

## **Breast Cancer and Occupation: The Need for Action**

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### **Abstract**

Breast cancer is the most prevalent cancer among women in the United States and other countries, making it a major public health concern. Despite significant scientific evidence about its known or suspected causes, research and prevention measures to identify and eliminate occupational and other environmental hazards and risk factors for breast cancer remain largely overlooked. As a result, hazards continue unabated for women generally, especially those who work outside the home. The science linking breast cancer and occupation in particular is growing. Researchers have identified commonly used chemicals that induce breast tumors in test animals. Animal studies link chemicals that mimic reproductive hormones to elevated breast cancer rates. Other animal and human studies link chemical exposures to increased breast cancer rates, including two recent investigations focused on occupational hazards. But the latter are the exception. Studies that attempt to identify and characterize workplace agents linked to breast cancer, as well as intervention studies focusing on the use of less toxic processes and substances, are limited. In what might be construed as a case of gender and social class bias, many research and funding agencies have ignored or downplayed the role of occupational studies despite their relevance to prevention efforts. Action required starts with making a national priority of promoting and supporting research on occupational and other environmental causes of breast cancer. Other public health actions include hazard surveillance and primary prevention activities such as reductions in the use of toxic materials, informed substitution, and green chemistry efforts.

### **Relationship to Existing APHA Policy Statements**

The following APHA policies inform this topic but do not cover it specifically:

- APHA Policy Statement 7415: Prevention of Occupational Cancer
- APHA Policy Statement 7715: Informing Workers of Occupational Health Risks

- APHA Policy Statement 8509: Occupational Disease Prevention: Increase Worker and Union Rights
- APHA Policy Statement 8607: Worker Notification of Adverse Health Findings
- APHA Policy Statement 9115: Support for Women’s Health Research
- APHA Policy Statement 9304: Recognizing and Addressing the Environmental and Occupational Health Problems Posed by Chlorinated Organic Chemicals
- APHA Policy Statement 9606: The Precautionary Principle and Chemical Exposure Standards for the Workplace
- APHA Policy Statement 2004-11: Threats to Public Health Science

### **Problem Statement**

Breast cancer is the most frequent cancer diagnosis among women in industrialized countries, and rates in North America are among the highest in the world.[1] The American Cancer Society estimated that about 295,000 new cases of the cancer would be diagnosed among US women in 2014 and that approximately 40,000 deaths would occur.[2]

It is widely recognized that environmental agents—including workplace hazards—play a significant role in cancer causation, modulated by genetic and lifestyle-related factors.[3] And, until recently, women’s occupational health hazards continued to be mostly invisible, studied inadequately and infrequently despite women’s long-time participation in the workforce.[4] This lack of gender perspective (and, therefore, gender bias), criticized for more than a decade, comes at a price: working women’s health.[5]

Eliminating hazards is a well-established public health strategy, and there is evidence that primary prevention of occupational and other environmental hazards linked to cancers “reduces cancer incidence and mortality and is highly cost effective.”[6] As do others using primary prevention approaches, APHA supports use of the precautionary principle of taking action in the face of scientific uncertainty.[7]

Notwithstanding the high incidence of breast cancer among women and calls for primary prevention of cancers linked to work and other environments, the two topics seldom cross paths.[8] The dominant epidemiological paradigm behind research and public policies remains firmly focused on individual lifestyles, genetics, and treatment options.[9,10] The exogenous (i.e., involuntary and commonly shared) hazards and risk factors associated with chemicals—the causes of breast cancer that can be prevented or reduced—are passed over, ignored, and/or downplayed.[11]

The lack of attention to job-related breast cancer hazards has serious implications with respect to primary prevention, not only for the many thousands of women employed in potentially high-hazard jobs but for the broader public.[12] Using findings from the dominant focus on individuals, the fund-raising efforts that support breast cancer research (e.g., pink ribbon campaigns) focus on individual solutions, early detection, and treatment. The drive-for-a-cure business model behind these efforts will not reduce the incidence of the disease. More than half of breast cancer cases cannot be explained by traditional causes or risk factors (e.g., weight, diet, alcohol use, genetics).[13] Some researchers have suggested that there likely are multiple, interacting environmental factors, some as yet unknown.[14]

In its 2013 report, the US Interagency Breast Cancer and Environmental Research Coordinating Committee indicated its concern about this situation. The committee pointed out that environmental factors are “more readily identified and modified than genetic factors and therefore present a tremendous opportunity to prevent breast cancer.”[15] Earlier, the 2008–2009 US President’s Cancer Panel Report (“Reducing Environmental Cancer Risk: What We Can Do Now”) concluded that “the true burden of environmentally induced cancer has been grossly underestimated.”[11]

Given this situation, the importance of workplace hazards should not be underestimated. The workplace and job-related activities are “the mother lode of all environmental contaminants and exposures.... Most of what leaches into our drinking water,

contaminates our food and pollutes our air comes from workplaces, where it first damages workers.”[16] Workers are present at every step in the life-cycle approach involved in the production of goods and services.

With respect to breast cancer, this requires paying particular attention to female workers. Yet, little has changed since the 1996 statement that there are few high-quality studies “directed specifically toward women” that lead to clear identification of job-related hazards linked to breast cancer.[17] According to the Breast Cancer Fund’s most recent review of the evidence, although women make up about half of the US workforce, “relatively few studies have been conducted to identify occupational exposures associated with breast cancer.”[18]

There is sufficient evidence to warrant a precautionary approach. Researchers have identified commonly used chemicals that induce breast tumors in test animals.[19] Animal studies link chemicals that mimic hormones—endocrine-disrupting chemicals (EDCs)—to elevated breast cancer rates.[20] The World Health Organization[21] and the European Union[20] have issued major reports on the potential harm caused by EDCs, as has the Endocrine Society.[22] According to the Endocrine Society’s important statement, the significant increase in the incidence of breast cancer in the industrialized world over the past 50 years may be due to “hormonally active chemicals.”[22]

Two Canadian articles have played an important role in bringing these associations to the fore. The first, published in 2012, showed particularly high rates of breast cancer in premenopausal women employed in automotive plastics and food canning work. Other sectors associated with elevated risks among women overall included agriculture, bars/gambling, and metalworking.[23] The robust association with manufacturing of automotive plastics suggests that hazards are widespread and common in this sector.

The second article listed chemicals commonly present in the production of plastics, some of them mammary carcinogens and EDCs; it also demonstrated that the work

environment in this sector is heavily contaminated with ingredient, by-product, and product dusts, vapors, and fumes.[24] Studies have shown that many plastics release estrogenic chemicals,[25] particularly when heat is present, as in plastic resin production and fabrication. Also, certain additives (e.g., phthalates, polybrominated diphenyl ethers) have been identified as EDCs. Some starting chemicals (monomers) in the manufacturing of polymers (e.g., bisphenol A, butadiene, vinyl chloride) are mutagenic and/or carcinogenic.[26] Animal studies have shown that several monomers, additives, and related solvents (e.g., vinyl chloride, styrene, acrylonitrile) are mammary carcinogens.[21] Cumulative exposure to mixtures of various estrogenic chemicals may compound effects.[27]

Other authors have found that breast cancer risk is almost double among female plastics and rubber industry workers.[28,29] Another study added weight with its finding that breast cancer risk among male workers in the rubber and plastics industries is almost quadruple.[30] A study of acrylic and nylon fiber (i.e., plastics) production workers showed that these individuals also had an excess risk of breast cancer when they were first exposed before the age of 36, with acrylic and rayon fibers and some aromatic hydrocarbons doubling the risk of estrogen/progesterone-positive tumors.[31]

The President's Cancer Panel has cautioned that "the available evidence argues for a precautionary approach to these diverse chemicals," including phthalates and bisphenol A. The panel noted that neither the International Agency for Research on Cancer nor the US National Toxicology Program classifies most EDCs as suspected carcinogens, nor are they regulated by American authorities.[11]

Breast cancer is linked to other hazards as well. The International Agency for Research on Cancer has issued a monograph on the probable association between night work and breast cancer.[32] This potential disruption of circadian rhythm is important in the United States; approximately 15% of US workforce members are engaged in night work, which disproportionately involves African Americans.[33]

This is not the only way in which members of minority groups may face greater risks. The Interagency Breast Cancer and Environmental Research Coordinating Committee also identified “environmental disparities” that placed some underserved populations (e.g., people in specific occupations) at increased risk of the disease, requiring the creation of policies to prevent and reduce its causes.[15] This is consistent with the finding in a Canadian study of elevated breast cancer rates among women living near industrial facilities such as steel mills, pulp mills, petroleum refineries, and thermal power plants.[34] Typically, these residents are of lower socioeconomic status and may work in the facilities. Minority workers historically have held some of the most hazardous jobs in the United States,[35] and occupational cancer risks are probably elevated among African American workers as a result of their increased exposure to carcinogens at work.[36]

These facts are consistent with a report published by the Centers for Disease Control and Prevention (CDC) indicating that, in 2010, breast cancer incidence was highest among Caucasian women; African American women were most likely to die from the disease, and it was the most common cause of cancer-related mortality among Hispanic women.[37]

It is increasingly clear that primary prevention of breast cancer focusing on elimination of work-related and other environmental carcinogens needs more attention, funding, and political, regulatory, and workplace action.[38]

### **Evidence-Based Strategies to Address the Problem**

Actions to prevent and reduce occupational and other environmental causes of breast cancer require recognition and acknowledgment of the barriers involved.

Brown and colleagues identified three ways forward after examining impediments to addressing environmental factors that affect breast cancer risks: moving causation

debates upstream to confront causes, shifting the emphasis from individuals to modifiable societal-level factors, and promoting direct involvement of the public in research.[10] The latter activity (also known as community-based research or participatory action research) may raise new questions and change how questions are approached, as well as altering the methods used and standards of proof.[10] Several efforts are effectively using the findings derived from such research.

The Interagency Breast Cancer and Environmental Research Coordinating Committee report called for “bold new approaches” to prevention efforts and increased research on chemical and physical agents; it also cited the need to make scientific knowledge accessible to the public and to engage affected stakeholders in the process.[15]

One example is the global Strategic Approach to International Chemicals Management (SAICM) framework. Endorsed by governments, public health organizations, workers’ organizations, and the International Labour Organization, this framework includes the recent important agreements and discussions at the 3rd International Conference on Chemicals Management. Using a life-cycle approach, the delegates (including Americans) reached a consensus that EDCs are a global emerging policy issue and that measures are needed to reduce exposures to and the effects of these chemicals. Among many factors related to electrical/electronic products, they prioritized elimination or substitution of hazardous chemicals, working on tools to help develop designs to reduce and eliminate the use of hazardous chemicals in their production, and tools and information about “safer” substitutes for chemicals of concern.[39]

The US Occupational Safety and Health Administration (OSHA) takes a similar approach in providing guidance to employers and workers about “transitioning to safer chemicals.”[40] OSHA’s 2013 toolkit provides information about chemicals of concern (including the worker-focused Chemical Hazard and Alternatives Toolbox, or ChemHAT[41]) and methods to address them (e.g., informed substitution, reductions in the use of toxic materials, green chemistry), along with tools to facilitate assessments of alternatives.

One of the most interesting job-related interventions addressing potential occupational breast cancer is the “Put Breast Cancer Out of Work” campaign. Initially a joint undertaking of the BlueGreen Alliance and the United Steelworkers union, other US unions have joined this educational campaign about carcinogens and EDCs found on the job. They advocate for primary breast cancer prevention via reductions in and elimination of hazards linked to breast cancer.[42]

The influential Breast Cancer Fund hosted a nine-session educational series about occupation and breast cancer in 2013–2014.[43] This national women’s health and advocacy organization is also a key player in a unique study focusing on the high breast cancer rates among San Francisco’s female firefighters.[44] Along with women’s health advocates, the group extends the growing network of those concerned about the elevated cancer numbers among blue-collar workers and the apparent neglect of research in this area.[45]

In Canada, in an effort to reduce and prevent hazards and subsequent breast cancer risks, women’s health organizations such as the National Network on Environments and Women’s Health have engaged in educational campaigns and workshops in collaboration with unions representing women in industries such as automotive plastics.[46]

Beyond these efforts, there are several approaches to gathering evidence. Studies can be done, especially in populations with exposure histories that can be well characterized (e.g., workplace or occupational studies). Taking lessons from “early warnings,” regulatory authorities can conduct hazard surveillance to determine where suspected chemicals of concern are used in workplaces or present in consumer products, and they can call for assessments of alternatives and informed substitution. Green chemistry efforts to replace chemicals of concern can be funded and implemented commercially.



International efforts such as SAICM can be used in other sectors, with their approach supported through public policies and industry practices.

### **Opposing Arguments/Evidence**

The chemical industry has generally dismissed studies and other evidence about chemical, environmental, and occupational causes of breast cancer. For example, the American Chemistry Council responded to the 2012 Canadian breast cancer study mentioned earlier by stating that it could “unnecessarily alarm workers” if its results were overinterpreted and that the specific chemical exposures had not been identified.[47,48]

Numerous studies and reports have documented how the chemical industry responds to studies and regulatory initiatives to deal with hazardous chemicals, including those linked to breast cancer. Delays and casting doubt are common tactics, say some authors, while others look at the costs of inaction and the possibilities for action.[49–55] A 2013 World Health Organization report, “State of the Science of Endocrine Disrupting Chemicals 2012,” counters industry claims with a summary and recommendations for regulatory activity in the European Union.[21] The European Environment Agency’s 2013 report “Late Lessons From Early Warnings: Science, Precaution, Innovation”[56] provides international analyses and recommends ways forward based on the precautionary principle.

### **Action Steps**

1. The U.S. Surgeon General should declare that there is an association between known classes of chemicals and breast cancer, and that women working with these chemicals are particularly at risk. The declaration should emphasize precautionary prevention policies and the importance of identifying the workplace and other environmental hazards that contribute to breast cancer.
2. The Department of Health and Human Services, the National Cancer Institute, the National Institutes for Health, and other relevant federal agencies should alter the

balance of breast cancer research funds to focus more on the etiologic and mechanistic pathways of suspect chemicals and breast cancer. This should include a portfolio of research methods examining the association between work-related exposures and breast cancer, including community-based/participatory action research. They also should promote and fund green chemistry, alternatives assessments, and other toxics use reduction efforts that focus on chemicals known or suspected of contributing to breast cancer.

3. The Environmental Protection Agency (EPA) should use relevant programs, (e.g., Design for Environment Program/DfE) to focus on chemicals identified as, or suspected of being, linked to breast cancer, particularly EDCs and mammary carcinogens. In doing so, they should promote and incentivize efforts to replace these chemicals with non-toxic alternatives or processes that do not require the hazardous chemicals.

4. The Centers for Disease Control and Prevention's (CDC) National Institute for Occupational Safety and Health (NIOSH) should use its right-of-entry authority for hazard surveillance activities to identify and investigate the causes of breast cancer in groups of workers in suspect sectors and workplaces or those who work with known and suspected chemicals. NIOSH should link these investigations to green chemistry approaches for substituting safer chemicals, its Research to Practice (r2p) program, and to EPA's DfE Program. Furthermore, CDC/NIOSH should disseminate research findings and health education information about the relationship between occupational and other environmental hazards associated with breast cancer that recognize who has the power to reduce or prevent hazards on the job.

5. The Occupational Safety and Health Administration (OSHA) should initiate special emphasis hazard surveillance programs to identify sectors and workplaces where breast cancer-linked hazards are present, and provide recommendations to employer on how to use its "Transitioning to Safer Chemicals Toolkit" for cancer prevention.

OSHA should require the State Plan agencies to implement these measures too. It also should use its Susan Harwood Foundation grants and other funds to support worker-focused projects that provide education, training and practice with practical tools to help workers and their employers identify possible breast carcinogens and less toxic alternatives, like the *Put breast cancer out of work* campaign.

6. Government agencies and foundations should incorporate green chemistry, toxics use reduction and informed substitution principles in their purchasing practices, to contribute to prevention and reduction of breast cancer in a life cycle approach that recognizes the power of purchasers.

## References

1. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer*. 2010;127:2893–2917.
2. American Cancer Society. Breast cancer. Available at: <http://www.cancer.org/acs/groups/cid/documents/webcontent/003090-pdf.pdf>. Accessed December 30, 2014.
3. Clapp RW, Jacobs MM, Loechler EL. Environmental and occupational causes of cancer: new evidence 2005–2007. *Rev Environ Health*. 2008;23:1–37.
4. Messing K. *One-Eyed Science: Occupational Health and Women Workers*. Philadelphia, PA: Temple University Press; 1998.
5. Messing K, Östlin P. Gender equality, work, and health: a review of the evidence. Available at: <http://www.who.int/gender/documents/Genderworkhealth.pdf>. Accessed December 30, 2014.
6. Espina C, Porta M, Schuz J, et al. Environmental and occupational interventions for primary prevention of cancer: a cross-sectorial policy framework. *Environ Health Perspect*. 2012;121:420–426.
7. American Public Health Association. Policy Statement 9606. Available at:

<https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/07/10/18/the-precautionary-principle-and-chemical-exposure-standards-for-the-workplace>. Accessed December 30, 2014.

8. Zahm SH, Blair A. Occupational cancer among women: where have we been and where are we going? *Am J Ind Med*. 2003;44:565–575.
9. Brody JG, Moysich KB, Humblet O, et al. Environmental pollutants and breast cancer: epidemiologic studies. *Cancer*. 2007;109(suppl 12):2667–2711.
10. Brown P, McCormick S, Mayer B, et al. ‘Lab of our own’—environmental causation of breast cancer and challenges to the dominant epidemiological paradigm. *Sci Technol Hum Values*. 2006;31:499–536.
11. President’s Cancer Panel. Reducing environmental cancer risk: what we can do now. Available at: [http://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP\\_Report\\_08-09\\_508.pdf](http://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf). Accessed December 30, 2014.
12. Clapp W, Howe GK, Jacobs M. Environmental and occupational causes of cancer revisited. *J Public Health Policy*. 2006;27:61–76.
13. Sasco A. Epidemiology of breast cancer: an environmental disease? *APMIS*. 2001;109(suppl 103):S80–S92.
14. Kruk J, Aboul-Enein HY. Environmental exposure and other behavioral risk factors in breast cancer. *Curr Cancer Therapy Rev*. 2006;2:3–21.
15. Interagency Breast Cancer and Environmental Research Coordinating Committee. Breast cancer and the environment: prioritizing prevention. Available at: <http://www.niehs.nih.gov/about/boards/ibcercc/>. Accessed December 30, 2014.
16. Cullen L. *A Job to Die for: Why So Many Americans Are Killed, Injured or Made Ill at Work and What to Do About It*. Monroe, ME: Common Courage Press; 2002.
17. Goldberg MS, Labreche F. Occupational risk factors for female breast cancer: a review. *Occup Environ Med*. 1996;53:145–156.
18. Gray J, Nudelman J, Engel C. State of the evidence: the connection between breast

cancer and the environment. Available at:

<http://www.breastcancerfund.org/assets/pdfs/publications/state-of-the-evidence-2010.pdf>.

Accessed December 30, 2014.

19. Rudel RA, Attfield KR, Schifano JN, Brody JG. Chemicals causing mammary gland tumors in animals signal new directions for epidemiology, chemicals testing and risk assessment for breast cancer prevention. *Cancer*. 2007;109(suppl):2635–2666.

20. European Commission. State of the art assessment of endocrine disrupters and related annexes. Available at:

[http://ec.europa.eu/environment/chemicals/endocrine/documents/studies\\_en.htm](http://ec.europa.eu/environment/chemicals/endocrine/documents/studies_en.htm).

Accessed December 30, 2014.

21. World Health Organization. State of the science of endocrine disrupting chemicals 2012. Available at: <http://www.who.int/ceh/publications/endocrine/en/>. Accessed December 30, 2014.

22. Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, et al. Endocrine-disrupting chemicals: an Endocrine Society scientific statement. *Endocrine Rev*. 2009;30:293–342.

23. Brophy JT, Keith MM, Watterson A, et al. Breast cancer risk in relation to occupations with exposure to carcinogens and endocrine disruptors: a Canadian case-control study. *Environ Health*. 2012;11:1–17.

24. DeMatteo R, Keith MM, Brophy JT, et al. Chemical exposures of women workers in the plastics industry with particular reference to breast cancer and reproductive hazards. *New Solut*. 2012;22:427–448.

25. Yang CZ, Yaniger SI, Jordan VC, Klein DJ, Bittner GD. Most plastics products release estrogenic chemicals: a potential health problem that can be solved. *Environ Health Perspect*. 2011;119:989–996.

26. Lithner D, Larsson Å, Dave G. Environmental and health hazard ranking and assessment of plastic polymers based on chemical composition. *Sci Total Environ*. 2011;409:3309–3324.

27. Ibarluzea JJ, Fernández MF, Santa-Marina L, et al. Breast cancer risk and the

- combined effect of environmental estrogens. *Cancer Causes Control*. 2004;15:591–600.
28. Ji BT, Blair A, Shu XO, et al. Occupation and breast cancer risk among Shanghai women in a population-based cohort study. *Am J Ind Med*. 2008;51:100–110.
29. Villeneuve S, Févotte J, Anger A, et al. Breast cancer risk by occupation and industry: analysis of the CECILE study, a population based case–control study in France. *Am J Ind Med*. 2011;54:499–509.
30. Ewertz M, Holmberg L, Tretli S, Pedersen BV, Kristensen A. Risk factors for female breast cancer—a case–control study from Scandinavia. *Acta Oncol*. 2001;40:467–471.
31. Labrèche F, Goldberg MS, Valois M-F, Nadon L. Postmenopausal breast cancer and occupational exposures. *Occup Environ Med*. 2010;67:263–269.
32. International Agency for Research on Cancer. Painting, firefighting, and shiftwork. Available at: <http://monographs.iarc.fr/ENG/Monographs/vol98/mono98.pdf>. Accessed December 30, 2014.
33. Costa G, Haus E, Stevens R. Shift work and cancer: considerations on rationale, mechanisms, and epidemiology. *Scand J Environ Health*. 2010;36:163–179.
34. Pan SY, Morrison H, Gibbons L, et al. Breast cancer risk associated with residential proximity to industrial plants in Canada. *J Occup Environ Med*. 2011;53:522–529.
35. Page JA, O'Brien MW. *Bitter Wages*. New York, NY: Grossman Publishers; 1973.
36. Briggs NC, Levine RS, Hall I, Cosby O, Brann EA, Hennekens CH. Occupational risk factors for selected cancers among African American and White men in the United States. *Am J Public Health*. 2003;93:1748–1752.
37. Centers for Disease Control and Prevention. Breast cancer. Available at <http://www.cdc.gov/cancer/breast/statistics/index.htm>. Accessed December 30, 2014.
38. Brophy JT, Keith MM, Park R, et al. Breast cancer and the environment: why research and preventive action are needed. *Curr Oncol*. 2013;20:E488–E490.
39. Strategic Approach to International Chemicals Management. Third session of the International Conference on Chemicals Management (ICCM3), Nairobi, September 17–

21, 2012. Available at:

[http://www.saicm.org/index.php?option=com\\_content&view=article&id=96&Itemid=48](http://www.saicm.org/index.php?option=com_content&view=article&id=96&Itemid=48)

5. Accessed December 30, 2014.

40. Occupational Safety and Health Administration. Transitioning to safer chemicals.

Available at: [https://www.osha.gov/dsg/safer\\_chemicals/index.html](https://www.osha.gov/dsg/safer_chemicals/index.html). Accessed December 30, 2014.

41. ChemHAT.org. Chemical Hazard and Alternatives Toolbox. Available at:

<http://chemhat.org>. Accessed December 30, 2014.

42. BlueGreen Alliance. Let's put breast cancer out of work. Available at:

<http://www.bluegreenalliance.org/blog/lets-put-breast-cancer-out-of-work>. Accessed December 30, 2014.

43. Breast Cancer Fund. Workers and occupation. Available at:

<http://www.breastcancerfund.org/clear-science/race-class-occupation-genetics-breast-cancer-risk/workers-and-occupational-breast-cancer-risk/>. Accessed December 30, 2014.

44. Breast Cancer Fund. Groundbreaking study to investigate why so many female firefighters are getting breast cancer. Available at:

<http://www.preventionstartshere.org/groundbreaking-study-to-investigate-why-so-many-female-firefighters-are-getting-breast-cancer/>. Accessed December 30, 2014.

45. Infante PF. Cancer and blue-collar workers: who cares? *New Solut.* 1995;5:52–57.

46. National Network on Environments and Women's Health. Chemical exposures and women's health. Available at: <http://www.nnewh.org/overview.php?section=4>. Accessed December 30, 2014.

47. Morris J. Study spotlights high breast cancer risk for plastics workers. Available at:

<http://www.publicintegrity.org/2012/11/19/11806/study-spotlights-high-breast-cancer-risk-plastics-workers>. Accessed December 30, 2014.

48. American Chemistry Council. Study does not demonstrate that workplace exposures cause cancer. Available at:

<http://www.americanchemistry.com/Media/PressReleasesTranscripts/ACC-news-releases/Study-Does-Not-Demonstrate-That-Workplace-Exposures-Cause-Cancer.html>.

Accessed December 30, 2014.

49. Natural Resources Defense Council. The chemical industry delay game. Available at: <http://www.nrdc.org/health/thedelaygame.asp>. Accessed December 30, 2014.

50. Shapiro S, Ruttenberg R, Goodwin J. Setting the record straight: the Crain and Crain report on regulatory costs. Available at: [http://www.progressivereform.org/articles/SBA\\_Regulatory\\_Costs\\_Analysis\\_1103.pdf](http://www.progressivereform.org/articles/SBA_Regulatory_Costs_Analysis_1103.pdf). Accessed December 30, 2014.

51. Occupational Safety and Health Administration. Business case for safety and health. Available at: <https://www.osha.gov/dcsp/products/topics/businesscase/costs.html>. Accessed December 30, 2014.

52. Worksafe. Prevention pays. Available at: <http://www.worksafe.org/2011/08/new-worksafe-report-prevention-pays-solutions-to-help-workers-and-businesses-thrive.html>. Accessed December 30, 2014.

53. Tuncak B. Driving innovation: how stronger laws help bring safer chemicals to market. Available at: [http://www.ciel.org/Publications/Innovation\\_Chemical\\_Feb2013.pdf](http://www.ciel.org/Publications/Innovation_Chemical_Feb2013.pdf). Accessed December 30, 2014.

54. United Nations Environment Programme. Global chemicals outlook: towards sound management of chemicals. Available at: [www.unep.org/hazardoussubstances/](http://www.unep.org/hazardoussubstances/). Accessed December 30, 2014.

55. United Nations Environment Programme. Costs of inaction on the sound management of chemicals. Available at: [http://www.unep.org/chemicalsandwaste/Portals/9/Mainstreaming/CostOfInaction/Report\\_Cost\\_of\\_Inaction\\_Feb2013.pdf](http://www.unep.org/chemicalsandwaste/Portals/9/Mainstreaming/CostOfInaction/Report_Cost_of_Inaction_Feb2013.pdf). Accessed December 30, 2014.

56. European Environment Agency. Late lessons from early warnings: science, precaution, innovation. Available at: <http://www.eea.europa.eu/publications/late-lessons-2>. Accessed December 30, 2014.