

## Introduction

The nature and direction of scientific inquiry is neither neutral nor random, but is best explained by its social and political context.<sup>1</sup> Breast cancer research is not exempt from the influence of social and political forces. However, the systemic forces that shape the creation of science are often sufficiently subtle to maintain the illusion that scientific inquiry is free of these powerful influences.<sup>1</sup> Ignoring such forces may constrain contemplation of the full range of possibilities in studying the environment, disparities, and breast cancer. Therefore, the following introduction briefly explores the social and political forces that have helped script what we know and what we do not know about the environment, disparities and breast cancer.

### The Gaps in Knowledge

**“The best way not to see something is not to look for it.”**

*Alice Stewart, Epidemiologist, discoverer of the link between fetal exposure to ionizing radiation and childhood cancer.*<sup>2</sup>

While the science reviewed on the following pages will guide future research efforts by what the studies say, it is equally informative to consider what these studies do not shed light on. Brody et al recently reported that the overwhelming majority of chemicals identified as animal mammary carcinogens or endocrine disrupting compounds have never been included in an epidemiologic study of breast cancer, and the overwhelming majority of chemicals to which we have been exposed have never been included in an animal cancer bioassay.<sup>3</sup>

Of those environmental pollutants for which questions have been asked, the science is dominated by research examining single agents or classes of chemicals one at a time, examined under the toxicological lens of “the dose makes the poison.” As described in the introduction to Section I, research exploring the relationship between breast cancer and exposure to chemical mixtures, the influence of when in a lifetime exposure occurs, and a search to understand environmental agents with the power to modify known reproductive risk factors is largely lacking.

The relative amount of information on individual topics in the science review does not imply a relative worth. We may know more about some chemicals than others simply because regulations have led to the scrutiny of some chemicals but not of others. For example, the fact that there is not a lot to say about the relationship between antibiotics and growth hormones in food and breast cancer does not mean that these exposures are not important. It only means these questions have not been addressed.

The research reviewed on disparities also has systemic shortcomings. Although the U.S. Public Health Service has been documenting the nation’s health and related disparities for a century, there has been a lack of progress in undertaking the research needed to address the unequal burden of disease including breast cancer. While in the 1950s African Americans had lower rates of cancer mortality than Whites, they currently have higher rates. But we do not yet fully know why such disparities exist. As described in Section III, in many cases, the broad, socially-constructed categories used to group individuals by race and ethnicity tend to obscure rather than illuminate underlying differential patterns of disease.

The scientific evidence presented on the following pages also suffers from the compartmentalization of the research between three discrete areas: the physical environment, disparities, and the social environment. The reality of the lives of people of color and the poor is more likely to resemble a coming together of the physical and social environment and disparities. Twenty years after the 1987 United Church of Christ Commission for Racial Justice released its groundbreaking study that found race to be the most potent variable in predicting where commercial hazardous waste facilities were located in the U.S., significant racial and socioeconomic disparities persist in the distribution of the nation’s commercial hazardous waste facilities.<sup>4</sup> The perfect storm of the geography of environment risk, race and social vulnerability is profoundly visible in the wake of Hurricane Katrina.<sup>4</sup>

The atomized nature of these prevailing models of inquiry is incongruous with the mechanisms of breast cancer, which reflect a complex web of potential interactions among multiple factors to produce the circumstances in which breast cancer develops, is promoted, and becomes clinically apparent (Table). The current understanding of the mechanisms of cancer indicates that all cancers arise from a convergence of the environment and genes,<sup>5</sup> and that neighborhood and social factors such as racism, the physical and chemical exposures incurred where people live, work, and play, biology, and other factors may all have a role. But most epidemiologic studies of breast cancer have focused on a narrow range of personal behaviors or genetics, ignored a broader spectrum of potential environmental risk factors, and neglected the question of how these exposures interact with genes.<sup>6</sup>

**Table 1. Mechanisms of Breast Cancer Development**

<b>Mechanism</b>	<b>Description</b>
<b>Initiation</b>	Tumor initiation may occur as much as 20 to 40 years before diagnosis, and consists of permanent changes in a cell. <sup>7</sup> Carcinogens that initiate tumor formation are genotoxic or able to directly damage DNA.
<b>Promotion</b>	Promotion involves the stimulation of cell proliferation or tumor growth and is thought to require repeated exposure to endogenous or exogenous compounds. Estrogen is believed to influence mammary carcinogenesis through promotion. Wolf and Weston state that tumor growth may be promoted by exposure to endogenous hormones or exogenous environmental hormone mimics. <sup>7</sup>
<b>Progression</b>	Progression is the transition from a benign to malignant tumor and also involves some level of genotoxicity. <sup>8</sup>
<b>Epigenetics</b>	Epigenetic mechanisms cause heritable changes in gene function without a change in the sequence of the DNA. There is evidence epigenetic mechanisms are involved in the regulation of critical tumor suppressor and growth regulatory genes in breast cancer that are important for DNA repair, cell cycle control, as well as cell growth and differentiation. <sup>9, 10</sup>

## **Where Does the Money Go?**

Research follows the money. The gaps in the science review echo where the money has not gone. Of those resources directed to cancer research, only a small amount of funding has been allocated to explore avoidable exposures to a wide range of occupational and environmental industrial carcinogens. Only 10 percent of the National Cancer Institute's (NCI's) \$5.9 billion 2008 budget request is allocated to "cancer prevention and control," and based on a review of NCI's stated research goals, most of NCI's expenditures in the field of prevention appear to be in search of improved detection and other control measures.<sup>11, 12</sup>

Money has also not flowed to disparities research. Although health disparities have been documented for a century, as recently as 1999, an Institute of Medicine committee charged with reviewing the programs of research at the National Institutes of Health (NIH) relevant to ethnic minority and medically underserved populations concluded that an inadequate one percent of the NCI's 1997 budget was allocated to research and training programs relevant to these populations, and that "no blueprint or strategic plan to direct or coordinate [health disparities] research activity appears to exist."<sup>13</sup>

Historically, breast cancer research has focused primarily on identifying targets for therapy and treatment. Prioritizing funding for treatment and related research while neglecting primary prevention research-related activities parallels the overall imbalance among health care and public health resource allocations. An analysis of U.S. state and local public health agency expenditures found that mean per capita spending for public

health in 2004–2005 was \$149, compared to \$6,423 for overall health care.<sup>14</sup> Public health, charged with creating healthful conditions for all, has competed unsuccessfully for resources supporting technologically intensive disease treatment aimed at individual consumers.<sup>15, 16</sup> In 2006, America's pharmaceutical and biotechnology research companies set a new record for biopharmaceutical research, spending \$55.2 billion to develop new medicines and vaccines, or about double the entire NIH budget of \$28.4 billion budget in the same year.<sup>17</sup>

Gaps in knowledge that stem from the lack of resources directed towards understanding the impact of environmental pollution on breast cancer feed back into society as messages that "there is no evidence" that pollution plays a role.<sup>3</sup> NCI's breast cancer prevention advice to patients explicitly downplays environmental etiology, stating "studies have not proven that being exposed to certain environmental exposures (such as chemicals, metals, dust, and pollution) increase the risk of breast cancer."<sup>18</sup> The "no evidence" message informs clinicians' perceptions about the role of the environment in the etiology of cancer, may influence the likelihood that clinicians ask their patients about workplace and community exposures, and thus may diminish the important historical role of clinicians as sentinel reporters.<sup>19</sup>

Finally, the decline in cancer funding – funding of federal grant applications for cancer research has fallen from about 30 percent to about 9 percent – is further reducing progress in cancer prevention research. An academic researcher and NCI grant reviewer stated recently in the *New York Times* that due to decreases in cancer funding, "a whole generation of American scientific researchers is at risk; careers are ending because of a lack of

federal dollars ... in effect, American mothers have been asked to swallow their objections instead of their tamoxifen; breast cancer is simply not an administration priority anymore.”<sup>20</sup>

### What Questions Are Asked?

Institutional racism and prejudices impact what questions are asked and what knowledge is included in science. To address disparities, we must understand how the legacy of racism and prejudice against people of color, sexual minorities, the disabled, immigrants, the poor and others in all its manifestations, (i.e., stressful experiences on the individual level, residential segregation, etc.) interacts with social, physical and other factors to impact health. Such research challenges our notions of ourselves, our nation, and our policies and practices that sustain inequalities and prejudices. The scientific infrastructure, the individuals and institutions that establish research priorities and disperse funding, are uncomfortable with this type of research. Their discomfort gets translated into policy that is reflected in the science review.

On a practical level, segregation serves to make the experience of others invisible and therefore questions are not formed in the first place. For example, clinicians who by virtue of the segregated nature of our society do not see young African American women dying of “triple negative” breast cancer would be less likely to ponder the reasons for this disparity than physicians who must relate this devastating news to their patients.<sup>21</sup>

Whether disparities research is framed as a social or biological question has profound implications.

While in historical hindsight, the assumptions that led some scientists to search for biological answers to social inequalities were clearly racist in nature, it would be perilous to assume science is free of such blinders in the present day.<sup>22</sup> The role of race in biomedical science has been and remains an area of fierce controversy.<sup>21-25</sup>

Advances in genetics have made it possible to characterize the genetic differences between individuals and populations and have led to the abandonment of “race” as a biological category during the last quarter of the twentieth century.<sup>25</sup> The fact that race is not a scientific category but rather captures socially-determined distinctions provokes skepticism about the study of race and genetics among some scientists, including Harold Freeman, former director of the NCI Center to Reduce Cancer Health Disparities.<sup>21</sup> Schwartz maintains in the *New England Journal of Medicine* that attributing differences in a biologic end point to race is imprecise and of no proven value in treating an individual patient, warns of the dangers inherent in practicing race-based medicine, and recommends that any investigation involving so-called racial distinctions should begin with a plausible, clearly defined and testable hypothesis.<sup>26</sup>

Other scientists, while acknowledging the historic and current inequities based in perceived racial or ethnic identities, believe there can be validity and benefit in the use of racial/ethnic self-categorizations in scientific research.<sup>23, 27, 28</sup> These scientists believe that ignoring race and ethnic background would be detrimental because this information serves as a necessary surrogate measure to identify, track and investigate health disparities and risk factors, and to facilitate testing, diagnosis and treatment when genetic factors are

involved.<sup>23</sup> They argue that because racial and ethnic groups differ from each other on a variety of social, cultural, behavioral, and environmental variables as well as gene frequencies, “race-neutral” epidemiology that relies solely on genotype cluster analysis could lead to spurious genetic inferences due to confounding by the many other ways the groups might differ.<sup>27</sup>

### **Who Frames the Questions?**

The 1999 Institute of Medicine review of the health disparities research portfolio at the NIH spoke to the fundamental difference between inclusion as a research subject versus individual and group inclusion in processes that pose what questions are asked and how they are answered. The report found “diverse study populations do not, in and of themselves, address the research needs of ethnic minority and medically underserved populations unless meaningful research questions relevant to these groups can be posed a priori and answered based on the appropriateness (i.e., diversity and generality) of the study population.”<sup>13</sup>

Following the Institute of Medicine’s findings that the research priority-setting process at NCI and NIH fails to serve the needs of ethnic minority and medically underserved groups, the National Center on Minority Health and Health Disparities was established with the goal of promoting minority health and to lead, coordinate, support, and assess the NIH effort to reduce and ultimately eliminate health disparities.<sup>29</sup> In FY 2008 NIH proposes to spend \$12 million dollars to support community-based participatory research on health disparities.<sup>30</sup>

This laudable effort on the part of NIH as well as foundations to fund disparities research also

reveals the systemic tensions that are perpetuated throughout the production of science that greatly influence the outcome of research. For example, while institutional decision-makers may place much value on the scientific merits of a well-written grant proposal, populations that are directly impacted by disparities are more inclined to judge expertise by researchers’ demonstrated commitment to developing the trust of the population under study. Research that incorporates the perspective of communities who are directly impacted by disparities faces many other hurdles. The concerns of community advocates include: (1) the resources committed for disparities research may be unequal to address the task at hand; (2) pre-existing systemic inequalities in educational opportunities make it difficult to generate qualified researchers with roots in the impacted population; and (3) differences in the maturity of programs across racial and ethnic populations place communities new to disparities research at a structural disadvantage compared to other populations. The concern is that the sum of these tendencies may produce the “scientific” conclusion that community-based health disparities research has been a failed experimental model.

Research has often fallen short of ensuring the incorporation of the direct knowledge of the activities, experiences, and ideas of workers, clinicians, community members, minority populations and others with insights relevant to scientific discovery, a practice that has adversely impacted environmental epidemiology. While exposure assessment conducted without the incorporation of such local knowledge is inherently limited, research funding rarely values the time and resources essential to gain the trust,

and to gather the first hand knowledge, of directly-impacted populations. Illustrative of this problem, reconstruction of radiation doses incurred by Native Americans as a result of the production and testing of nuclear weapons was severely flawed by a failure to include Native Americans' knowledge of their diet, activities, and housing. Important pathways of exposure were missed including exposures to radioactive iodine from eating small game.<sup>31</sup>

## **Summary**

There are many limitations in the science review on the following pages. Methodological issues discussed throughout the review do not alone account for these shortcomings. Non-scientific economic, social and political forces have and continue to shape our knowledge of the environment, disparities and breast cancer. How funding priorities were set, money was awarded, questions asked and not asked, framed in one way versus another, all help explain the deficiencies in our knowledge. The examples provided are by no means an exhaustive accounting of the non-scientific currents that are embedded in the papers that follow.

We are moving towards answers to questions about the environment, breast cancer and disparities as a direct result of political action on the part of advocates who waged a successful campaign that led to the passage of the Breast Cancer Act in 1993 leading to the establishment of the California Breast Cancer Research Program, and in turn to the Special Research Initiative. While patient, environmental and community-based advocates have had great success in promoting changes at NCI and other academic

funding mechanisms regarding the nature and extent of research on disparities and environmental pollution, their influence is likely dwarfed by the historical factors, social, and political described above. A clear understanding of the impact of these forces can inform strategic thinking about how to effectively bolster the influence of communities impacted by breast and other cancers in setting a new research agenda. Only in this way can we frame the right questions and find the path to relevant answers about the relationship between the environment, disparities and breast cancer. The limitations of the current science as reflected in this review speak volumes about the need to proceed with a sense of urgency.

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