecular Pathology
Research Triangle Park, NC

►**Scientific Reviewers:**

Francine Laden, Sc.D.
Associate Professor of Environmental Epidemiology
Dept. of Environmental Health & Dept. of Epidemiology
Harvard University
Boston, MA

Stephanie A. Robert, Ph.D.
Professor and Director of Doctoral Studies
School of Social Work
University of Wisconsin-Madison
Madison, WI

John E. Vena, Ph.D.
UGA Foundation Professor & Department Head
College of Public Health, Epidemiology & Biostatistics
University of Georgia
Athens, GA

►**Advocate Reviewer:**
Ann Hernick
Breast Cancer Alliance of Greater Cincinnati

►**Non-Voting Member:**
Julia G. Brody, Ph.D.
Executive Director

California Breast Cancer Survivorship Consortium Review:

►**Chair:**
Electra Paskett, Ph.D., M.P.H.
Professor, College of Public Health
Assoc. Director for Population Science
Ohio State University – Comprehensive Cancer Center
Columbus, OH

Michelle Holmes, M.D., Dr.P.H.
Associate Professor
Department of Epidemiology
Brigham and Women's Hospital, Channing Lab
Harvard University
Boston, MA

Gretchen Kimmick, M.D., M.S.
Associate Professor of Medicine
Medical Oncologist
Duke University Medical Center
Durham, NC

►**Advocate Reviewer:**
Jaci Holland
Columbus Black Women's Health Project
Westerville, OH

►**Non-Voting Member:**
Blase Polite, M.D.
Clinical Oncologist
Assistant Professor of Medicine
University of Chicago Medical Center
Chicago, IL

Partnership to Advance Breast Cancer Research Review:

Sarah Gehlert, Ph.D.
E. Desmond Lee Professor of Racial and Ethnic Diversity
The Brown School
Washington University
St. Louis, MO

Sandra Steingraber, Ph.D.
Ecologist and Author
Trumansburg, NY

►**Non-Voting Member:**
Julia G. Brody, Ph.D.
Executive Director
Silent Spring Institute
Newton, MA

Contact information:
UCOP Budget and Capital Resources
1111 Franklin Street, 6th Flr.
Oakland, CA 94607-5220
Office website: http://budget.ucop.edu
Report website: http://budget.ucop.edu/legreports/