Environmental Risk Factors for Breast Cancer

Peggy Reynolds, Ph.D.

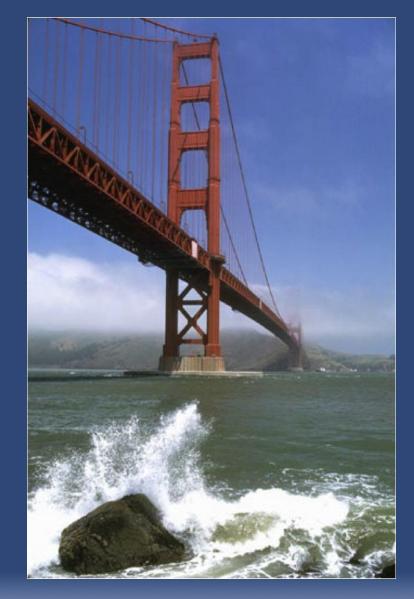
University of California Office of the President February 21, 2019





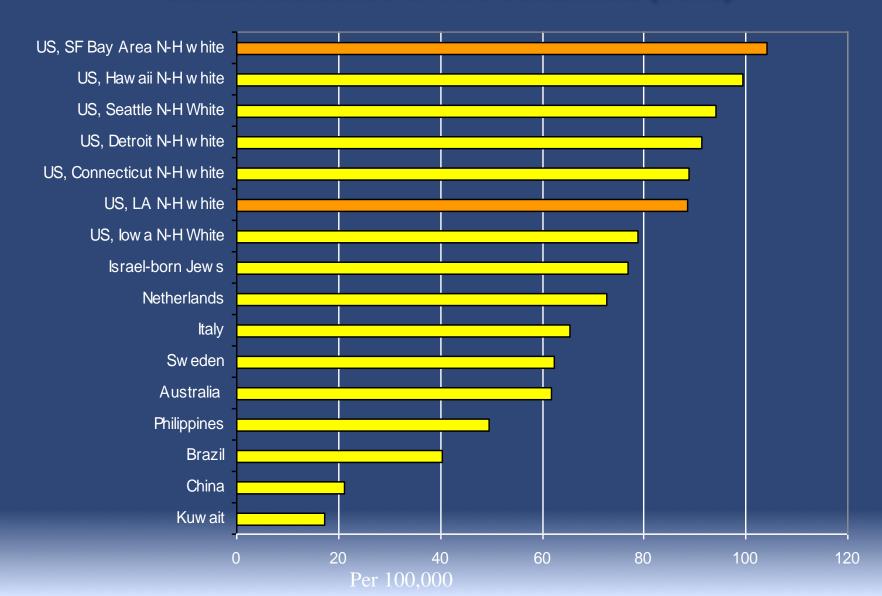
Outline

Regional variations in breast cancer
Environmental risk factors
Challenges for research
Current initiatives

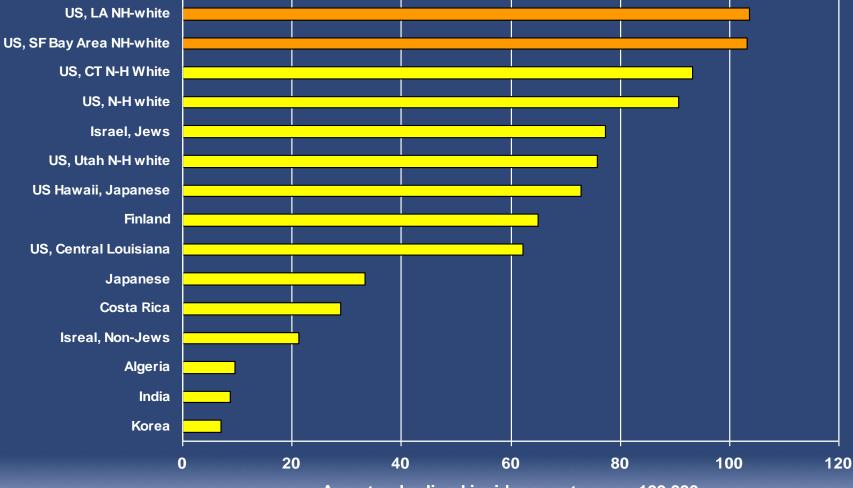


Breast cancer incidence rates in the San Francisco Bay Area have been reported to be among the highest in the world.

Breast Cancer Incidence, Females 1987 *Cancer Incidence in Five Continents* (IARC)

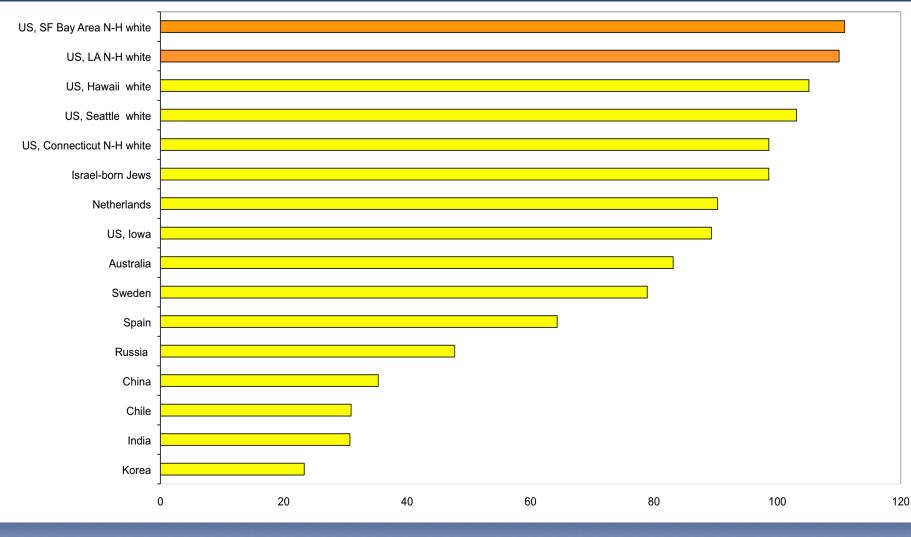


Breast Cancer Incidence, Females, 1997 Cancer Incidence in Five Continents (IARC)



Age-standardized incidence rates, per 100,000

Breast Cancer Incidence, Females 2007 *Cancer Incidence in Five Continents* (IARC)



Rate Per 100,000

Regional Variations in Breast Cancer Incidence in California

Funded by NCI Grant #U01CA81789 and BCRP Grant #6JB-0111



Study Comparison Areas

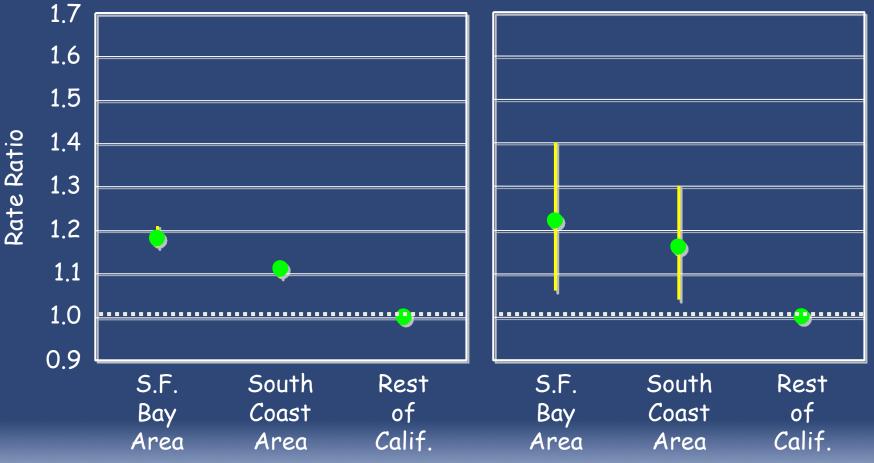


Breast Cancer Rate Ratios, by Region

Adjusted for Age and Race/Ethnicity

Statewide

CTS Cohort



Why Might Rates Differ?

Differences in:

- Race/Ethnicity
- Urbanization
- Socioeconomic status
- Personal risk factors
- Something else?
 - Environmental contaminants?



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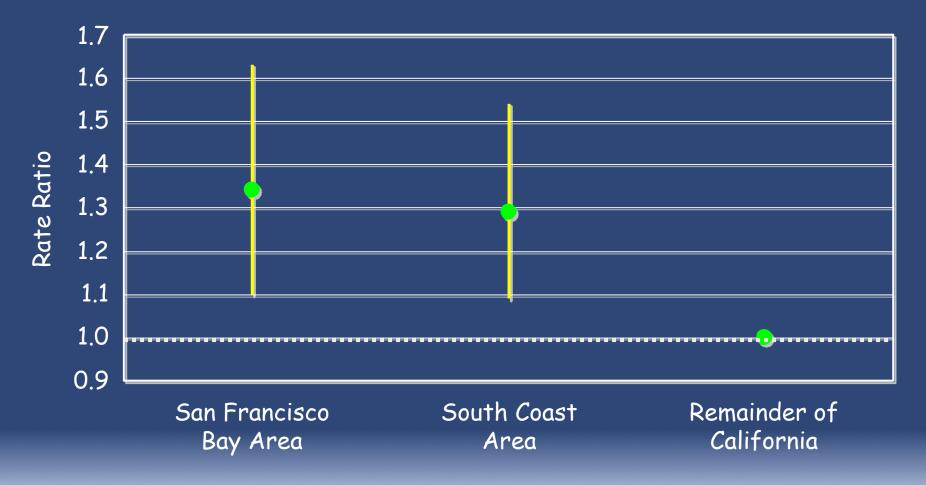
https://www.calteachersstudy.org

CTS Personal Risk Factor Covariates

- Family history of breast cancer
- Age at menarche
- Parity
- Age at first full term pregnancy
- Physical activity (last three years)
- Body mass index
- Menopausal status
- Body mass*menopausal interaction
- Alcohol consumption
- Hormone replacement therapy
- Breastfeeding history

CTS Cohort Breast Cancer Hazard Ratios, by Region

Adjusted for Age, Race/Ethnicity, Socioeconomic Status, Urbanization and Personal Risk Factors



Reynolds, et al. Epidemiology, 2004

Established Environmental Risk Factor for Breast Cancer

Ionizing radiation

- High doses
- In adolescence



CBCRP Strategic Research Initiative



Exposures from the Physical Environment

- Environmental Tobacco Smoke/Secondhand Smoke
- Combustion byproducts
- Persistent organic pollutants
- Pesticides
- Solvents and industrial chemicals
- Water contaminants
- Hormones in food
- Metals
- Flame retardants PBDEs
- Plastics
- Bisphenol A
- Compounds in Personal Care Products
- Pharmaceuticals
- Radiation (medical and non-medical)
- Electric and Magnetic Fields
- Light-at-night
- Vitamin D/sunlight



Environmental Chemicals/Pollutants

- The U.S. EPA has registered approximately 85,000 synthetic chemicals for use.
- More than 200 chemicals have been shown in animal studies to increase mammary tumors.
- Timing of exposure is critical for some compounds.

BUT WE DO NOT KNOW ...

- The potential health effects of about 90% of the synthetic chemicals registered by U.S. EPA overall or at critical periods.
 - Much about human exposure or health effects of chronic, low-level exposure to mixtures.



Chemicals of Concern

Solvents & industrial chemicals: PCBs

Higher breast cancer risk from PCB exposure associated with a genetic variant in a recent study.

Flame Retardants: PBDEs

 Measurable quantities of these persistent chemicals found in almost every human. Limited data indicate the potential for carcinogenic and endocrine disrupting effects.

Combustion By-Products: PAHs

 From active/passive smoking, diet and air; current research is focused on genetic susceptibility affecting DNA repair.







Chemicals of Concern Bisphenol A (BPA)

- Virtually everyone has lowlevels of BPA in their body, primarily due to canned foods and plastic beverage containers.
- There is strong evidence of estrogenic effects of BPA, and of a link between low-level exposure and breast cancer in animal studies.

BUT WE DO NOT KNOW...

About the levels and impacts of human exposures and body burdens over time





Campbell's soup advertisement, 1945

Chemicals of Concern Pesticides

Chemicals used to control insects, weeds, fungus, etc. are found in measurable levels in everybody due to exposure through food, air and water.

- DDT/DDE Still found in human tissues.
 Evidence has not support increased incidence, but a new study suggests that exposure in childhood increases risk.
- Other Organochlorines Dieldrin and 13 other OC have been linked to risk, but evidence is inconsistent and mostly negative.
- Atrazine Linked to hormonal changes in wildlife, this herbicide induces mammary gland tumors in *some* rats.

BUT WE DO NOT KNOW. . .

How long-term, lower level exposure from an early age is affecting breast cancer risk.





Chemicals of Concern

Compounds in Personal Care Products

- There is reason for concern about the compounds in personal care products, as they are:
 - Widely used;
 - Applied directly to and able to enter the body;
 - Composed of thousands of ingredients about which little is known;
 - Made from compounds linked to breast cancer and hormonal disruption; and
 - Minimally regulated.

BUT WE DO NOT KNOW. . .

The nature and extent of the impact of compounds in personal care products and breast cancer.



Has 5 ingredients posing potential breast cancer risks.

Source: Environmental Work Group



Hair products that contain placenta and estrogen are heavily marketed to African American women and girls

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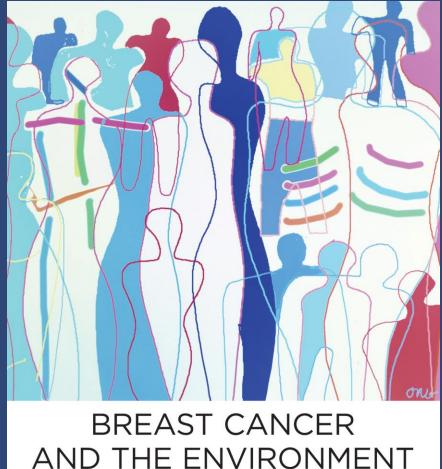
September 2007



www.cbcrp.org/sri

Identifying Gaps in Breast Cancer Research: Addressing Disparities and the Roles of the Physical and Social Environment

> Breast Cancer Research Program



December 7, 2011

Institute of

Medicine Report

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INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMIES

IOM Study Charge

Susan G. Komen for the Cure[®] and its Scientific Advisory Board requested that the Institute of Medicine (IOM)

- Review evidentiary standards for identifying and measuring cancer risk factors;
- Review and assess the strength of science base on relationship between breast cancer and the environment;
- Consider potential interaction between genetic and environmental risk factors;
- Consider potential evidence-based actions that women could take to reduce their risk;
- Review methodological challenges in research on breast cancer and the environment; and
- 6. Develop recommendations for future research.

Defining Environment

- Defined broadly: all factors not directly inherited through DNA
- Environmental exposures may act on multiple levels to influence breast cancer



Life Course Approach

- Substantial changes in the breast through the life course, especially in response to hormonal signals
- Timing of environmental exposures may be important in increasing or reducing breast cancer risks or influencing developmental events

Associations with Breast Cancer Risk

- Among the factors reviewed, consistent associations with increased risk in epidemiologic studies:
 - use of combination estrogen-progestin products
 - current use of oral contraceptives
 - exposure to ionizing radiation
 - overweight and obesity among postmenopausal women
 - alcohol consumption
- Decreased risk:
 - greater physical activity
- No indication of association:
 - personal use of hair dyes
 - non-ionizing radiation

Why don't we know more?

Complexity of Origins of Breast Cancer

- Biology of breast development and origins and progression of breast cancer not fully understood
- Past focus on exposures during adulthood may have missed critical exposure windows during early life
- Exposure to a complex and changing mix of environmental agents over the course of a lifetime
- Many agents never studied in ways relevant to breast cancer

Challenges in Studying Breast Cancer and the Environment

Assessing human exposure

Limitations in establishing timing and amount of exposure

Designing and analyzing epidemiologic studies

- Experiments rarely possible
- Likely long latency between exposure and diagnosis
- Widespread, low-level exposures limit contrasts
- Identifying genetic influences
 - Large studies needed to detect robust associations
 - Limited environmental exposure data in genomic datasets

Interpreting animal and in vitro data

- Inconsistencies in results among species and strains
- Exposures not always comparable to human experience

Opportunities for Evidence-Based Actions

Examples of actions that may reduce breast cancer risks related to environmental exposures:

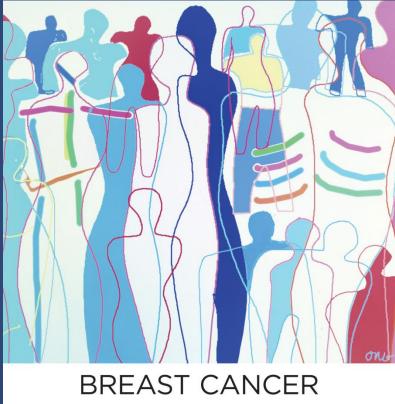
- avoid inappropriate medical radiation exposure throughout life
- avoid use of estrogen-progestin menopausal hormone therapy
- avoid or end active and passive smoking
- Iimit alcohol consumption
- maintain or increase physical activity
- minimize overweight and weight gain to reduce risk of postmenopausal breast cancer
- limit exposure to agents biologically plausible as contributors to breast cancer

Why not more opportunities for individual action?

Incomplete Evidence Base

Scientific community's understanding is still incomplete regarding:

- which exposures might best be avoided and when
- whether interventions that modify exposures have longterm benefit in reducing breast cancer risk
- potential for unintended consequences of interventions



BREAST CANCER AND THE ENVIRONMENT

A LIFE COURSE APPROACH

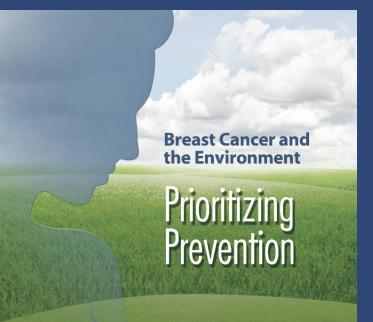
OF THE NATIONAL ACADEMIES

Report can be viewed and downloaded free at

www.iom.edu/BreastCanc erEnvironment

Interagency Breast Cancer and Environmental Research Coordinating Committee (IBCERCC)

- Created by congressional mandate in 2008
- Charge: to identify a comprehensive strategy for research across the federal agencies in breast cancer and the environment
- Led by NIEHS and NCI
- Final Report February 2013



Report of the Interagency Breast Cancer and Environmental Research Coordinating Committee (IBCERCC)

IBCERCC Recommendations

- Prioritize prevention
- Transform how research is conducted
- Intensify the study of chemical and physical factors
- Plan strategically across Federal agencies
- Engage public stakeholders
- Train transdisciplinary researchers
- Translate and communicate science to society

Breast Cancer and the Environment

Prioritizing Prevention

Report of the Interagency Breast Cancer and Environmental Research Coordinating Committee (IBCERCC) Available at http://www.niehs.nih.go v/ibcercc

NIEHS/NCI BCERP Collaborative

Breast Cancer and the Environment Research Program



ABOUT PARENTS & CAREGIVERS HEALTH PROFESSIONALS OUTREACH ORGANIZATIONS RESEARCHERS EDUCATIONAL MATERIALS LINKS Q

About

Home > About

Purpose

With the information and resources available on this website, we aim to:

- Raise awareness about the potential relationship between environmental exposures during certain vulnerable times in the life course, known as windows of susceptibility, and breast cancer risk
- Explain why a precautionary approach is being taken to aid decisionmaking where the evidence of harm is stronger in animal than in human studies



https://bcerp.org

NIEHS Sister Study



SISTER STUDY

ABOUT SISTER STUDY

FOR PARTICIPANTS

FOR RESEARCHERS

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"Woman by woman, sister by sister, we can make a difference."



en español

A Study of the Environmental and Genetic Risk Factors for Breast Cancer.

https://sisterstudy.niehs.nih.gov

Women's Work and the Environment

Almost entirely neglected in the literature.
 "Canary in the coal mine" effect

 Workplace chemical hazards typically higher than the general population.

Can help identify risk factors of concern.

Development of a Data Visualization Tool to Explore Occupational Chemical Exposures among California Working Women





Funded by CBCRP Grant #212B0901

Background – *Women's* Occupations and Risks from Chemicals (WORC)

- Funded by California Breast Cancer Research Program (CBCRP, Grant#21ZB-0901; Co-PIs=Robert Harrison, Peggy Reynolds)
- Response to CBCRP's California Breast Cancer Prevention Initiative (CBCPI) RFP on "Occupational Chemical Exposures in California and Breast Cancer Risk"
- 5-year project (2016-2020), 3 phases
- Overarching objective: advance our understanding of the degree to which workplace chemical exposures may increase breast cancer risk among California working women

Community Engagement: WORC Advisory Committee







Julia Liou, MPH Catherine Porter, JD CA Healthy Nail Salon Collaborative/ Asian Health Services (Shared Role)



Gail Bateson, MS WorkSafe



Laura Stock, MPH Labor Occupational Health Program (LOHP)



Janette Robinson Flint Black Women for Wellness



Mila Thomas SEIU Local 1021

Two Phases to Date

Phase I:

- Identify where women are employed in California.
- Identify workplace chemicals of concern (CoC) for breast cancer risk.
- Identify the overlap between where women are employed in California and workplace exposures to groupings of CoC for breast cancer risk.

Phase II:

- Develop a visualization tool based on information from Phase
 I.
- Identify data gaps.

California Women by Employment Status*, 2010-2014

	Ν	%
All women (16+) in CA	15,179,998	
Working Women	7,774,697	51 %
Non Working Women	7,405,301	49 %
Not in labor force	6,464,108	43%
Unemployed	941,193	6%

* American Community Survey, 2010-2014

Chemical Data Sources

Lists identifying relevant chemicals

- Carcinogens International Agency for Research on Cancer, Silent Spring Institute, EPA
- Endocrine disruptors TEDX & IEH lists
- Mammary gland toxicants Silent Spring Institute

Creation of WORC Database

- Created a list of 1,000+ chemicals-of-concern (CoC) for breast cancer
 - Includes indicators for mammary gland carcinogens, endocrine disruptors, mammary gland toxicants, and high production volume chemicals
 - categorized in 27 groups based on chemical properties and/or usage
- Constructed dataset summarizing workplace sampling data (OSHA) for limited number of CoCs by industry
- Created Job Exposure Matrix (JEM) to identify overlap of occupations with exposures to CoCs for:
 - 145 occupations (representing ~ 85% of CA female workforce)
 - 9 broad occupational groups identified as likely to have high proportion of informal workers
- Provided data to data visualization vendor

Visualization Tool

Created an interactive online tool to:

- Provide information about the California female workforce
 - By occupation, race/ethnicity, age group
- Summarize groups of chemicals of concern
- Identify potential chemical exposures by occupation
- Be useful to multiple stakeholder groups
- Now available on the CBCRP website:

http://www.cbcrp.org/research-topics/worker-exposure.html



Women in California are being exposed to risky chemicals at work.

Exploring Chemical Exposure for California's Women Workers

About

Working Women at Risk

161 occupations were reviewed for potential exposure to chemical groups linked to breast cancer.

There are more than 6.5 million women working in these occupations, according to the U.S. Census's American Community Survey. In addition, there are women who work in "informal" jobs. Informal jobs do not show up in official data sources and operate outside of established labor laws. The number of women working in informal jobs in California is not known. We can only estimate the number of women who work informally. Here, we examine what we do know about all women in the California workforce and the chemicals they are potentially exposed to.



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Exploring Chemical Exposure for California's Women Workers

Explore Chemicals

Methods + Sources

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Working Women at Risk

PERSONAL CARE AIDES

Maids and housekeeping cleaners

Women may be exposed to harmful chemicals on the job. 24 categories of chemicals that include chemicals of concern for breast cancer are shown below. We investigated the potential exposure of women in this occupation group to these 24 categories of chemicals.

Being exposed to even one of the chemicals in these groups may be cause for concern.

select a category to learn more about exposure, the chemicals, and the women who are exposed



Exploring Chemical Exposure for California's Women Workers

Explore Chemicals

Methods + Source

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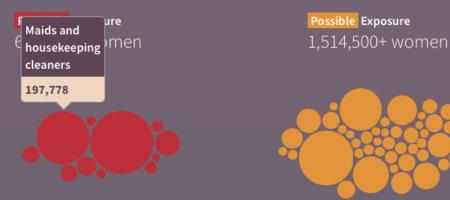
Antimicrobials

32 Chemicals of Concern | 2,207,100+ formal women workers with possible or probable exposure

This category includes substances that suppress the growth of harmful microorganisms such as bacteria, viruses, or fungi on inanimate objects and surfaces. This category excludes crop and household pesticides (see Pesticides) category).

Who Works with these Chemicals?

Formally employed women across 58 occupations:



Who are the formal workers with probable or possible exposure?

		Black

Informally employed women across 19 occupations:

Data Gaps

- Primary gap: lack of systematically-collected quantitative chemical exposure data
- Other gaps:
 - Incomplete and inaccurate information on occupation and industry in cancer surveillance databases (e.g. CCR, SEER)
 - Dearth of simultaneously-collected information on cancer and occupation/industry in national and statewide population surveys
 - Limited biomonitoring data from nationally-representative workforces
 - Underrepresentation of informal workers in existing data sources

Recommendations for Future Research and Policy Directions

Exploratory research that links:

- existing cancer outcome data
- occupation/industry data
- sociodemographic data
- national and statewide survey data
- biomonitoring data

 Policy aimed at enhancing current data collection systems to fill data gaps and promote the initiation of new occupational health surveillance systems aimed at cancer outcomes

Phase III Pilot Exposure Study, 2018-2020

- Focus on domestic household cleaners and hotel housekeepers:
 - Represent a large segment of the workforce
 - Include a substantial number of informal workers
 - 80% Latina
 - Considerable opportunity for chemical exposures from cleaning products
 - Understudied for breast cancer risks
- Currently underway



Summary

- Relatively little is known about environmental risk factors and breast cancer
- Challenges for human health research
- Environmental risk factors are currently a high priority for:
 - Advocacy groups
 - CBCRP initiatives
 - New NIH initiatives

Thank you!