*Using Maps to Promote Health Equity*

This report is one in a series of papers on best practices for using maps to promote health equity. Commissioned by The Opportunity Agenda, in partnership with the Health Policy Institute at the Joint Center for Political and Economic Studies, this project was made possible by The California Endowment. The complete volume of research and case studies is available on-line at: http://www.opportunityagenda.org/mapping.

# The Challenge of Local Public Health Practice in Eliminating Health Disparities

## Using GIS as a Tool To Illustrate Health Inequity

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## *Introduction*

It is well known among local public health practitioners that health, disease, and death are not randomly distributed in our communities. Poor health and premature death concentrate among people with low incomes and people of color residing in certain places.[1] In the United States access to proven health protective resources—such as clean air; healthy food; recreational space; and opportunities for high-quality education, living wage employment, and decent housing—is highly dependent on the neighborhood in which one lives. As a result of inequity in access to these resources, many neighborhoods must contend with a cluster of health hazards and a dearth of health resources. These persistent social inequities accumulate over people's lives and, by increasing the odds of premature disease and death, successfully conspire to diminish the ultimate quality and length of human life in these neighborhoods. In many American cities, enormous differentials in life expectancy among neighborhoods can be demonstrated.[2] Almost invariably, low-income neighborhoods of color bear the brunt of this heavy burden of disease and premature death.

Current U.S. local public health practice focuses overwhelmingly on individual-level and disease-specific interventions designed to remediate the "downstream" health consequences of social inequity. The challenge of 21st century American public health practice is to characterize and fully illuminate the powerful relationship between social inequities and health inequities and to identify comprehensive policy strategies and multidisciplinary interventions that improve community health through an explicit focus on reducing social inequity. This challenge requires moving from a narrow dialogue about health disparities to one squarely focused on health inequity. However, the relationship between social inequity and health inequity remains largely invisible to the lay public and to many policymakers, including many influential health policymakers. A further challenge to local public health practice is that illustrating these relationships requires the analysis of data from disparate domains, including economics, employment, land use, education, housing, and health. These non-health data domains are generally unfamiliar and somewhat less accessible to local public health epidemiologists and, unlike most health datasets, are often not configured at the individual level. Geographic information systems (GIS) technology offers a powerful tool for overcoming these barriers by arraying these various data across a common geographic platform. More important, social inequity itself is often manifested as the spatial concentration of health and environmental hazards, economic disinvestment, and social stressors. Thus the depiction of health inequity often mandates a spatial analysis of these data and their interrelatedness at the community or neighborhood level. GIS permits a neighborhood-level perspective on the relative access to these important non-health resources and opportunities. Finally, GIS also allows data to be presented in a user-friendly form for health scientists, policymakers, and the lay public.

## *Moving From Health Disparities to Health Inequity*

### Health Disparities

> "Health disparities are differences in the incidence, prevalence, mortality and burden of diseases and other adverse health conditions that exist among specific population groups in the United States"
>
> —NIH Working Group on Health Disparities

In Healthy People 2000, the nation established the goal of *reducing* health disparities between racial and ethnic minorities and the rest of the population. Under the subsequent leadership of U.S. Surgeon General David Satcher, Healthy People 2010 reset that goal to focus on *eliminating* health disparities among segments of the population, including differences that occur by gender, race or ethnicity, education or income, disability, geographic location, or sexual orientation. Moving from merely *reducing* to *eliminating* health disparities will require a deeper understanding of the primary drivers of health disparities and a very different local public health practice than what is currently funded and practiced in state and local health departments in the United States. Health disparities, as defined by the National Institutes of Health (NIH), are a somewhat static concept that simply "exists" among specific U.S. population groups. The definition lends itself to an understanding of health disparities as a construct that is akin to differences in genetics, health care access, or health knowledge among U.S. population groups. This simple construct explicitly ignores the social context in which these differences are embedded and tends to imply and encourage a narrow scope and disease-specific public health approach to the phenomenon of profound racial and ethnic health disparities in this country. Much of this limited approach is grounded in the so-called medical model.

### The Medical Model

The preponderance of state and federal public health programs designed to eliminate health disparities is deeply rooted in the medical model. The medical model assumes that health is highly dependent on health care. Simply stated, the medical model posits that differential rates of disease and death among groups are primarily explained by differences in clinical risk factors and risk behaviors, including health care–seeking behaviors, among different population groups. The medical model focuses most heavily on certain proximate causes of morbidity and mortality, including genetics, health care access and quality, and individual health knowledge. With its focus directed primarily on individual behaviors and risks, the medical model is most easily applicable to situations where health disparities are narrowly defined as the differential incidence of certain specific diseases. Consequently, many federal health disparity elimination initiatives promulgated by federal public health authorities quickly devolve into a litany of disease-specific strategies and largely ignore the commonalities of the socioecological context in which many, if not most, of those diseases are embedded. The medical model solutions proposed tend to involve the intensification of screening and remedial clinical services to specific populations and numerous variations on the theme of increasing patient–

professional interactions among populations presumed to be at risk for or already afflicted with the diseases in question. Examples of this narrow disease-specific focus abound and have characterized the essence of state and local public health practice related to health disparities over the past decade. Substantial evidence shows that these medical model strategies have not been successful.[3] The constrained medical model design of many health disparity elimination initiatives is in part a consequence of the manner in which health disparities data have been depicted.

The U.S. Centers for Disease Control and Prevention (CDC) and its parent agency, the Department of Health and Human Services (HHS), sets the standard for data reporting and analysis nationally, and local health departments tend to follow suit. The general approach of HHS agencies has been to identify specific disease focus areas for its health disparities efforts. For instance, CDC's Office of Minority Health and Health Disparities (OMHD), in its "Examples of Important Health Disparities" on its website, follows this approach by immediately pointing to differential disease rates among various race/ethnic groups in infant mortality, diabetes mortality, chronic liver disease, injuries, sexually transmitted diseases, and AIDS. Although OMHD identifies the factors of race, gender, and economic status as variables influencing health status, it seems to imply that these factors operate primarily by controlling access to health care. The lack of explicit reference to the social determinants of health or any contextual factors that substantial research has now demonstrated as underlying these disparities limits the thinking about solutions to a largely medical model approach. Following this path, state and local health departments typically illustrate health disparities as static differences in the burden of specific diseases between various racial and ethnic groups and report these as rates in tables or graphically represent them in bar or line graphs. For example, the Maryland Department of Health and Mental Hygiene in its 2008 *Health Disparities Data Highlights*[4] uses the following table to illustrate mortality disparities in the state. The table offers various analytic measures to illustrate the magnitude of the disparities, including age-adjusted mortality ratio, excess rate disparity, and ratio disparity rank. Elsewhere in the data monograph, the department attempts to illustrate the variation in magnitude of black–white mortality rates across Maryland counties using both line and bar graphs. In the Maryland disparities data presentation, the magnitude and consistency of the disparity in mortality is evident; however, as with the NIH definition, the reader is presented with a difference in rates devoid of an explanatory context. Thus the health disparities phenomenon appears to exist in a vacuum, leaving the reader to form his or her own perhaps speculative conclusions about why these differences exist. Nowhere in the data presentation are there any data related to income, education, housing, or any other social determinant of health with the exception of health insurance rates. Although this was arguably not the intention of this health disparities data report, that is precisely the point of this paper. This comprehensive yet decontextualized health disparities information has the potential to harden biased perceptions about innate biological, behavioral, or cultural differences between racial and ethnic groups or to devolve into rote assumptions about differing access to medical care among racial, ethnic, and social groups.

African American vs. White Mortality Disparity, 15 Leading Causes of Death, Maryland 2005

| Ratio Disparity Rank | Excess Rate Disparity Rank | Statewide Cause of Death Rank | Disease | Age-adjusted Mortality per 100,000 Black | White | Ratio | Age-adjusted Difference per 100,000 |
|---|---|---|---|---|---|---|---|
| 7 | 1 | 1 | Heart Disease | 253.3 | 200.9 | 1.26 | 52.4 |
| 9 | 4 | 2 | Cancer | 207.7 | 185.7 | 1.12 | 22.0 |
| 7 | 8 | 3 | Stroke | 53.3 | 42.3 | 1.26 | 11.0 |
| | | 4 | Chronic Lung Disease | 25.4 | 38.4 | 0.66 | -13.0 |
| 6 | 3 | 5 | Diabetes | 43.1 | 21 | 2.05 | 22.1 |
| | | 6 | Accidents | 24.8 | 24.7 | 1.00 | 0.1 |
| 10 | 10 | 7 | Flu & Pneumonia | 24 | 21.9 | 1.10 | 2.1 |
| 5 | 6 | 8 | Septicemia | 32.9 | 16 | 2.06 | 16.9 |
| 12 | 12 | 9 | Alzheimer's Disease | 15.2 | 18.3 | 0.83 | -3.1 |
| 1 | 2 | 10 | HIV / AIDS | 26.6 | 2.1 | 12.67 | 24.5 |
| 4 | 7 | 11 | Kidney diseases | 23.7 | 10.6 | 2.24 | 13.1 |
| 2 | 5 | 12 | Homicide | 25.2 | 3.6 | 7.00 | 21.6 |
| | | 13 | Chronic Liver Disease | 7.5 | 8.4 | 0.89 | -0.9 |
| | | 14 | Suicide | 4.6 | 10 | 0.46 | -5.4 |
| 3 | 9 | 15 | Certain Perinatal | 9.9 | 3.8 | 2.61 | 6.1 |

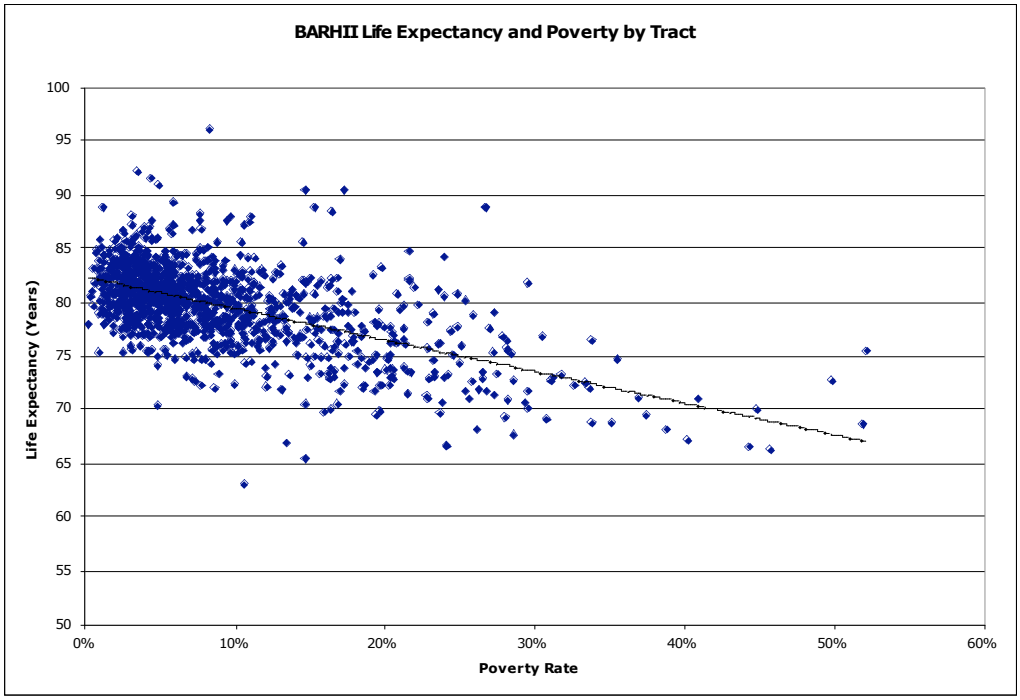
Source: Maryland Vital Statistics Annual Report 2005

## Health Inequities

> Disparities in health that are a result of systemic, avoidable and unjust social and economic policies and practices that create barriers to opportunity.
> —Virginia Department of Health

The challenge of moving from reducing to *eliminating* racial and ethnic health disparities will require state and local public health departments to develop a novel public health practice that targets the so-called social determinants of health. These public health practices will have to look beyond the behavior of individuals and medical services to the structure of opportunity in society, including access to high-quality education, living wage employment, safe and affordable housing, reliable and convenient transportation, nutritious foods, recreation, and other health protective social resources that are beyond the control of individuals but are critical prerequisites to population health. These social determinants are the primary root causes of health disparities. Thus, once placed into the context of the social determinants of health, health disparities can be better understood as health inequities.

One of the first challenges in presenting these data is that unlike traditional health data, health inequities data reveal the *association* between a social variable and a health variable. An example is life expectancy and income. The nature of the association is that at the population level, as income increases, so does life expectancy and vice versa. The following graphic depicts how life expectancy and household income are related in the San Francisco Bay Area. The Bay Area Regional Health Inequities Initiative (BARHII) has been using such analyses to help communicate the need to transform local public health practice to better address the root causes of health disparities.




This approach to depicting health inequity data has four basic characteristics:

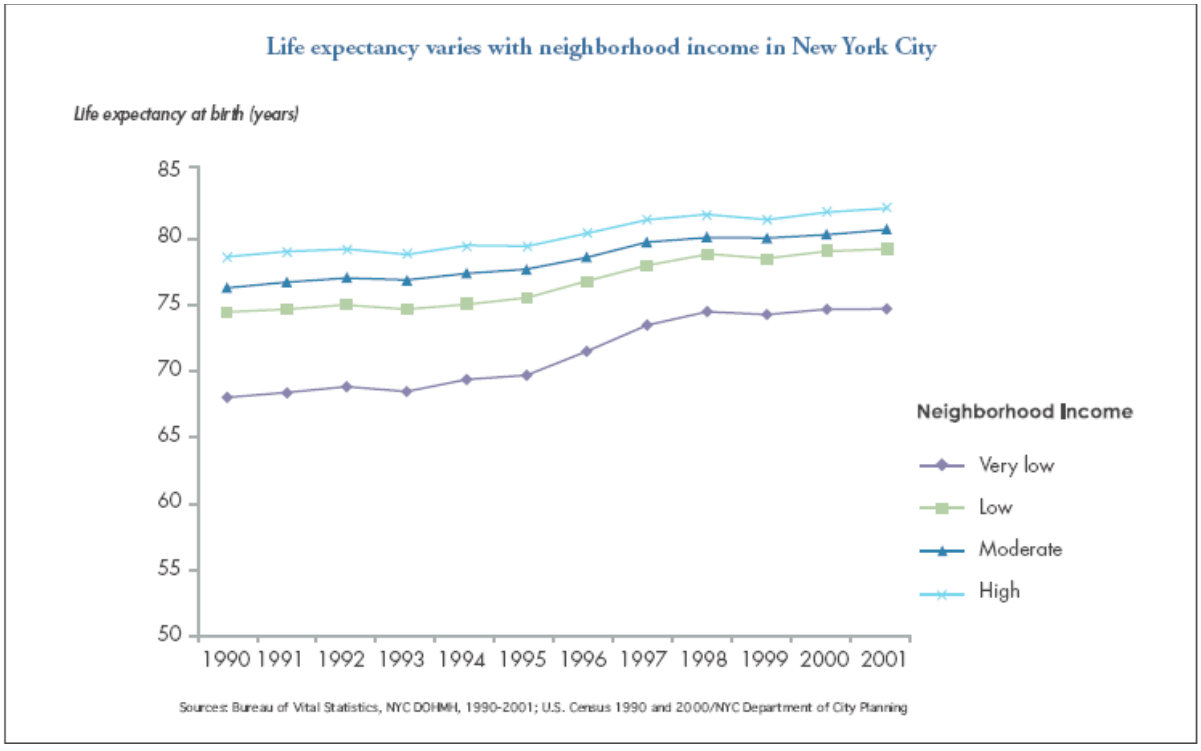
1. Uses aggregate health measures (e.g., life expectancy or overall mortality rate)
2. Highlights the relationship between health outcomes and important social measures (i.e., the so-called social determinants of health)
3. Employs continuous and inclusive measures so that all segments of the population are represented, as opposed to dichotomous categories such as white/black, poor/non poor that often imply that the problem is confined to a certain segment of the population and therefore not everybody's problem
4. Illuminates the direction of possible population-level policy solutions that are nonmedical and not exclusively focused on individual behaviors

Use of aggregate measures as opposed to disease-specific measures (e.g., diabetes prevalence) allows the data to avoid drawing the reader into a reflexive individual behavior frame. Referring back to the Maryland disparities table, one can look at the black–white differences in heart disease and infer a difference in physical activity, tobacco use, or diet as the primary explanation for the disparity. Each of those explanations subtly indicts individuals for presumed behaviors that are considered

unhealthy vices. However, life expectancy differences do not necessarily evoke the same individual behavior frame that disease-specific measures often do.

The graphic also depicts the striking relationship between a social measure and a health measure. Drawing the reader's attention to the tight relationship between income and life expectancy promotes a deeper understanding of how non-health factors may be influencing health. It is this argument that state and local public health practitioners must make to influence policymakers and the general public that health is not merely access to health care and that social policy is health policy. It is this understanding that underlies and ultimately will legitimize health impact assessments and other quantitative approaches to predicting the health consequences of non-health decisions.

The use of a continuous measure allows all readers to find themselves on the graphic. The BARHII example stratifies all income groups along a continuum so that the reader is capable of identifying his or her income stratum and observing the average life expectancy associated with that stratum. In this way, all segments of the population can better understand how their health may be constrained by social policy and access to opportunity. Ideally, this inclusiveness makes for a stronger policy argument and creates a broader constituency for change.




The graphic also implies a policy strategy insofar as it reveals the interconnectedness of income and life expectancy. Although this association does not necessarily infer causation, it does suggest a policy case for raising income at the low end or, perhaps, increasing access to those health protective resources to which higher incomes facilitate access. By adding a powerful health justification for existing policy arguments about

social equity, this analysis helps bolster ongoing efforts to improve social equity in other domains.

The local health departments of Philadelphia, Baltimore, Hennepin County, and the state of Colorado have produced similar analyses. New York City Department of Health and Mental Hygiene has added a longitudinal component to this analysis and depicted how these gaps have remained largely unchanged over the past decade.

All of these analyses demonstrate a relationship between death rates and measures of income at the neighborhood level. However, graphics illustrating these relationships often prove to be opaque to policymakers and the general public and thus do not serve as effective standalone representations of health inequity data.

**GIS As a Tool for Depicting Health Inequity**

The third essential public health service is to inform, educate, and empower people about health issues. The mandate to inform and educate the public requires that data presentation be a central component of local public health practice. In fact, to the extent that state and local public health departments have a unique contribution to the public discourse, it is grounded in the data and other forms of evidence to which public health practitioners have direct and ready access. Much of public health practice is the translation of science and scientific methods and concepts to more easily digestible forms that the public and policymakers can understand and apply. Thus the effective presentation of public health data is essential to successful public health practice.

As discussed earlier, both the move from reducing to eliminating health disparities and the subsequent movement from the concept of disparity to inequity require new ways of portraying the issue and helping shape the discourse to create effective solutions. Many people do not have an affinity for bar charts, graphs, or even rudimentary statistics. Therefore, a significant challenge in this work is conveying relatively complex health data and analyses into formats that laypeople and policymakers can understand and use. GIS technology offers a powerful solution to this problem, and public health practitioners have embraced it.

Despite applying data approaches that use the four previously outlined characteristics, overcoming general public discomfort with scientific tables, charts, and graphs remains a barrier to public health practitioners. GIS mapping offers an effective way to overcome that barrier. Maps, although not universally accessible, are much more accessible to a greater segment of the lay public and policymakers than traditional scientific data formats. In addition, GIS offers the ability to unmask enormous spatial inequities that are the manifestation of profound social inequities. These spatial inequities remain largely invisible to large swaths of the public as a result of persistent racial and economic segregation in the United States.

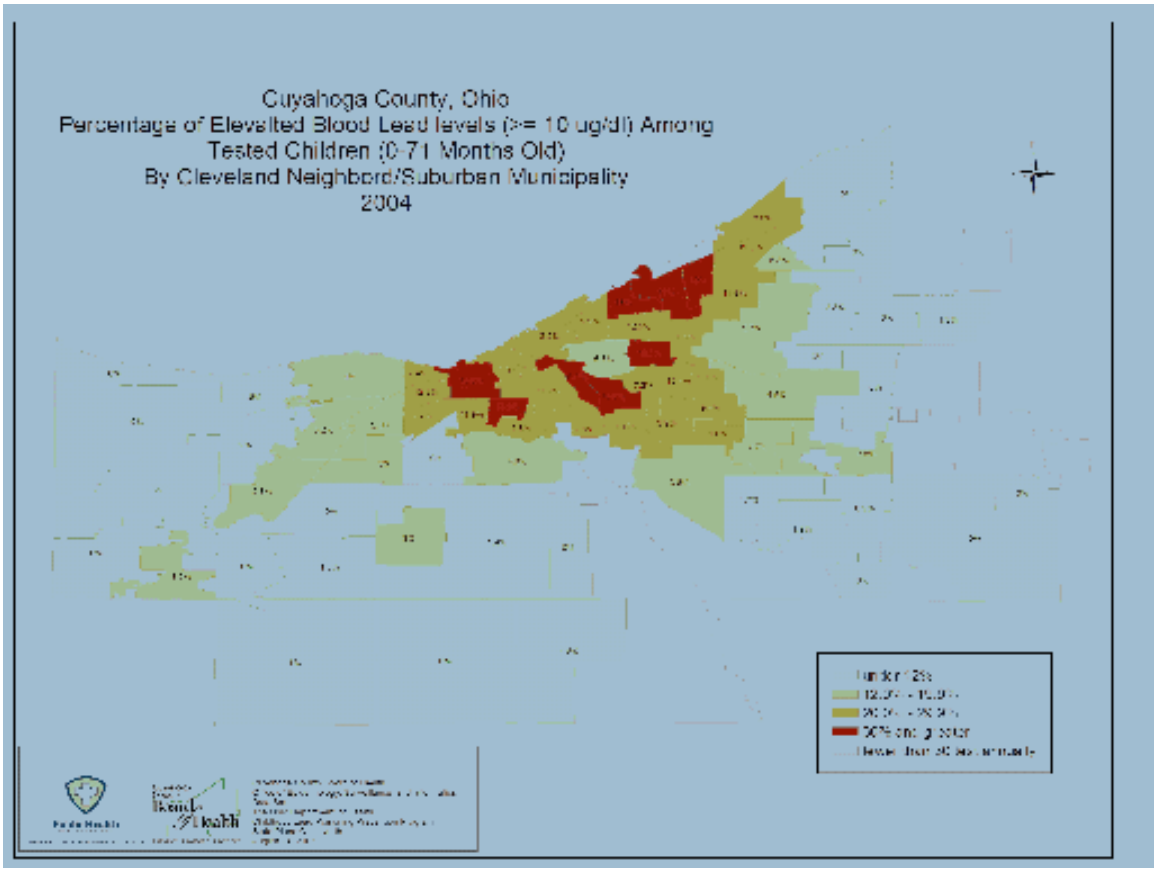
GIS technology has become much more widely available to health departments over the past decade, and most state and local governments have some capacity to array datasets

across geographic areas.[5,6,7,8] The use of GIS technology by state and local health departments can be loosely categorized into four broad areas:

1. To plan the deployment of health care services and resources to match or anticipate demand
2. To map the distribution of risk factors, vectors, environmental toxins, or disease to ascertain the existence of clusters or outbreaks
3. To evaluate or communicate the overall burden of specific risk factors or diseases by geographic community
4. To analyze the relative distribution and burden of disease in *relationship to* the distribution of other important social, economic, and political resources.

Each of these four uses of GIS technology has the potential to illustrate health inequity; however, most health departments have not used GIS with this intent. The first use, evaluating the deployment of health care services, has been the primary purpose of mapping technology in many health departments. This use is straightforward and typically employed to make determinations regarding the site choices of new health facilities in proximity to populations that express demand for these services. This use of GIS does not help explicate health inequities but may illustrate health care service inequities when critical services are geographically inaccessible to low-income populations.

A second use of GIS among health departments is mapping the distribution of a particular disease or condition to look for geographic patterns that might imply an outbreak or a relationship to a source of toxicity. A good example of this use is Cuyahoga County Health Department's use of GIS to illustrate the distribution of lead poisoning cases in the greater Cleveland area. Here the health department utilizes GIS to illustrate the distribution of elevated lead levels in children by neighborhood. This map, although not explicitly illustrating inequity, does highlight the unequal burden of this environmental disease in children in the greater Cleveland area. This pattern of lead poisoning cases might trigger an association between aging or blighted housing stock and deteriorating lead paint. However, the map itself does not explicitly make that association. A similar approach to the use of GIS may be in mapping communicable disease cases to ascertain point sources of contagion or person-to-person spread of communicable disease within local communities or within social networks. These case maps are usually not published for confidentiality reasons, but they do provide the opportunity for health department epidemiological staff to analyze data spatially.




A third use of GIS in health department practice is to map the distribution of disease to evaluate the relative burden of that disease in a community. The Tarrant County Health Department in Texas uses GIS technology to illustrate the distribution of heart disease death rates by zip code, illustrating areas with a threefold to fourfold difference in age-adjusted heart disease death rates. This approach might reveal specific disease "hotspots" that may provide hypotheses for further exploration or may offer communities a way of prioritizing their health needs in partnership with the health department.

**Figure 4: Geographic Distribution of Diseases of the Heart Deaths by ZIP Code, Tarrant County, 2005**


These data were prepared by Tarrant County Public Health for its use, and may be revised any time, without notification. Tarrant County Public Health does not guarantee the correctness or accuracy of any features on this map. Tarrant County assumes no responsibility in connection therewith. Said data should not be edited by anyone other than designated personnel, or through written approval by GIS Manager. These data are for informational purposes only and should not create liability on the part of Tarrant County Government, any officer and/or employees thereof.

**Rate per 100,000**

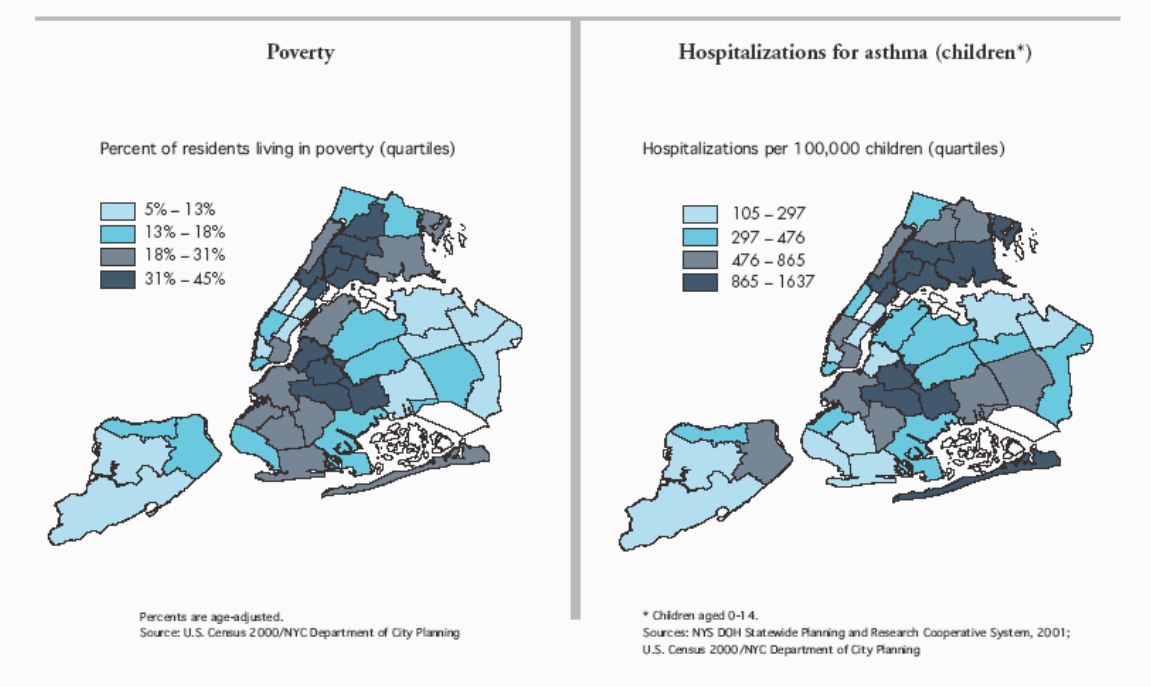
| | | | |
|---|---|---|---|
| 50.17 - 111.51 | 334.53 - 446.03 | Water | |
| 111.52 - 223.01 | Excluded or No Data | County Boundary | |
| 223.02 - 334.52 | | | |

***Leading Causes of Death in Tarrant County, 2005*** 10

The fourth use of GIS by local health departments is to assess the relative distribution and burden of disease in *relationship to* the distribution of other important social, economic,

and political resources. This is the least common use of GIS among the four primary uses, and it is the focus of this paper. Very few local and state health departments have approached their public health epidemiology and data work in this manner, and it appears to be the result of an evolutionary process from the more straightforward uses of GIS described previously. The GIS work described as follows is being done by local and state health departments that have recognized the need to do more than merely depict health disparities as static differences in rates of specific diseases because of the risk that the audience might simply adopt a narrow medical model orientation and ignore the larger context of these disparities. As stated earlier, these contextual factors are largely invisible to even experienced health policymakers, so the challenge is to highlight the relationships between familiar measures of social inequity and their health correlates. Each of these examples represents the work of departments that are determined to change the nature of public health practice to better focus on the root causes of health disparities, and each is committed to using data to drive this transformation of public health practice. GIS serves as a useful tool for harnessing the power of health data to tell a larger story of health and social inequity.

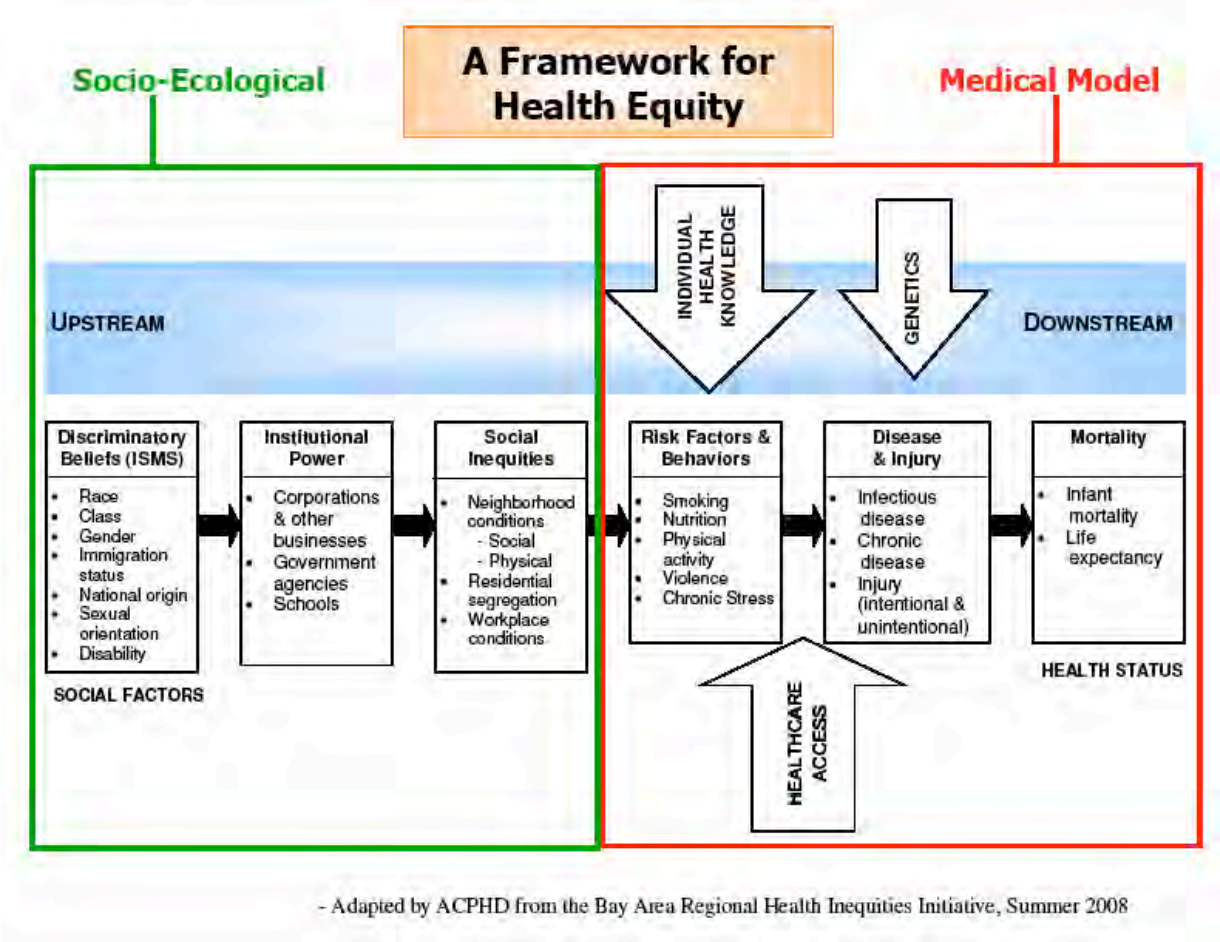
One approach to mapping the distribution of disease burden across communities and relating that to the distribution of other social resources is to produce two maps, side by side, one reflecting the distribution of the health measure and the other displaying the social measure. The New York City Department of Health and Mental Hygiene takes this approach in its report *Health Disparities in New York City.*




**Depicting the Distribution of Life Expectancy**

Alameda County Public Health Department (ACPHD) has adapted the Bay Area Regional Health Inequities Initiative's *A Framework for Health Equity* (see the figure) to

demonstrate and explain the comprehensive scope of work necessary to address stark differences in health outcomes by income, race/ethnicity, and place.

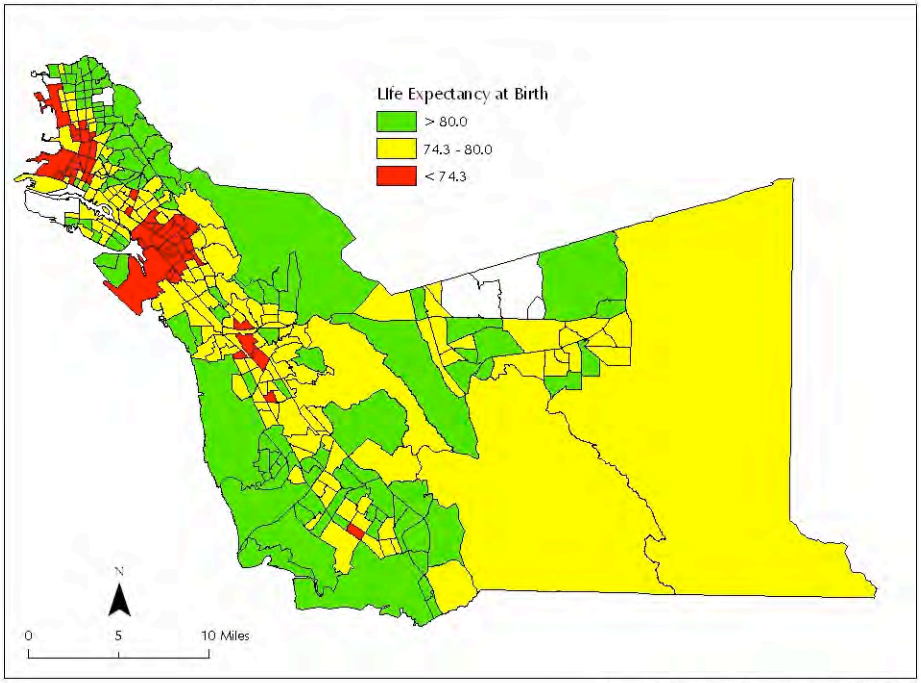



The framework is not meant to represent a comprehensive and explanatory logic model; rather, it is a simplified depiction of a spectrum of potential intervention points for a public health practice that is cognizant of and focused on the powerful structural causes of health disparities in addition to the "downstream" consequences. Public health departments traditionally work on the right side of the figure—providing immunizations, diabetes education, smoking cessation, and other services to individuals in need. Additionally, health departments spend vast sums of money providing clinical medical services to the uninsured and underinsured in the outpatient, emergency room, and inpatient settings. These downstream public health strategies are essential because they affect risk behaviors and provide access to health care services, which we know influence health outcomes. Using this framework, the department has used GIS to map the geographic distribution of all the downstream variables including death, burden of various diseases, and health behaviors. However, the linkage between these downstream outcomes and upstream social factors has been more difficult to portray. One approach has been to use GIS to illustrate the distribution of aggregate measures of health such as life expectancy. The following map depicts life expectancy by census tract in Alameda County and groups life expectancy into three categories: high, medium, and low. The map is intended to draw attention to the existence of high-mortality "hotspots" in the

county and to highlight the fact that these areas are not randomly distributed across the county. The map was released as part of a comprehensive report on health equity and received prominent coverage in all of the major daily newspapers, including the *San Francisco Chronicle* and *Oakland Tribune,* under headlines such as "Where You Live May Signal Life Expectancy"[9] and "Study Spotlights Bleak Effects of Poverty."[10]

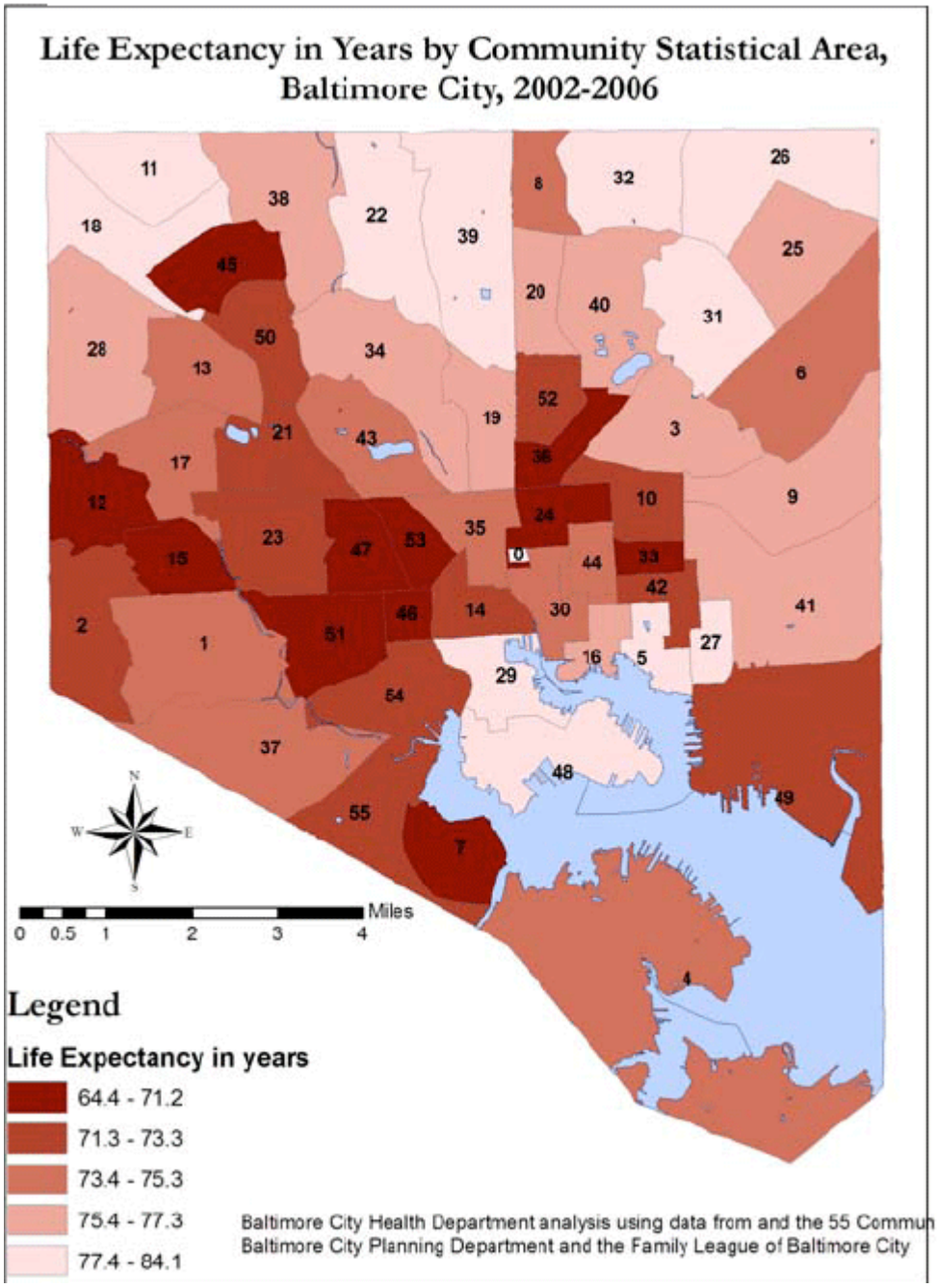
As a result of this work, the department developed a policy unit within the health department that was charged with developing a local policy agenda focused on education, housing, transportation, land use, incarceration, and other key social determinants that have a powerful influence on health outcomes.

**Life Expectancy by Tract**

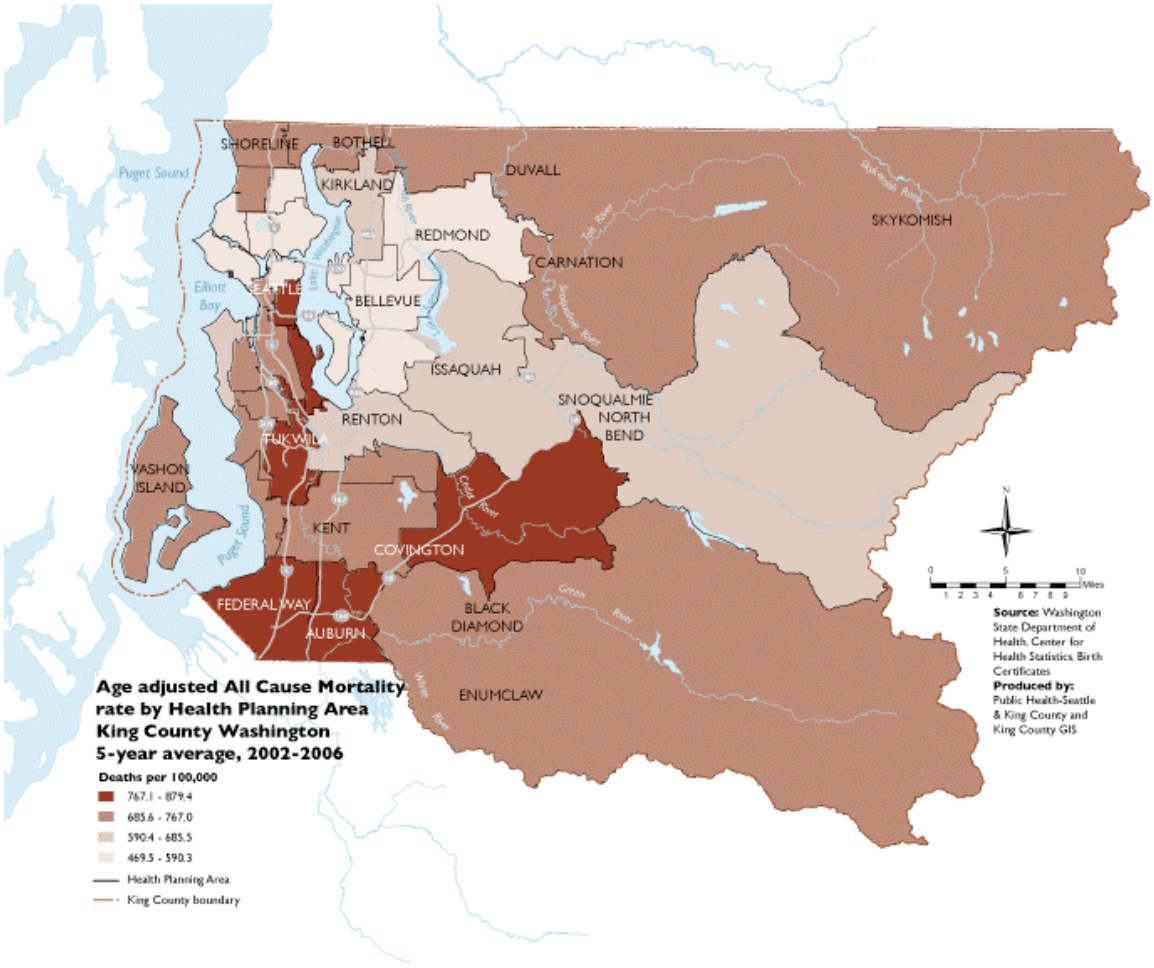



Source: CAPE, with data from vital statistics 1999-2001.

Similarly, the Baltimore City Health Department published a distribution of life expectancy in the City of Baltimore by community statistical areas and revealed a 20-year life expectancy gap among neighborhoods. This dramatic finding also led to front-page newspaper coverage in *The Baltimore Sun* under the headline, "20-year life gap separates city's poorest, wealthy."[11]

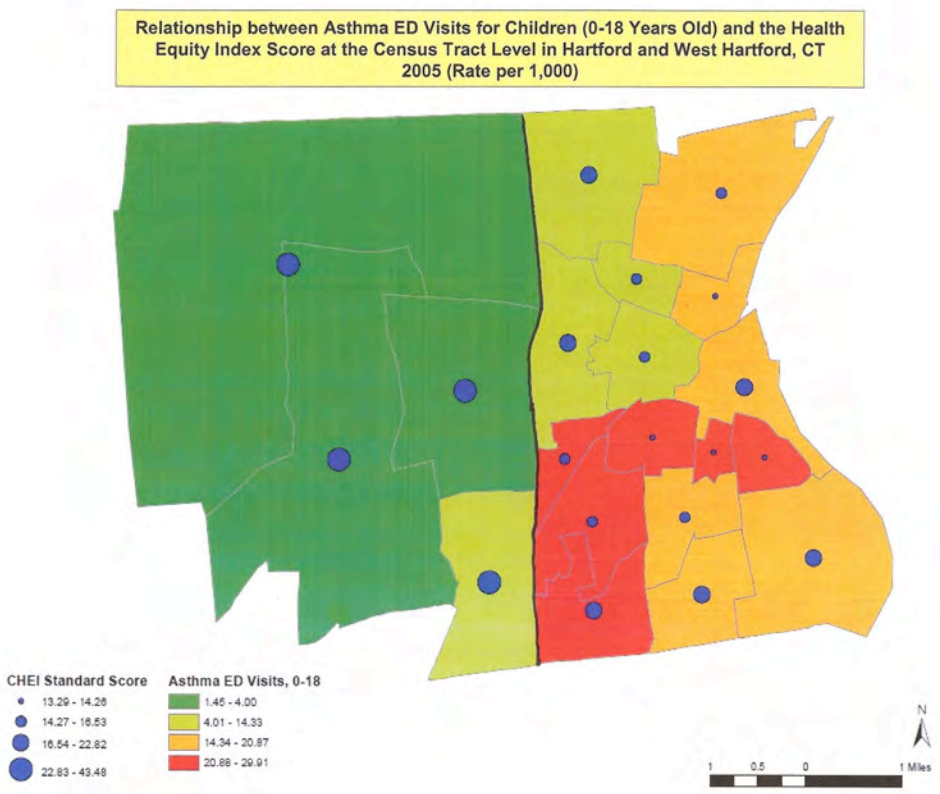



Similar maps have been produced by the Seattle King County Public Health Department using measures of overall mortality.




The Connecticut Association of Directors of Health, Inc. (CADH) has developed a health equity index (HEI), a tool that provides a way to conceptualize and measure the influence of neighborhood social context on population health and health disparities. It is based on a set of nine social determinants linked to health status: Economic Security, Livelihood and Employment, Education, Environmental Quality, Health Care Access, Housing, Civic Involvement, Community Safety, and Transportation. The components are statistically analyzed against health outcome data. The instrument has been tested within 20 neighborhoods in Connecticut. Preliminary findings indicate that a lower HEI score is correlated with higher levels of chronic disease, injuries, emergency admissions, premature mortality, and communicable diseases. The findings are measurable and evidence-based, providing associations that link health outcomes with economic, environmental, and social indicators. CADH turned to GIS to illustrate the results of HEI analysis. They sought a way to depict both the HEI measure and the health measure on the same map to show the relationship between the two. The following graphic was created by CADH to illustrate the relationship between childhood asthma emergency

room visits and the health equity index score at the census tract level in the city of Hartford and West Hartford.




Conclusion: The second goal of Healthy People 2010 is to eliminate health disparities. Governmental public health practice at the state and local level faces the challenges of measuring, depicting, understanding, and explaining the causes of persistent and growing health disparities. Efforts to analyze and explain health disparities lead to the recognition that the social determinants of health serve as a potentially powerful explanatory variable for health disparities. The distribution of disease and premature death in American communities is highly predictable. To an alarming extent, the neighborhood where one lives predicts how long one will live. In virtually every public health area, be it immunization, chronic disease, injury prevention, HIV/AIDS, sexually transmitted diseases, obesity, or even disaster preparedness, local public health departments and the people they serve are confronted with the consequences of structural poverty, institutional racism, and other forms of systemic injustice. The challenge of 21st century American public health practice is to characterize and fully illuminate the powerful relationship between social inequities and health inequities and to identify comprehensive multidisciplinary interventions that improve community health through reducing social inequity. GIS technology offers state and local health departments a powerful tool to meet this challenge and to illustrate to policymakers and the lay public the need to change course in American health policy.

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[9] *Oakland Tribune,* April 17, 2008.
[10] *San Francisco Chronicle,* April 18, 2008.
[11] *The Baltimore Sun,* October 16, 2008.