

# Urgent Unanswered Questions About Breast Cancer



**Who is at highest risk for breast cancer?**



**Do pesticides cause breast cancer?**



**How does where we live affect our risk?**



**Why are most immigrant women less likely to get breast cancer?**



## **Inside Learn About:**

Women living in cities are more likely to get breast cancer than women living in rural areas. **See page 5.**

Almost all immigrants to the United States are less likely to get breast cancer than women born and raised here. **See page 6.**

Women who were exposed to radiation or some toxic chemicals when they were babies or going through puberty are at higher risk of breast cancer. **See page 10.**

Which U.S. ethnic group has the highest survival rate from breast cancer?  
**See page 11.**

Over 5,000 chemicals can be found in various hair, skin, and nail care products on the market today. Most have never been tested to see if they can cause breast cancer.  
**See page 13.**

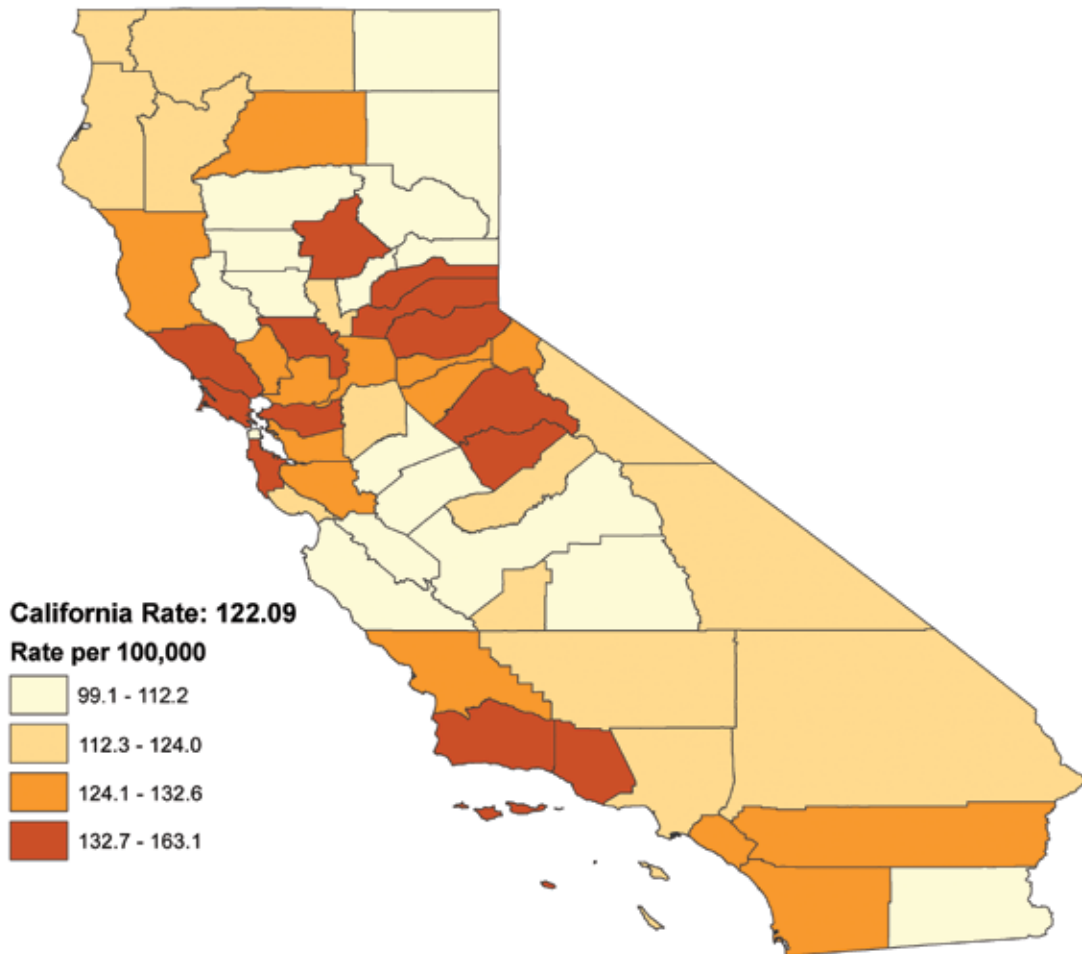
Evidence is mounting that exposure to light at night—for example, by working night shifts—raises a woman's chances of getting breast cancer. **See page 14.**

Contaminants in drinking water may be involved in breast cancer. **See page 15.**

What group of disabled women has a lower-than-average risk for breast cancer?  
**See page 17.**

# Invasive Breast Cancer in California for 2006-2008

## Age-Adjusted Rates among Females by County



Based on California Cancer Registry June 2010 Quarterly Extract

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Map created by the California Environmental Health Tracking Program

*Invasive breast cancer rates vary widely across California. Who gets breast cancer can't be explained just by genes or family history. Why does where we live seem to matter? What about where we work, play, learn, and pray? Is it the air, water, and other physical elements, or our neighborhood and community? Or do they all play a role? The CBCRP is funding research to answer these urgent questions.*

# Table of Contents

<b>Introduction</b> .....	1
<b>Part I. Three California Women with Breast Cancer</b>	
Stories of the multiple factors that may affect breast cancer risk in the fictional lives of three women:	
Danielle—an African American bus driver from Oakland .....	2
Luisa—a Hispanic immigrant former farm worker in Philo .....	6
Wendy—a Japanese American physician in Laguna Beach.....	9
<b>Part II. Urgent Unanswered Questions: Promising Research Ideas</b> .....	12
What are the most intriguing questions about our environment and the differences in breast cancer among different populations that might help us understand this disease?	
<b>Part III. Urgent Unanswered Questions: Research We Are Funding to Find Answers</b> .....	19
How is CBCRP advancing our understanding of disparities and environmental risks for breast cancer and to seek ways to prevent and cure this disease?	
<b>References</b> .....	25
<b>About our Special Research Initiatives</b> .....	27
Special Research Initiatives Steering Committee.....	27
Special Research Initiatives Strategy Team.....	27
Authors of <i>Identifying Gaps in Breast Cancer Research</i> .....	29
<b>Acknowledgments</b> .....	31



## Introduction

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 to die from, breast cancer?

What is the role of the environment in this disease?

These two areas of research have not received enough attention, but they hold great promise for progress against breast cancer. To find answers to these questions, the California Breast Cancer Research Program (CBCRP) is funding our ground-breaking Special Research Initiatives.

We are committed to targeting our funds toward research that will most quickly lead to major breakthroughs. 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 this disease. A draft of our extensive scientific review, *Identifying Gaps in*

*Breast Cancer Research*, is posted with complete research references on our web site at [www.cabreastcancer.org/sri/reports](http://www.cabreastcancer.org/sri/reports).

In Part I on these pages, we present highlights and summaries from *Identifying Gaps in Breast Cancer Research*. Part II lists promising ideas for research into the reasons why some groups of women bear a greater burden of breast cancer, and how the environment contributes to this disease. Part III describes the ground-breaking research we are funding under our Special Research Initiatives. This research is designed not only to increase knowledge, but also to create solutions that will move us toward prevention and cure.

In the Appendix, “About our Special Research Initiatives,” we provide information on the innovative process we used for selecting the research we are funding. We also list many of the leading experts from California and around the nation who helped us launch this effort to answer urgent research questions—toward the goal of ending the suffering caused by breast cancer.



## Part I

### Three California Women with Breast Cancer

*Danielle, Luisa, and Wendy, whose stories are told below, are fictional composite profiles based on the 21,000 women diagnosed each year with breast cancer in California. These three examples of California women with breast cancer highlight important, under-researched questions that need to be answered in order to move rapidly toward prevention and cure of the disease.*

#### **DANIELLE— Diagnosed Young with a Hard-to-Treat Tumor**

Danielle is a 39-year-old African American bus driver. After breathing vehicle exhaust all day on the job, she returns to her home two blocks from a busy Oakland freeway. Day and night, diesel trucks rumble along the next block and idle nearby. The crime level in her neighborhood is a source of stress for her, and she is reluctant to go outside for exercise, even a short walk.

And now Danielle has a new worry. She has been diagnosed with breast cancer. Her tumor is serious and deadly, the type that does not depend on the hormones estrogen and progesterone to grow and does not respond to hormone-blocking medications such as Tamoxifen. Her tumor also has a DNA pattern called basal-like subtype, which is another indication that it will be difficult to treat and cure. Danielle's tumor was not detected until it had grown large enough to feel and had spread beyond her breast. Because her tumor was detected after it had progressed so far, her odds of survival are further decreased. Advanced breast cancer is an



all-too-common diagnosis among younger women like Danielle. One reason is that mammograms are not an effective screening tool for women under 40, and there is no effective alternate method.

Why did Danielle get breast cancer and why is she less likely to survive the disease? And what can be done to prevent and cure tumors like Danielle's? Science doesn't yet have answers, but we know that progress is likely to come from answering two intertwined questions:

—Why do some groups of women bear a greater burden of breast cancer?

—How does the environment contribute to this disease?

#### **Young and Black: A Group with a Larger Burden of Breast Cancer**

Danielle is an example of one of the ways the burden of breast cancer falls harder on some racial and ethnic groups than on others. Overall, white women have a higher rate of breast cancer than African American women. Yet young African American women are more likely to be diagnosed with breast cancer than their white counterparts.



Among U.S. women under age 50, African Americans have the highest rate of breast cancer of any racial/ethnic group. This pattern has held true for many years. Recently, however, the breast cancer rate for African American women under age 50 has been dropping, bringing it closer to that of white women.

### A Higher Death Rate

In addition to being more likely to get breast cancer at young ages, African American women like Danielle are at higher risk for recurrence and death. African American women of all ages have a higher death rate from breast cancer (34.7 per 100,000) than white women (25.9 per 100,000), even though white women have a higher rate of getting the disease.

Young African American women like Danielle are more likely than white women to get tumors that do not depend on the hormones estrogen or progesterone to grow, a sign that the tumors are more aggressive. In the U.S., other ethnic groups are also more likely than white women to have these deadly, difficult-to-treat tumors. They include American Indians, Filipinas, Chinese, Koreans, Vietnamese, Indians, Pakistanis, Latin Americans, and Puerto Ricans. In addition, young African American women are much more likely than white women to get fast-growing “triple negative” tumors. Triple negative tumors are more aggressive and deadly in three ways. They don’t depend on the hormones estrogen and progesterone to grow, and they can’t be treated by blocking the action of the cell protein HER2.

Danielle’s tumor was not caught at the earliest stage, when survival is most likely. Here, too, Danielle is not unusual. A diagnosis of breast cancer at later, more deadly stages, is more common among African American women than among any other U.S. racial/ethnic group. But delayed diagnosis is not the whole story. Even when African American women are diagnosed at the same stage of breast cancer as white women, white women are more likely to survive.

There are several possible explanations for African American women being less likely to survive breast cancer, aside from their tumors being harder to treat. African Americans may be more likely to

suffer underlying health conditions, in addition to breast cancer. They may have lower income, lower education levels, and poorer access to health care.

Danielle, however, has no other health problems. She has a job with health insurance, and medical care is accessible to her in Oakland. Yet her chance of surviving is still lower than that of a white woman in a similar situation, with a similar diagnosis. The reasons for this disparity are not fully understood. One possibility is that even with equal access to medical care, African American women don’t receive or complete the same breast cancer treatment as white women. This different treatment could affect Danielle’s chance of surviving.

### Genes Affect the Body’s Reactions to Toxic Exposures

Genes could be another possible reason why young African American women like Danielle are diagnosed with breast cancer more often and are less likely to survive it. But there are no “African American genes.” Race is a social category based on perception. Different races don’t have different genes. Nevertheless, some gene patterns are more common among some racial and ethnic groups than others. These gene patterns may play a role



*Old florescent light ballasts, leaking transformers, and other sources have contaminated water and soil in many areas with PCBs. These compounds persist for a very long time, and appear to change estrogen levels and probably cause some cancers, including breast cancer.*

in breast cancer, but they do not act alone. It is likely that genes and environmental influences interact to produce breast cancer.

For example, African American women may be more likely to have a gene that makes them more susceptible to breast cancer if they are exposed to certain toxic chemicals called PCBs. In the past, PCBs (polychlorinated biphenyls) were used in electric equipment, paint, copy paper, sealants, and plastic. Because of their link to cancer, PCBs have been banned since 1976. However, these oily chemicals do not break down in the environment, and they accumulate in fatty tissues of living things, including humans. Studies have shown that women who are exposed to PCBs are at greater risk for breast cancer if they have a certain variation in a gene called CYP1A1. Some research shows that African American women are more likely than women from the general American population to have this gene variation.

Evidence is mounting that gene-environment interactions like PCBs-CYP1A1 are potential causes of breast cancer. Without toxic chemical exposures, genetic variations like CYP1A1 would pose much less risk for the disease. Yet the role of the environment in breast cancer has received far less research attention than the role of genes alone.

### Toxic Chemicals from Danielle's Environment

Whether or not her genes make her more susceptible, Danielle's breast tumor may have been triggered by toxic chemicals from her environment.

Danielle's job and home expose her to high levels of air pollution from vehicles. Some compounds from vehicle exhaust, including polycyclic aromatic hydrocarbons (PAHs) may cause breast cancer. PAHs are also emitted by heavy industries, such as coal-burning power plants. As a group, African American women live closer to polluting industries than their white counterparts. Research is needed into the role air pollution plays in differing burdens of breast cancer among various ethnic and racial groups.

Like almost all American women (and men), Danielle is exposed to chemicals in personal care products, such as cosmetics, shampoos, conditioners,



*Diesel fumes from ships, trains, trucks, and equipment are a major contributor to the air pollution in the Port of Oakland.*

skin lotions, and nail polish. A total of over 5,000 chemicals can be found in various personal care products. Most have not been tested for their ability to cause breast cancer. Some common ingredients that have been studied, including parabens and phthalates, can be absorbed through the skin and lungs. These compounds can then travel into and throughout the body. They are suspected of causing or contributing to cancer.

Compared to women from other racial and ethnic groups, Danielle may have been exposed to an extra dose of cancer-causing ingredients in personal care products. African American women are the targets for heavy marketing of hair products containing estrogen and placenta. Both of these ingredients can affect the body's system of hormone regulation in ways that possibly could lead to breast cancer, especially if they are used early in life when the breast is still developing. Over half of African American women may use these hair products.

Moreover, toxic exposures do not happen alone, but in mixtures. The many personal care products Danielle has used in her life, combined with the air pollution on her job and in her neighborhood, have exposed her to an ever-changing combination of toxins. These mixtures may have more cancer-causing potential than any one chemical alone. The risks from real-life chemical mixes need more research.

### More Environment-Breast Cancer Links in Danielle's Life

Danielle's environment is much more than the sum of her chemical exposures. Other features of her

physical environment and her social environment may also have played a role in her risk for breast cancer.

- **City Life.** A growing body of research indicates that the place a woman lives and works makes a big difference in whether or not she gets, and survives, breast cancer. Danielle lives in the city of Oakland. Women living in California cities are more likely to get breast cancer than women living in rural California. This is also true throughout the world for city women compared to rural women in the same country. In the U.S. as a whole, the death rate for breast cancer is higher in urban areas than in rural areas. Researchers are not sure why. Higher levels of air pollution may be part of the explanation, but there may be others.
- **Lack of Vitamin D.** According to current evidence, high vitamin D levels in blood and fat appear to protect against breast cancer. Mistakenly classified as a vitamin more than a century ago, vitamin D is actually a hormone with many targets of action inside the body, including the breast. While milk and supplements contain synthetic forms of vitamin D, the leading source is still sunlight on skin, which causes the human body to produce vitamin D. African American women are ten times more likely than white women to have a vitamin D deficiency. One reason is that the skin pigment melanin slows down vitamin D synthesis, so women with darker skin need more time in the sun than lighter-skinned women to produce the same amount of vitamin D. Moreover, air pollution acts as dimmer switch on sunlight, reducing the body's ability to produce vitamin D.
- **Limits on Exercise.** Living in a place where crime makes people afraid to go out on the street to exercise may also be a factor in Danielle's breast cancer. Regular exercise has been shown to reduce the risk of the disease and increase the odds of survival.
- **Early Puberty.** When a girl begins having menstrual cycles at a young age, it raises her risk for breast cancer later in her life, and it also appears to raise her risk of death from breast



*Early puberty raises the risk for breast cancer.*

cancer. As a group, African American girls reach puberty much younger than U.S. white girls and U.S. Latina girls. The age when breasts develop is decreasing among all ethnic groups, but it is declining most among African American girls. Family stress, child obesity, lack of exercise, and some toxic exposures all appear to increase the risk for early puberty.

- **Racial Discrimination.** Research has shown that racial discrimination can affect health. Personally experiencing discrimination often leads to changes in the body, such as higher blood pressure, that contribute to disease. In addition, there is evidence that living in a racially segregated neighborhood is typically associated with concentrated poverty and exposure to health-damaging conditions in the physical and social environment. These conditions increase stress, which leads to and worsens a variety of health problems, including heart disease. However, the impact of neighborhood segregation on breast cancer has not yet been studied. Living in a stressful neighborhood has, however, been shown to make residents more vulnerable to harmful effects from toxic exposures. More research is needed to discover if the stress of discrimination plays a role in raising the risk of breast cancer among women like Danielle.

## LUISA — Facing Breast Cancer with No Health Insurance

Luisa is a 63-year-old immigrant from Mexico who has lived in California for 35 years. Starting in her teens back in Mexico, Luisa worked in farming. She also worked in apple orchards and vineyards for many years near her present home, just outside the small northern California town of Philo. For the past 12 years, Luisa has joined her cousin on a job cleaning motel rooms in nearby towns. She and her husband, Enrico, live in housing right next to the vineyard where Luisa once worked, and where her husband still works. The water they drink and use for bathing comes from a well on the property.

A year and a half ago, Luisa was diagnosed with breast cancer. The doctor told Luisa she had choices for her treatment. Luisa could have surgery to remove only her breast tumor, plus radiation treatment five days a week for six weeks. The other option was for Luisa to have her entire breast removed, a complete mastectomy. Enrico and members of Luisa's close-knit extended family were all involved in Luisa's decision about her treatment.

Luisa and Enrico don't have health insurance. That was one reason Luisa chose the less expensive treatment: removal of her entire breast. Another concern was that the nearest radiation center was an hour's drive away. Daily transportation to and from the center for six weeks of treatment would have been hard to arrange. Even though Luisa chose what seemed to be the simplest treatment option, more than four

months passed before she actually had her surgery.

## Immigrating to U.S. Raises Breast Cancer Risk

The United States has one of the highest rates of breast cancer in the world. For decades, researchers have found that moving to the U.S. from other countries—except some northern and western European countries—increases the chance that a woman will get breast cancer. The reasons why remain a mystery. However, risk clearly grows with the number of years spent living in the U.S. Immigrant women who arrived as adults are less

likely to get breast cancer than women born and raised here. They are also less likely to be diagnosed with breast cancer than women who moved to the U.S. as children and teenagers. The longer immigrant women like Luisa stay in the U.S., the higher their rates of breast cancer. Their U.S.-born daughters have still higher rates. One possible explanation is that moving to the U.S. exposes women to more environmental toxins that may contribute to breast cancer. These may include the cleaning solvents and pesticides to which Luisa was exposed on her



jobs. Also, the longer immigrant women live in the U.S., the more their lifestyles become like those of their adopted country. Their diets, exercise levels, sun exposure, and social support may all change. Research into a possible link between changes in immigrant women's diets and breast cancer risk has been inconclusive. Other aspects of immigrant women's lifestyles need more research.



### Did Pesticides Play a Role in Luisa's Cancer?

California women like Luisa who live in rural areas are less likely to get breast cancer than are women who live in the state's cities. Luisa is also part of an ethnic group—Hispanics/Latinas—with a lower rate for breast cancer than either white women or African American women. However, Luisa is part of a subgroup of rural, Hispanic/Latina women whose risk for breast cancer may be higher because they have been exposed to pesticides. One quarter of pesticides used in the U.S. are applied in California.

In her long years of farm work, Luisa has been in contact with many different pesticides. She may have been exposed to pesticides banned in the United States, when she worked on farms in Mexico. Changes in breast cells that start tumors can occur 20, 40, or even more years before cancer is diagnosed, so pesticides from Luisa's youth in Mexico could have played a role. Luisa's exposure to pesticides continues because her husband tracks them home from the vineyard. The motels where she works as a cleaner also use pesticides to control ants and roaches. In addition, the well water she drinks and uses may be contaminated with pesticides.

The pesticide-breast cancer connection has not been studied enough, but ten common pesticides cause laboratory animals such as rats to get mammary gland cancer (the animal equivalent of breast cancer). Many other pesticides can disrupt the body's hormone system in ways that may lead to breast cancer.

Pesticides could also have put Luisa's daughter at higher risk for breast cancer, since Luisa was exposed to pesticides during her pregnancy. Exposure to pesticides in the womb or during puberty may affect developing breast tissue. Many years later, this could make an adult woman more susceptible to breast cancer. Research has shown that women who were exposed to DDT before age 14 had a much higher risk of breast cancer later in life than those who were exposed only after age 14. Most research on pesticides and breast cancer has focused on one pesticide or class of pesticides and ignored exposures early in life. More research is needed to see if early or long-term, chronic exposure to real-life mixtures of pesticides, like that Luisa has experienced, leads to breast cancer.

### A Mix of Toxic Exposures

Like Danielle, Luisa has been exposed to more than one kind of environmental toxin. Luisa's job cleaning motel rooms puts her in contact with cleaning products that contain substances that could play a role in breast cancer. Moreover, the well that is the source of Luisa's drinking water may be contaminated with more than pesticides. Arsenic, one of the metals that could contribute to breast cancer, is sometimes found in drinking water. Drinking water can also be contaminated with other heavy metals, fertilizers, industrial chemicals, medications, and personal care products. Very little research has been done on the relationship of these mixtures of pollutants to breast cancer.

The combination of arsenic, pesticides, and toxic substances found in cleaning products could have been more harmful to Luisa than any of them



*Like pesticides, chemicals in cleaning products may play a role in breast cancer. Multiple exposures may be even more toxic, and timing may also play a role.*

alone. However, no research has yet been conducted on this mix of toxins and breast cancer.

### Access to Treatment

Luisa did not have full access to breast cancer treatment for several reasons. One was her lack of health insurance. Women who don't have health insurance are less likely to receive the current standard recommended treatment: surgery to remove their tumor plus radiation.

Secondly, Luisa was worried that she would not be able to get to the radiation center five days a week for six weeks. Research has shown that the further a woman lives from a radiation center, the more likely she will choose mastectomy instead of breast-conserving surgery.

Luisa's access to treatment was also compromised because she waited more than four months to have surgery. One study found that Hispanic/Latina women who prefer speaking Spanish were more likely than white women to have their treatment delayed for three months or more.

Lack of access may be one reason why Hispanic/Latina women like Luisa are more likely than white women to receive substandard breast cancer treatment. Other groups less likely to receive standard breast cancer treatment include African American,

Asian American, Pacific Islander, Native Hawaiian, American Indian, and Alaska Native women.

### Luisa's Chance of Survival

More than one in every five California women don't have health insurance. Luisa is one of them. Hispanic/Latina women like Luisa are twice as likely to be uninsured as women from any other ethnic group in the state. Research shows that uninsured women are less likely to receive regular medical exams, including mammograms. One result is that women without health insurance are less likely to be diagnosed with a small tumor that can be most successfully treated, and more likely to be diagnosed with a larger tumor that has possibly had time to spread to other parts of the body.

Nevertheless, Luisa has two characteristics going for her. First, rural women like Luisa have a lower death rate from breast cancer than women living in cities. Second, research has shown that social support can increase a woman's chance of survival. Luisa's close-knit ethnic community and extended family provide her with lots of social support.



*Health care coverage in the U.S. is fragmented and complex. Women are particularly vulnerable for lack of coverage because they are less likely than men to be covered by their employers. Rural residents and non-English speakers have even greater difficulties in accessing screening and treatment. Photo credit: Marilyn Bechtel, People's World.*

## WENDY — At First Glance, Unlikely to Get Breast Cancer

A third-generation Japanese American, Wendy is an emergency room physician. Her work includes night shifts and some 24-hour shifts. Now, at age 56, she's been wishing she could slow down a little and spend more time at her comfortable home in the southern California city of Laguna Beach.

Wendy's plans have been thrown into question since she was diagnosed with breast cancer a month ago. However, she is feeling hopeful because her tumor was small, less than 1/2 inch in diameter. There are also no signs that it has spread to any other place in her body.

### Is Wendy Part of A Low-Risk or A High-Risk Group?

Wendy is surprised that she has breast cancer. She belongs to a U.S. ethnic group with the lowest rate for the disease. Breast cancer statistics in the U.S. have generally been grouped into four large racial and ethnic categories: white, African American, Hispanic/Latina, and Asian/Pacific Islander. These correspond roughly to ancestry in the continents of Europe, Africa, Central and South America, and Asia. Among these four U.S. groups, Asian/Pacific Islander women have the lowest rate of breast cancer.

But if Wendy looks at the ethnic patterns closely, she might be less surprised by her diagnosis. When U.S. statistics on women of Asian/Pacific Islander ancestry are divided into subgroups, major differences emerge. Japanese American women

have the highest rate of breast cancer of all U.S. Asian/Pacific Islander women. In California, Japanese American women get breast cancer at a rate almost as high as white women, the group with the highest rate of disease. One danger from grouping all Asian/Pacific Islander women together is that women from this racial/ethnic grouping may mistakenly believe they are at a very low risk for breast cancer.

Increasingly, breast cancer researchers consider Asian American and Pacific Islander as two separate categories, but even this distinction doesn't go far enough. More investigation is needed into the breast cancer risk of the many subgroups

within each category. Native Hawaiian and Filipino American women, for example, may, as a group, have very different poverty rates, medical insurance coverage, lifestyle practices, or social support networks. Asian Indian immigrants may live in neighborhoods very different from those of Cambodian or Hmong immigrants.

Wendy's chance of getting breast cancer is also higher than her mother's or her grandmother's. As Luisa's story showed, third-generation immigrants to the United States are more likely than second- or first-generation immigrants

to get breast cancer. The risk for fourth-generation immigrants is even higher.

Wendy's tumor was found while it was still very small, and it has apparently not spread to another place in her body. In this she is typical. Among the major racial/ethnic groups, U.S. Asian/Pacific





Islander women are the least likely to be diagnosed with advanced-stage disease.

### The Affluence Paradox

High income is associated with breast cancer risk. So is having advanced education. For reasons not understood, breast cancer is one of the few health problems more common among high-income women than low-income women. It is also more common in affluent neighborhoods than in low-income neighborhoods.

Although high-income women like Wendy are more likely to get breast cancer than poorer women, they are also more likely to have their tumor caught when it is still small and has not spread. This may help explain why women with higher incomes and education levels have a better chance of surviving the disease. Other possible explanations for the lower death rate among wealthier, more educated breast cancer patients such as Wendy include better access to treatment and less aggressive tumors. However, none of these reasons completely explain why affluent women are more likely to survive.

### Light at Night

Wendy's work hours may have played a role in her breast cancer. Scientific evidence, coming mostly from research on women who work night shifts, consistently shows that women are at a higher-

than-average risk for breast cancer if they are exposed to light at night. This evidence is further supported by studies showing that blind women—totally blind or severely visually impaired women whose eyes take in no or little light—have a lower-than-average risk of breast cancer. If a woman is exposed to light at night when she is pregnant with a girl, it may also raise her daughter's risk for breast cancer later in life.

### Toxic Chemicals and Radiation

At home and on the job, Wendy has been exposed to a number of hazards that are suspected of playing a role in breast cancer. Health care workers like Wendy may be exposed to the solvent ethylene oxide, which is used to sterilize medical equipment. She could also be exposed to solvents—found in furniture, carpets and carpet pads, and bedding—that may cause breast cancer. Another possible cause of breast cancer from Wendy's environment is radiation. When health care workers spend time near x-ray and some other scanning equipment, they may be exposed to a type of radiation proven to cause breast cancer. Radiation and toxic chemicals may act together in the body, raising the risk of breast cancer more than would radiation alone.

At home, Wendy is exposed to flame retardants that are known to interfere with the body's hormones in ways that may contribute to breast cancer. PBDEs are types of flame retardants related to the PCB chemicals. PBDEs have been widely used since the 1970s to fireproof plastic and foam products, including TV sets, computers, and foam cushions in furniture. Over time, they can leach out into indoor air and dust.

Because PBDEs are used in so many products, almost every American is exposed. California requires some of the highest levels of flame retardants, making these chemicals especially common here. The level of PBDEs in the blood of California residents is double the national average, and house dust levels are four to ten times higher than those of other states. In spite of their widespread use, very little is known about the health effects of PBDEs. No breast cancer studies have been conducted on PBDEs in humans. Moreover, because PBDEs only came onto the market 30 years ago, it is too early to tell whether women exposed to





*First-generation immigrant women in the U.S. have low rates of breast cancer. Their daughters are more likely to get the disease. Their granddaughters are even more at risk.*

PBDEs during infancy and childhood are at higher risk for breast cancer.

Another widely-used chemical is bisphenol A (BPA). Like PBDEs, it is used in plastics, but it is also used in plastic water and milk jugs, baby bottles, sippy cups, food can linings, and some dental sealants. BPA acts like estrogen in the human body. In young laboratory animals, it can alter the development of the breast and speed the onset of puberty, changes that may be linked to breast cancer.

Wendy may have been exposed to flame retardants, BPA, or other toxic chemicals at critical periods of her life, such as while she was in the womb, as an infant, or during puberty. These toxic exposures could have caused changes in her developing body that made her more likely to get breast cancer years later.

### **The Group with the Highest Survival Rate**

As a Japanese American, Wendy is a member of the ethnic group most likely to survive breast can-

cer. U.S. white women have the second-highest survival rate. African Americans have the lowest. However, the breast cancer survival rates for all racial/ethnic subgroups have not been thoroughly studied. Clearly, women from certain racial and ethnic groups have better access to testing and treatment, and this is probably one reason they are less likely to die from the disease. But differences in access to health care are not the whole story. Discovering why Japanese American women are more likely to survive breast cancer could provide important clues to improving survival for women of all racial and ethnic groups.

*Breast cancer has many contributing factors. Identifying all the causes of a particular woman's tumor is an impossible task. However, when researchers look at large groups of women, patterns of possible cause emerge. Investigating these patterns could lead to prevention and cure. In the following section, we present the most promising ways to tackle these hard-to-research questions.*

## Part II

# Urgent Unanswered Questions: Promising Research Ideas

Every day, California women are facing breast cancer in ways similar to Danielle, Luisa, and Wendy. Answering the research questions their stories raise could be key to prevention and cure. Below are promising ideas for research into the reasons why some groups of women bear a greater burden of breast cancer, and how the environment contributes to this disease.

These research ideas were generated through a process that included scientists, health care providers, women with breast cancer, breast cancer advocates, and other Californians. The public and experts had opportunities both to suggest and rate research ideas.

The California Breast Cancer Research Program is funding research, described in Part III, based on a number of these ideas. However, we have uncovered far more urgent unanswered research questions than we can address with the funds available to us. We commend and thank the Avon Foundation for Women for joining with us in funding research into the breast cancer-environment connection and the greater burden of this disease carried by some groups of women. We invite other funding agencies to also collaborate with us in funding, or to fund on their own, research based on the ideas listed below.



*CBCRP has long supported research by groups like the Guam Communications Network.*

likely to get breast cancer or less likely to survive.

- Investigate whether social support in diverse racial and ethnic communities makes a difference in whether women get breast cancer, whether they get tested for the disease, the treatment they receive, and their chance of surviving.
- Study the causes of racial and ethnic differences in early puberty in girls. Early puberty is a sign that a girl will be at higher risk for breast cancer later in her life.
- Study the rates of occurrence of various types of tumors in diverse racial and ethnic groups and subgroups. Breast tumors can be classified in various ways, and some types are more likely to be deadly.
- Explore the social, cultural, biological, and behavioral factors that may influence differences in whether women get or survive breast cancer, by detailed racial/ethnic subgroup, education and income level, and whether the women were born in the U.S. or immigrated here.
- Develop appropriate measures to assess, address, and include diverse minority cultures in cancer research.



### Race and Ethnicity

*Women from various racial and ethnic groups have very different rates of getting breast cancer and of surviving the disease.*

- Find out if stress plays a role in women from some racial and ethnic groups being more

- Uncover the cultural factors that impact breast cancer diagnosis, treatment, and survival among diverse African American, American Indian/Alaska Native, Asian American, Pacific Islander, and Latina/Hispanic subgroups.
- Develop and evaluate diet and exercise programs based in the cultures of diverse racial and ethnic subgroups of women diagnosed with breast cancer. Compare these diet and exercise programs to standard approaches.

### Immigration

*Newly arrived immigrant women—except those from northern and western Europe—are less likely to get breast cancer than women born and raised in the U.S.*

- Determine what is different about immigrant women that makes their breast cancer rate so much lower and why their chances of getting breast cancer increase after living in the U.S.
- Investigate how immigration and adopting of U.S. culture impacts survival after a diagnosis of breast cancer for all racial and ethnic groups.



### Urban Living

*Women living in cities are more likely to get breast cancer than women living in rural areas.*

- Initiate collaborations between communities, health researchers, policy makers, environmental scientists, social scientists, and urban

planners to study neighborhood environments, applying models of multiple stressors and cumulative breast cancer risk.

- Investigate aspects of culture and neighborhood that influence childbearing practices, including age of having children and breastfeeding. Having children at younger ages and breastfeeding both are protective against breast cancer.

### Income/Education Level (Socioeconomic Status)

*Breast cancer is one of the few health problems more common among affluent women than low-income women, and more often found in affluent neighborhoods than low-income neighborhoods.*

- Research what is different about high socioeconomic status women and high socioeconomic status neighborhoods that goes with higher rates of breast cancer.
- Explore the relative and joint roles of individual and neighborhood socioeconomic status. Living in a high socioeconomic status neighborhood raises a woman's risk for breast cancer, regardless of her personal socioeconomic status.
- Investigate how individual and neighborhood socioeconomic status influences the breast cancer risk of various racial and ethnic groups.
- Conduct a pilot project to test policies to encourage breastfeeding in low income communities where breastfeeding rates are low. Breastfeeding is protective against breast cancer.
- Find out why women on Medi-Cal (California's government-funded program of health care for low-income people) have more aggressive breast tumors.

### Personal Care Products

*Over 5,000 chemicals can be found in various hair, skin, and nail care products on the market today. Most have never been tested to find out if they can contribute to breast cancer. Moreover, some of these chemicals are known to interfere or*



*suspected of interfering with hormones in ways that can contribute to breast cancer.*

- Research chemicals commonly found in cosmetics and other personal care products for which there is evidence of involvement in breast cancer. These include parabens, phthalates and certain organic solvents (acetone, ethylene glycol, TEA, toluene, and methylene chloride).
- Investigate the possible role of sunscreens in breast cancer.
- Explore how home remedies, herbs, teas, and dietary supplements commonly used in ethnic and other populations affect breast cancer risk.

### Vitamin D

*Evidence suggests that having a higher level of vitamin D in the body is protective against breast cancer.*

- Directly measure vitamin D levels in women's bodies and find out if these levels affect breast cancer risk.
- Investigate whether vitamin D from sun exposure, in conjunction with diet, can reduce the risk of getting breast cancer and increase survival after diagnosis.

### Light at Night

*Evidence is mounting that working nights raises a woman's chance of getting breast cancer. The most likely reason is that these women are exposed to more light at night.*

- Identify sleep behaviors (timing, number of hours, and amount of light in the room) that impact hormones in ways that may contribute to—or help prevent—breast cancer.
- Further investigate the link of night-time light exposure with breast cancer risk.
- Research whether exposure to light at night during a mother's pregnancy affects her daughter's risk for breast cancer later in life.



*Does exposure to light at night increase a woman's chance of getting breast cancer?*

### Chemicals

*Chemicals that may contribute to breast cancer or have been proven to cause breast cancer are so common in the environment that every American is exposed.*

- Develop strategies chemists could use to test new industrial molecules in the design stage so the chemical industry can avoid creating more chemicals that cause breast cancer.
- Find ways to test women now for exposure in the past to chemicals or other environmental exposures that may lead to breast cancer.
- Investigate how exposure to brominated flame retardants (PBDEs) and other chemicals commonly found in the environment may influence breast cancer. These include phthalates (found in plastic products, building materials, pesticides and personal care products) and bisphenol A (found in hard plastics, the lining of food and beverage cans, dental sealants, CDs and DVDs, and other types of plastics).
- Advance the application of California's Proposition 65 law and other chemicals policies for chemicals of concern for breast cancer. Under

Proposition 65, the state government publishes a list annually of chemicals known to cause cancer or birth defects. Businesses and government agencies are required to post a warning if they are exposing the public to any of these chemicals.



## Air Pollution

*Studies on Long Island found links between air pollutants and breast cancer risk.*

- Study the links between breast cancer and various chemicals found in gasoline and diesel fuel, the chemicals these fuel components turn into when they are burned in engines, and the chemicals they then become when they interact with processes inside the human body.
- Investigate the role of one class of air pollution chemicals, polycyclic aromatic hydrocarbons (PAHs) in breast cancer risk; improve exposure estimates by identifying and moni-

toring susceptible subpopulations or highly exposed workers over time.

## Drinking Water

*California drinking water is sometimes contaminated with low levels of substances suspected to cause breast cancer. These include chemicals formed when water is disinfected with chlorine.*

- Find out if women have higher breast cancer rates in areas of California where drinking water is contaminated with the dry cleaning chemical perchlorethylene, as is true in Cape Cod.
- Determine which chemicals that cause mammary gland cancer (the animal equivalent of breast cancer) in lab animals are in California's drinking water, and whether breast cancer rates are higher in areas where the water has higher levels of these chemicals.
- Investigate whether MX, a chemical by-product of water disinfection and a known mammary gland carcinogen, plays a role in causing breast cancer.
- Find out if women whose drinking water comes from treated waste water have a higher risk of breast cancer.

## Pesticides

*One quarter of the pesticides used in the U.S. are applied in California.*

- Use California's pesticide use registry and Safe Drinking Water Act data to pinpoint areas of intense use of, or potential exposure to, pesticides. Pay particular attention to atrazine and simazine, pesticides known to cause mammary cancer in animals (mammary cancer is the animal equivalent of breast cancer).
- Find out if pesticide use raises the breast cancer risk of women and girls in farm worker communities.



## Radiation

*One type of radiation—ionizing radiation—is a proven cause of breast cancer, and exposure to ionizing radiation raises a women’s risk for the disease.*

- Evaluate the use of radiation in mammograms and breast cancer treatment for subpopulations of women who may be susceptible to radiation’s harmful effects.
- Research how genes affect radiation-related cancer risk.

## Timing of Exposure

*Exposure to toxic chemicals at critical times in life—including while developing in the womb, as a baby, and during puberty—may increase a woman’s breast cancer risk many years later, when she is an adult.*

- Investigate exposure to chemicals that act similarly to the hormone estrogen. Find out if exposure to these chemicals at levels now actually found in babies’ blood increases the risk that laboratory mice will get mammary cancer (the animal equivalent of breast cancer).
- Develop better methods for measuring exposure to chemicals and other possible environmental causes of breast cancer through the life course.

- Investigate exposures to real-life mixtures of pesticides at points in the life course when these exposures are most likely to increase breast cancer risk, including during development in the womb, at puberty, and before childbearing.

## Multiple Exposures

*Most research on chemical and other exposures from the environment has been done on a single exposure. More research is needed on real-life mixtures of exposures.*

- Develop new methods to analyze and measure the breast cancer-related impact of combined exposures to real-life mixtures of chemicals and other suspected environmental causes of cancer.
- Develop methods for analyzing at the same time several chemicals, gene-environment interactions, and timing of exposures.
- Research complex connections between breast cancer and the environment, using recent advances in geographic information systems (GIS) technology, exposure assessments, and methods for examining social processes.
- Develop new methods in epidemiology, analytical chemistry, and toxicology to explore



*Childhood exposure to some pesticides and plastics could increase breast cancer risk.*



the impact of multiple, combined, interacting exposures from the environment.

### Gene-Environment Interactions

*Some women have a gene that may make them more susceptible to breast cancer if they are exposed to certain toxic chemicals. Other, as yet undiscovered gene-environment interactions may be significant in breast cancer.*

- Study variations in genes among diverse racial and ethnic groups that raise or lower their susceptibility to various cancer-causing exposures from the environment.
- Investigate interactions between pesticide exposure and the genes that are involved in the chemical reactions within the body through which pesticides may affect breast cancer risk.

### Occupation

*Breast cancer risk varies by occupation.*

- Conduct a long-term study of the breast cancer risk of women exposed to solvents, heavy metals, and/or industrial chemicals at work.
- Study why nurses and teachers have a higher-than-average incidence of breast cancer.
- Investigate breast cancer rates among women in occupations where there is concern that

exposure to chemicals or other environmental toxins may be related to breast cancer, including nail and hair salons, electronics, agriculture, and cleaning.

### Disabilities

*Little research has included questions about the breast cancer risk of women with disabilities.*

- Conduct comprehensive studies to understand the breast cancer-related experiences of women with a broad spectrum of disabilities and subgroups within disabilities. Include barriers to prevention, detection, and treatment, and strategies for overcoming these barriers.

### Sexual Orientation

*There is a lack of research on the breast cancer risk of lesbians and bisexual women.*

- Define a study population of lesbians and other sexual minority women for use in breast cancer research, taking into account sexual orientation and self-perception of sexual orientation.
- Study the breast cancer rate of transgender women and men who use large amounts of the hormone estrogen over many years.

### Better Information about Who Carries a Greater Burden of Breast Cancer

*Why are African American women least likely to survive breast cancer? Why are recent immigrants less likely to get the disease? One important method breast cancer researchers use to answer questions like these is comparing how often breast cancer strikes—and what happens to women after they are diagnosed with the disease—in various subgroups of women. But making these comparisons is difficult today, because detailed demographic information about women with breast cancer, such as their ethnic subgroups and immigration histories, is not available.*

- Collect detailed data on breast cancer within all ethnic and racial subgroups.
- Create scientifically valid data on how and why immigrant women adopting aspects of American culture increases their chances of

getting breast cancer. This should include complete data on where the women were born, the age they moved to the U.S., their income and education level, where they live now, and how long they have been in the U.S.

- Standardize the racial, ethnic, socioeconomic, and relevant demographic information collected by California agencies with an ongoing mission to collect breast cancer information, including the California Cancer Registry and the California Health Information Survey.



*While older women are more likely to get breast cancer, younger women often have more aggressive forms. The differences between the rates and the kinds of breast cancer in women of different ages and from different places and cultures could point to factors that increase or decrease our risk of the disease.*

*Are there contaminants in our drinking water that affect breast cancer risk? Do plastics, like those in water bottles, affect our chances of getting breast cancer? Who is most susceptible?*





## Part III

# Urgent Unanswered Questions: Research We Are Funding to Find Answers

The California Breast Cancer Research Program is funding new research into the reasons why some groups of women bear a greater burden of this disease and environmental links to breast cancer. We selected the research we are funding based on the opinions of experts nationwide. With the initiatives described below, we are joining forces with California institutions and organizations, and also making use of California public

laborating to discover why. They want to decrease breast cancer deaths among racial and ethnic groups with the highest death rates.

The study, titled **Understanding Racial and Ethnic Differences in Stage-Specific Breast Cancer Survival**, will bring together six collaborating researchers to find out if data from eight ongoing California breast cancer research projects can be combined to yield

answers. **Anna Wu**, Ph.D., of University of Southern California and the Breast Cancer in Asian American Women Study is leading the

effort. Together, the researchers could create a database with extensive health information on over 13,000 California women with and without breast cancer, including significant numbers of African American, Hispanic/Latina, Japanese American, Chinese American, Filipina American, and white women, with smaller numbers of American Indian/Alaska Native women.

#### Collaborators:

- **Leslie Bernstein**, Ph.D., Beckman Research Institute of the City of Hope, Women's CARE Study and *In Situ* Breast Cancer Study
- **Katherine Henderson**, Ph.D., Beckman Research Institute

of the City of Hope, California Teachers Study

- **Ester John**, Ph.D., Cancer Prevention Institute of California, SF Bay Area Breast Cancer Study
- **Marilyn Kwan**, Ph.D., Kaiser Foundation Research Institute, Kaiser Pathways and Life after Cancer Epidemiology Study (LACE)
- **Kristine Monroe**, Ph.D., University of Southern California, Multi-Ethnic Cohort

If the collaborating researchers succeed in creating this powerful new database, they can apply for additional California Breast Cancer Research Program funding to answer questions about why some groups of women are more likely to die from breast cancer. They could use the database to study differences in tumor characteristics, social environments, and physical environments between racial and ethnic groups and subgroups. This could identify things that women can do, or changes that need to be made to physical and social environments, that could lower breast cancer death rates or prevent women from getting the disease.

Another way to better understand why some women are more likely to get and die from breast cancer is to improve state data. We are funding a study that builds on California's

## This study could identify differences that would lower breast cancer death rates.

policy, to leverage the state's resources in ways that can steer breast cancer research in new, promising directions.

Our goal is to fund research that not only increases knowledge, but also points toward solutions that will move us toward prevention and cure.

### Why Are Some Racial/Ethnic Groups More Affected by Breast Cancer?

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. In a study that could only be conducted in California, researchers from across the state are col-

national leadership in collecting information about who gets cancer, including breast cancer. Scientists already use this information to investigate the breast cancer burden of some groups of women. However, the information collected by various California agencies and researchers often does not include important data, such as the ethnic subgroups and immigration histories. Our study, titled

## New tools will make it easier for scientists to find out why some groups of women are more likely to get, or die from, breast cancer.

**Demographic Questions for California Breast Cancer Research**, is designed to empower researchers to find out more about which women are most affected, in order to improve this situation.

**Scarlet Lin Gomez, Ph.D.**, of the Cancer Prevention Institute of California, is convening an expert panel to create a core set of standard questions on race, ethnic group, migration history, income and education level, disability, sexual orientation, and gender, and test them in various languages. Scientists will be required to use these standard questions in future research that we fund, and we will encourage their use by other researchers. This will expand the information available to researchers, and allow scientists to find out more by comparing or combining data from different studies.

### Why Does Moving to the U.S. Raise a Women's Chance of Getting Breast Cancer?

The longer immigrant women live in the U.S., the more likely they are to get breast cancer. Finding out why could point to ways to prevent the disease in any woman. Researchers have long known that most countries in the world have lower breast

cancer rates than the U.S. When women immigrate here from these countries, their rates of breast cancer are lower at first. As they live here longer, their risk rises.

Their U.S.-born daughters' risk is higher, and their U.S.-born granddaughters' risk is higher still. The reason probably lies in some combination of differences between the physical and social environments women left in their countries of origin, and their new environments here in the U.S.

Research into this question has received little funding. It is complex and difficult to conduct. There are often language and cultural barriers between scientific researchers and immigrant women. In addition, this type of research involves investigating many different aspects of women's lives at the same time, and figuring out how they all might interact to raise—or lower—the risk of breast cancer.

The California Breast Cancer Research Program is funding up to three pilot studies to investigate changes over time in immigrant women's behavior, social lives, or physical environment that may be linked to their risk for breast cancer. Women from the immigrant communities being studied will be involved in designing and carrying out the research.

This research could remove a barrier that has blocked progress in the past, by developing successful methods for studying the many possible causes of the rise in immigrant women's breast cancer risk after they move to the U.S. It could also point to changes that could be made to prevent breast cancer in both immigrant women and U.S.-born women.



*Advisors to the Environmental Causes of Breast Cancer across 3 Generations Study include two grown up daughters of the original study members.*

### If a Woman Was Exposed to Chemicals Years Ago, Can They Cause Breast Cancer Today?

In the first-ever “womb to breast cancer” study in women, rather



*Studies suggest what we are exposed to before we are born affects our risk of breast cancer and other diseases.*

than lab animals, we are finding out if women exposed to certain chemicals while they were developing in the womb are more likely to get breast cancer. This study is based on growing scientific evidence that women who were exposed to toxic chemicals at critical periods in their lives are more likely to get breast cancer years later. The critical periods include during development

study, because researchers need information about exposures decades before a woman gets breast cancer.

Titled **The Environmental Causes of Breast Cancer Across Generations**, this study takes advantage of a critical resource, one of the rare research projects that collected blood samples years ago and then tracked women later

in life. **Barbara Cohn**, Ph.D., of the Public Health Institute will use blood collected 40 years ago as part of the Child Health and Development Stud-

ies. Some of the women who originally participated have since developed breast cancer; most have not.

Dr. Cohn will test the blood samples for certain chemicals to see how they relate to the risk of breast cancer in the daughters born to the women in the study. The chemicals include the banned pesticide DDT, other pesticides, and PCBs (a group of chemicals formerly used in electrical equipment and some

building finishes). These chemicals break down slowly in the environment and accumulate in human tissue. Many of them disrupt reproduction and the immune system. They are suspected of causing breast cancer.

This study will measure pregnant mothers' blood levels of these chemicals, and of the chemicals the PCBs become as the body tries to break them down, to estimate exposure to the daughters in the womb. Then, Dr. Cohn will look for associations with breast cancer now that the daughters are older. She will also recruit daughters and granddaughters, and collect samples from them, to see if breast cancer-causing damage done by toxic chemicals gets passed from generation to generation. This ground-breaking research could significantly advance understanding of whether early-life chemical exposure leads to breast cancer later and, if so, point to ways to prevent the disease.

### **Do Common Chemicals Play a Role in Breast Cancer?**

To get truly see the environment's role in breast cancer, researchers need to study many factors in a large, diverse population of women over time. Ideally, researchers would be able to collect different kinds of information about the women. This would include each woman's environments, lifestyle, racial and ethnic background, immigration history, sexual orientation, genes, health history, etc. Because cancer develops over years, researchers also need to

## **When we understand why immigrants' risk of breast cancer increases the longer they live in the US, we might figure out how to prevent it.**

in the womb, the first months of life, and during puberty.

Exposure to radiation at critical points in life can cause breast cancer later, and the ongoing Child Health and Development Studies in California found early exposure to the pesticide DDT increased later breast cancer risk. However, scientists still know very little about which chemicals—and which mixtures—can do this type of damage. The question is hard to

gather this data over time, and have the tools to address multiple breast cancer risk factors at the same time.

California already has a unique resource with these qualities for conducting research into the breast cancer-environment connection. The ongoing statewide California Teachers Study is actively following over 133,000 California women teachers, who periodically provide information about their lives, including giving blood samples. And teachers are more likely to get breast cancer than woman in other jobs.

a larger, longer-term study to develop the methods and measure exposures to find out what is different between those who have breast cancer and those who do not, in different racial and ethnic groups.

Teachers are not the only group who may provide useful clues about the environmental causes of breast cancer. Kaiser Permanente of Northern California's Research Program on Genes, the Environment, and Health is also collecting data on over 200,000 women patients that could be used to find out more. Kaiser has been invited to take part in

of the disease, we need better tools for investigating—all at once—many factors that may be involved in breast cancer.

To start meeting this research need, the CBCRP is convening an expert panel that includes social scientists, environmental scientists, and experts on ethnic and other differences in breast cancer. The panel, in a study titled **Toward a New Paradigm of Breast Cancer Causation and Prevention**, will apply to breast cancer research an emerging new scientific tool, complexity theory.

Complexity theory is used to understand biological systems that interact on many levels, from inside cells to the social and physical environment. It has been successfully used in such diverse ways as describing the structure of an ant colony, understanding the disease fibromyalgia, and explaining the worldwide decline of frog populations.

The expert panel, led by **Robert Hiatt**, M.D., Ph.D., M.P.H., of the University of California, San Francisco, will develop a model of breast cancer causation based on complexity theory. The model will take into account combinations of interacting causes that may include genes, breast tissue structure, hormones, chemicals from the environment, events during development in the womb, diet, immigration history, barriers to exercise due to neighborhood, age at puberty, exposure to sunlight and to light at night, income and education level, social support, radiation exposure, and cultural attitudes about breastfeeding.

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## This study will look at chemical exposure in the womb to see if exposed children are more likely to develop breast cancer as adults.

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The California Breast Cancer Research Program is funding a pilot project to leverage over ten years of California Teachers Study data. Titled **Exploring Disparities and Environmental Exposures in Teachers**, **Peggy Reynolds**, Ph.D., and **Susan Hurley**, M.P.H., of the Cancer Prevention Institute of California, are identifying critical environmental risk factors for further study. Using the Teachers data and existing statewide data, they will consider genes, the social and built environments that teachers live in, and other aspects of risk to evaluate the role of specific chemicals in breast cancer.

If the results of this pilot project are promising, we will fund

this research effort with a pilot project and possibility of a future long-term study.

### If So Many Different Things Act Together to Cause Breast Cancer, Can it Be Prevented?

A new scientific tool used to explain why frogs are dying worldwide may help shed light on the complex causes of breast cancer and lead to prevention. Up until now, scientists have too often studied only one possible cause of breast cancer at a time. If we are going to make progress in uncovering the environment's role in breast cancer and in understanding why some groups of women bear a greater burden

The resulting model of breast cancer causation will be designed as a tool backed by scientific evidence that can be used to inform policy decisions. The policy decisions it could potentially impact range widely, from whether to allow a chemical to remain in use to whether to make a city zoning change that could reduce racial housing segregation.

#### **Cracking Open Complex Questions with Innovative Statistics:**

It also takes complex math to evaluate the impact of many complex causes leading to breast cancer. New, more powerful

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## **We are joining forces with ongoing California research to investigate toxic chemicals role in breast cancer.**

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computers and software make this complex math possible. We are funding three research teams to develop new statistical methods that will allow researchers to better measure the many factors that act in combination with each other across a woman's life span, increasing or lowering her risk of getting breast cancer.

**David Nelson**, Ph.D., of the Cancer Prevention Institute of California, will use a statistical technique called data mining in a study titled **Model-building with Complex Environmental Exposures**. His team will find out which, if any, of the thousands of pesticides used in California agriculture pose a breast cancer risk to the state's teachers. This

study uses data already collected by the ongoing California Teachers Study and California's state government Pesticide Use Report system.

**Daniel Stram**, Ph.D., of the University of Southern California, will use innovative statistical methods to investigate differences in breast cancer among African American women. The study, titled **New Methods for Genomic Studies in African American Women**, will analyze complex genetic data from the ongoing African American Breast Cancer Study. The research team will attempt to find the

best methods, especially for studying women of mixed ancestry. They will also explore what makes individual women susceptible to breast cancer,

as a step toward identifying new targets for prevention and treatment.

**Eric Roberts**, M.D., Ph.D., of the Public Health Institute, is working to make breast cancer data more useful to the public and advocates. This study, titled **Cancer Mapping: Making Spatial Models Work for Communities**, will create statistical tools for exploring differences in breast cancer between small fractions of California counties, while still maintaining patient privacy. Breast cancer rates, up until now, could be compared between counties, but not by smaller geographic areas, and California counties are so large that comparing their breast

cancer rates doesn't generate enough information. Tools and maps created in the course of this study could be used to identify communities vulnerable to breast cancer, generate hypotheses about social and environmental causes of the disease, and provide information advocates need to push for prevention measures.

### **Can California Lower Women's Exposure to Breast Cancer-Causing Chemicals?**

Right now, the California government is developing a new policy on chemicals for the state. It could lead to better regulations to protect Californians from chemicals that harm humans and the environment. This is a chance to protect women from chemicals that cause breast cancer. However, science does not yet have all the answers about which chemicals those are. To make breast cancer prevention part of the new chemicals policy, the California Breast Cancer Research Program is funding two studies to figure out how best to test chemicals for their potential to cause breast cancer.

American women have been and are exposed to tens of thousands of chemicals. The vast majority of these chemicals have never been tested to see if they cause breast cancer. Most of those that do cause animals to get mammary cancer (the animal equivalent of breast cancer) have never been included in a study to see if they are playing a role in human breast cancer.

Chemicals can cause a variety of changes in the body that can

lead to breast cancer. They can change a breast cell's genes in ways that allow a tumor to start. This kind of chemical damage can occur decades before the tumor is diagnosed. Chemicals can also stimulate a tumor's growth. Chemicals that are similar in structure to the hormone estrogen, which can also stimulate breast tumor growth, are

## Do any of the thousands of pesticides used in California pose a breast cancer risk?

suspected of stimulating breast tumor growth even when they are present in the body at very low levels. Another way chemicals can play a role is by transforming a harmless breast tumor into cancer. And chemicals can

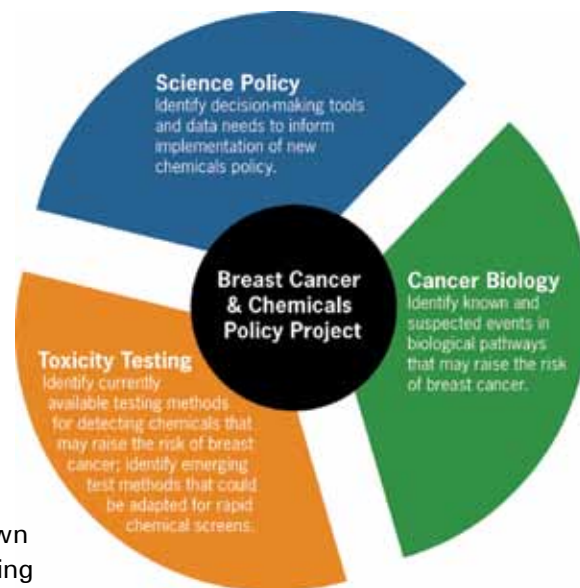
interfere with the body's own natural processes for stopping tumors.

**Megan Schwarzman, M.D., M.P.H.**, of the Northern California Center for Occupational and Environmental Health, will lead a study titled **Toward the Development of a California Chemicals Policy that Considers Breast**

**Cancer.** Dr.

Schwarzman and her project co-director, **Sarah Janssen, M.D., Ph.D.**, are convening a research work-

ing group to identify the mechanisms, tissue changes, and other markers that are most important to breast cancer. The working group will rank currently available tests that can be performed on chemicals to see if they generate these changes in the body.



They will also make recommendations for new tests that are needed and for prioritizing chemicals for testing. This will be used to encourage those developing California's new chemicals policy to consider breast and other hormonal cancers.

But we will not be content to rely only on the tests that are currently available. To follow up on this study, we will offer funding for **Making Chemicals Testing Relevant to Breast Cancer**. Researchers will develop new methods to determine which chemicals are most likely to contribute to breast cancer. These tests to screen chemicals will be created or refined based on the specific biological mechanisms and other markers involved in breast cancer development. This project will provide the needed laboratory advances to create a chemicals policy that can reduce breast cancer risks.



*The Organic Analytical Toxicology Branch of the Centers for Disease Control and Prevention (CDC) conducts research and develops methods for analyzing selected synthetic and naturally occurring organic chemicals and their metabolites or reaction products in blood or urine. The CBCRP is sponsoring research to encourage testing specific to breast cancer and to develop new tests.*

## References

Fuller descriptions of research funded under the California Breast Cancer Research Program's Special Research Initiatives are posted on the CBCRP web site.

Other information presented on these pages is drawn from the California Breast Cancer Research Program's review of previous research on the reasons why some groups of women bear a greater burden of breast cancer and the role of the environment in the disease. A draft of this research review, *Identifying Gaps in Breast Cancer Research: Addressing Disparities and the Roles of the Physical and Social Environment*, is available on the CBCRP web site at [www.cabreastcancer.org/sri/reports](http://www.cabreastcancer.org/sri/reports).

Specific chapters of *Identifying Gaps in Breast Cancer Research* that provided information for each section of "Urgent Unanswered Questions about Breast Cancer" are listed below.

### Part I: Three California Women with Breast Cancer

#### Danielle

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues; Chapter B1, Air Pollution; Chapter B2, Persistent Organic Pollutants; Chapter C, Compounds in Personal Care Products; Chapter I, Vitamin D and Sunlight.

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity.

Section III, Neighborhood Context and Breast Cancer.

On triple negative breast cancer, see Bauer KR, Brown M, Cress RD, Parise CA, Caggiano V. Descriptive analysis of estrogen receptor (ER)-negative, progesterone receptor (PR)-negative, and HER2-negative invasive breast cancer, the so-called triple-negative phenotype: A population-based study from the California Cancer Registry. *Cancer* 2007;109:1721–1728.

On early puberty, see Steingraber S. *The Falling Age of Puberty in U.S. Girls: What We Know, What We Need to Know*. San Francisco: Breast Cancer Fund, 2007.

#### Luisa

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues; Chapter B4, Pesticides; Chapter B5, Solvents

and Industrial Chemicals; Chapter B6, Water Contaminants.

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity; Chapter C, Disability Status; Chapter D, Culture; Chapter E, Health Insurance.

Section III, Neighborhood Context and Breast Cancer.

On health insurance, see Institute of Medicine. *Care without Coverage: Too Little, Too Late*. Washington, DC: National Academy of Sciences, 2002.

#### Wendy

Introduction.

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues; Chapter B2, Polybrominated Flame Retardants; Chapter B5, Solvents and Industrial Chemicals; Chapter B10, Bisphenol A; Chapter F, Radiation; Chapter H, Light at Night.

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity; Chapter D, Culture.

Section III, Neighborhood Context and Breast Cancer.

On elevated levels of PBDEs in California residents, see Zota AR, Rudel RA, Morello-Frosch RA, and Brody JG. Elevated House Dust and Serum Concentrations of PBDEs in California: Unintended Consequences of Furniture Flammability Standards? *Environmental Science and Technology* 2008, 42: 8158–8164.

## Part II: Promising Research Ideas

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues; Chapter B1, Air Pollution; Chapter B2, Persistent Organic Pollutants; Chapter B4, Pesticides; Chapter B5, Solvents and Industrial Chemicals; Chapter B6, Water Contaminants. Chapter C, Compounds in Personal Care Products; Chapter F, Radiation; Chapter H, Light at Night; Chapter I, Vitamin D and Sunlight.

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity; Chapter B, Sexual Minority Women; Chapter C, Disability Status; Chapter D, Culture.

Section III, Neighborhood Context and Breast Cancer.

This list of research ideas and additional ideas generated during the process of selecting research for the California Breast Cancer Research Program's Special Research Initiatives can be found on the CBCRP web site, [www.CaBreastCancer.org/sri/](http://www.CaBreastCancer.org/sri/).

## Part III: Research We Are Funding to Find Answers

### Why Are Some Racial/Ethnic Groups More Likely to Die from Breast Cancer?

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues.

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity.

### Why Does Moving to the U.S. Raise a Women's Chance of Getting Breast Cancer?

Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter D, Culture.

Section III, Neighborhood Context and Breast Cancer.

### If a Woman Was Exposed to Chemicals Years Ago, Can They Cause Breast Cancer Today?

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues; Chapter B2, Persistent Organic Pollutants.

### Can We Help California Lower Women's Exposure to Breast Cancer-Causing Chemicals?

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues.

### If So Many Different Things Act Together to Cause Breast Cancer, How Do We Figure Out How to Prevent It?

Introduction.

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues.

### How Can We Find Out More About the Breast Cancer Burden Carried by Various Racial and Ethnic Groups?

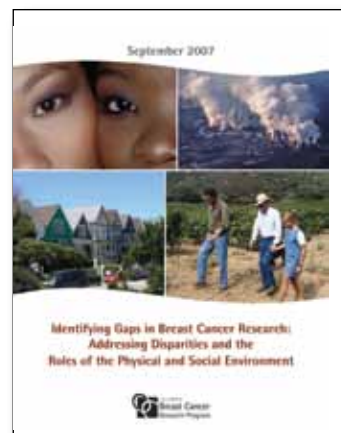
Section II, Disparities in Breast Cancer: Domains of Individual-Level Social Inequality: Chapter A, Race/Ethnicity, Chapter D, Culture.

Section III, Neighborhood Context and Breast Cancer.

### Can Teachers Help Us Discover More About the Environmental Causes of Breast Cancer?

Introduction.

Section I, Exposures from the Physical Environment and Breast Cancer: Introduction and Overarching Issues.





## About our Special Research Initiatives

For too long, women have asked questions like, “Did things in the environment cause my breast cancer?” and “Why are more white women getting breast cancer, while more black women are dying from the disease?” These are difficult questions to investigate. And for too long, breast cancer research has not risen to the challenge.

To find answers, the California Breast Cancer Research Program is investing over \$20 million in a radical new funding approach, our Special Research Initiatives. These initiatives are a departure from the way most research is funded in the U.S. today, where scientists select the topics of the research they conduct. This traditional research approach has not led rapidly enough to prevention and cure of breast cancer. To spur faster progress, we selected the research we are funding through a publicly accessible process that involved hundreds of experts in California and across the nation. Over 300 research scientists, policy makers, breast cancer advocates, women with breast cancer, health care providers, and members of the public contributed ideas and helped shape our Special Research Initiatives.

We are committed to making the best use of California’s unique resources for this endeavor. The state has an extensive research structure, an established cancer registry and other critical databases, regional and geographic diversity, and racial, ethnic, and economic diversity. These resources make California an ideal laboratory for large-scale research into the environment’s role in breast cancer and the reasons why some groups of women carry a greater burden of the disease.

### Special Research Initiatives Steering Committee

The Steering Committee guided a two-year process of development of our Special Research Initiatives.

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Ecologist, Cancer Survivor and Author, *Living Downstream: An Ecologist Looks at Cancer and the Environment* and *Having Faith: An Ecologist’s Journey to Motherhood*.

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### Special Research Initiatives Strategy Team

The Strategy Team considered over 400 research ideas submitted for our Special Research Initiatives. Taking into account input from experts nationwide, California’s unique research resources, and previous research into environmental links to breast cancer and the greater burden of the disease carried by some groups of women, the team shaped the research we are funding.

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### **Editors and Authors of *Identifying Gaps in Breast Cancer Research***

Much of the information presented in “Urgent Unanswered Questions About Breast Cancer” is drawn from our 500-page report on previous research into the environmental links to breast cancer and why some groups of women bear a greater burden of the disease. The editors and authors of this report, *Identifying Gaps in Breast Cancer Research: Addressing Disparities and the Roles of the Physical and Social Environment*, are listed below. A draft of the report is available on the California Breast Cancer Research Program web site.

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## About the California Breast Cancer Research Program

The mission of the California Breast Cancer Research Program is to eliminate breast cancer by leading innovation in research, communication, and collaboration in the California scientific and lay communities.

The CBCRP supports cutting-edge breast cancer research in California, including collaborative research with community-based researchers, innovative and developmental projects that would not otherwise receive funding, and translational research designed to more quickly deliver solutions to the people who need them.

The program is funded through a state tax on tobacco, voluntary donations on state income tax forms, and contributions from individuals and foundations.

Since 1994, the CBCRP has awarded over \$213 million in 894 grants to 101 institutions across California. Ninety-five percent of our revenue goes directly to funding research and education efforts.

This publication is a part of the CBCRP's ongoing commitment to making information about the results of the research we fund, and about breast cancer, available to the public.



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