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The importance of place of residence in predicting late-stage diagnosis of breast or cervical cancer

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Abstract

We tested whether inner-city women were at significantly increased risk of late-stage cancer diagnosis because they resided in extremely poor and socially isolated neighborhoods or in neighborhoods meeting the federal definition of a medically underserved area (MUA). Cancer registry data on women in three American cities were matched to Census data. Using logistic regression we found that residence in economically and socially distressed or medically underserved neighborhoods tended to increase the likelihood of late-stage cancer diagnoses. Further, we found that not all areas that are economically and socially distressed receive the federal MUA designation. Consequently, we argue that economically and socially distressed neighborhoods should be automatically designated as MUA.
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Introduction

In the United States most health care is delivered through the market and paid for by insurance. Even health-care services for the poor, paid for by federal and state governments through the Medicaid program, are delivered through the market. Medical services are not evenly distributed by geographic location, however. Though inner-city residents may live close to hospitals and other health-care providers in many major US cities, research has found they see doctors or other health-care professionals less often than residents in more affluent areas (Wright et al., 1996). The segregation and lack of economic resources that characterize areas with concentrated urban poverty raise the question whether residents in these areas are receiving regular primary care services and appropriate follow up.

Overall, health care markets in the United States have performed imperfectly in serving poor, less educated, and uninsured women (Rosenbaum et al., 1995). It is low-income women as a group who are most unlikely to have access to Pap smears and mammograms (Goldberg and Lessard, 2001). Within the US health-care services provided to rural women are often compared to those available to urban women. Our study recognizes that inner-cities are a special case within urban areas. We hypothesize that women are at a significantly higher risk of late stage breast or cervical cancer diagnosis if they reside in urban neighborhoods identified as underclass, extremely poor, or medically underserved. Mammography and Pap tests are effective screening tools for breast and cervical cancer. Therefore, if screening use is widespread and followed by timely treatment, cancer registry data should include very few cases of late stage diagnosis for breast or cervical cancer.

We analyze stage of cancer diagnosed in 1989–1990. We locate our research in the industrial restructuring and slow economic growth that occurred within the United States during the period from 1970 to 1990. The resulting unemployment increased income inequality and promoted the geographical concentration of persistent poverty and social distress in inner-city areas (Mincy, 1994; Jargowsky, 1997). In the 1970s and 1980s, crowding and competition for urban land and housing markets

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pushed some groups from the brink of poverty into poverty or homelessness. Individuals living in inner-city neighborhoods confronted an unstable social environment characterized by small business flight, housing abandonment, poor and deteriorating schools, increasingly violent crime, chronic joblessness, illiteracy, and disease. In urban centers, the working population was increasingly bifurcated into a professional and managerial class and a pool of largely unskilled working or jobless poor. This change was accompanied by increasing demands placed on the urban housing stock in the 1980s, which resulted in the simultaneous growth of ghetto formation alongside urban gentrification.

The impact of these socio-economic changes fell disproportionately on urban minorities (Katz, 1993; Wilson, 1987). Wilson argued that out-migration of middle-class blacks increased the social isolation of poor inner-city blacks because it reduced access to mainstream institutions and networks, thus helping to create a permanent inner-city "underclass." Katz noted that in the 1980s, detachment from the labor market, urban poverty, and race and ethnicity were interconnected in a manner that was new in American history. In contrast to previous decades in which unemployment tended to be cyclical, Katz showed that inner city poverty had become the result of chronic joblessness, with blacks and Hispanics comprising an increased share of those without jobs in the 1970s and 1980s. Certainly, blacks and Hispanics are considerably more likely than whites or Asians to be poor in the US Though 13.5% of all persons in the United States had incomes below the federally designated poverty level in 1989, 28.1% of Hispanics, and 31.9% of blacks lived in poverty as compared to 10.7% of whites and 12.2% of Asians and Pacific Islanders (US Census Bureau, 1991).

The 1987 publication of Wilson's underclass concept generated considerable debate within the social sciences and renewed policy interest in urban poverty in the United States. The specifically urban focus of Wilson's social and economic geography and the new tools available to geocode urban data prompted researchers to use both traditional ecological perspectives and social area analysis to consider social transformation and social isolation (Sampson and Morenoff, 1997). Though the underclass was only about 4% of the national population in 1990, it comprised a significant proportion of residents in many US cities (Kasarda and Bachman, 1993).

The influence of neighborhoods on health care markets was not a specific focus of Wilson's studies. However, we believe that both demand and supply of medical care is undercut by the residential segregation and isolation from mainstream institutions that characterize many inner-city communities. A neighborhood that undermines its resident's ability to obtain and retain jobs (the primary source of health insurance in the US) would also reduce access to medical services. We expect poverty and social disadvantage to create an environment that is not conducive to investments in healthcare. Specifically, we anticipate that very poor, socially isolated neighborhoods will constrain their residents' ability to engage in health-promoting behavior, such as cancer screening. Moreover, residents will be more likely to discount the future benefits of current health-care investments (Kiefe and Hyman, 1996). This is the basic assumption underlying our hypothesis that inner-city residence is a determinant of late-stage cancer diagnosis.

Previous studies have shown that the quality and quantity of health care services within an area will vary according to physician advice and the value given to health-care information by community residents (Evans and Stoddart, 1994). Social, psychological, cultural, and economic constraints within a community affect exposure to risk factors. These same constraints also mediate small-area variations in medical practice and the quality of care delivered. Thus, neighborhood effects influence the supply and demand for health-care services (Congdon, 1995; Corin, 1994; Roos and Roos, 1994) which consequently are significantly under-allocated to inner-city areas (Wennberg, 1993).

We chose to examine breast and cervical cancer screening because they are both part of routine primary care and a target of major public health education campaigns. There has been little change in Pap smear usage since 1990, the year of this study. In 1987, 74% of women 25 and older reported having had a Pap smear within three years, and in 1998, 80% reported having had one (Breen et al., 2001). Alternatively, the mammography screening environment in the US has been transformed since 1990. Mammography is now the standard screening modality for breast cancer. Mammography use was already dynamic in 1990; annual screening in the nation had doubled in the 3-years between 1987 and 1990 (Breen and Kessler, 1994). Subsequent rates are measured biennially and, though the rate of increase slowed in the decade from 1990 to 2000, increases have still been impressive (Breen et al., 2001). To provide an example, reported biennial mammography use in the National Health Interview Survey, among women 50–64, the age group most likely to be screened, was 32% in 1987 and 74% in 1998.

Use of mammography screening is not uniform across the country (Legler et al., 2002). The breast cancer screening literature includes studies of both rural and urban areas. Generally, lower rates of population density and residence in a rural area have been found to have a negative impact on mammogram usage and on the chances of receiving an early diagnosis of breast carcinoma (Menck and Mills, 2001; Bryant and Mah, 1992). Results of research within urban areas, suggest racial and socioeconomic differences have large and independent effects on breast cancer detection (Selvin et al., 1998; Merkin et al., 2002). Women in lower socioeconomic groups use mammography at significantly lower rates than the rest of the female population (Harper, 1993; Anderson and May, 1995). Calle et al. (1993) found that low-income women in central cities were less likely to report Pap smear tests and pelvic exams than were other women. In 1992, it was still the case that some state Medicaid programs did not reimburse for breast or cervical cancer screening despite their proven efficacy in detecting early stage cancer and in saving lives (Boss and Guckes, 1992).

In fiscal year 1991, Congress appropriated $29.1 million to the Centers for Disease Control and Prevention (CDC) to increase low-income women's access to mammography and Pap smear screening (Hensen et al., 1996). The appropriation also designated funds for referral to appropriate treatment centers and development of public education programs. These efforts have met with considerable success. A report examining key indicators of access to health care services for women in 50 states and the District of Columbia found that of 11 national benchmarks (including poverty, health insurance coverage, first trimester prenatal care, and treatment of high blood pressure and diabetes), only the benchmark for mammograms for women age 50 and over was met (NWLC, 2000).

In this study we analyzed variations in breast and cervical cancer diagnosis from 1989 to 1990 using theories of the urban underclass to inform our empirical conceptualization of at-risk neighborhoods. Previously, we examined the impact of residence in at-risk neighborhoods on diagnostic outcomes for cancer. We compared the impact of two indicators—an interdisciplinary "underclass" index and a poverty level indicator—to characterize residence in disadvantaged neighborhoods on diagnostic stage among women with cancer (Figueroa and Breen, 1995). We originally hypothesized that the underclass index, because it includes a mix of geographic, economic, and socio-cultural factors, would be more likely to explain diagnostic stage than would a measure of pure income deprivation alone. In this paper, we take as a starting point that both measures signal economic and social distress and we examine the importance of these measures in light of the impact of residing in a federally designated "medically underserved area" (MUA). Thus, we have expanded our inquiry to include the MUA measure. We have also refined the dependent variable definition of late-stage cancer diagnosis to better capture the distinction between early and late-stage breast cancer.

Methods

Data

We used Surveillance, Epidemiology, and End Results (SEER) cancer registry data from 1989 to 1990 to study the impact of residential location on cancer outcomes. SEER is an NCI-sponsored population-based registry of cancer incidence with clinically confirmed stage at diagnosis (Ries et al., 2000). We chose Atlanta, Georgia; Detroit, Michigan; and San Francisco, California, because these three major metropolitan SEER areas have both high- and low-income tracts and racially and ethnically diverse populations. The SEER program does not collect socioeconomic data on individuals, families, or communities. Therefore, we linked each SEER cancer case diagnosed in 1989 and 1990 with data from the 1990 US decennial Census, which provides neighborhood-level indices of underclass, extreme poverty, and medical underservice.[1]

A major obstacle in the United States to understanding health disparities in cancer is an inability to match data on individual income, occupation, education, and health-care coverage, with medical data that are available from private and public sources (Krieger, 1992). Because data on cancer screening are self-reported from surveys while data on incidence and stage at diagnosis come from cancer registries, researchers do not have covariates on the same patients to indicate whether persons who obtain screening are diagnosed with cancer at an earlier stage than those who do not obtain screening. Moreover, registry data are abstracted from medical records and do not include conventional socioeconomic indicators. Because an address is available for most patients, however, we were able to geocode addresses from cases diagnosed in 1989 and 1990 and match them to the 1990 decennial Census data at the tract level.

The Census tract unit may be larger or smaller than a typical neighborhood. The average sample size for tracts contained in the 1990 Census was 630 persons (Jargowsky, 1997). However, Census tracts are frequently used in the poverty literature as a proxy for neighborhoods in which residents are likely to face similar social and economic circumstances (Brooks-Gunn et al., 1997). Both the underclass and extreme

[1] Of 5775 SEER cervical cancer cases diagnosed in 1989 and 1990, 6.5% of all records could not be matched (11.2% in San Francisco, 4.8% in metropolitan Detroit, and 17.6% in metropolitan Atlanta). Thus, 5401 SEER cervical cancer cases (93.5%) were matched with Census tract data in all three cities (1860 in San Francisco, 2472 in Detroit, and 1069 in Atlanta). Among 14,132 breast cancer cases diagnosed in 1989 and 1990, 5.2% could not be matched (7.6% in San Francisco, 2.6% in Detroit, and 5.8% in Atlanta). This yielded 13,398 breast cancer cases (94.8%) that could be matched with Census tract data in all three cities (5251 in San Francisco, 5692 in Detroit, and 2455 in Atlanta). The San Francisco/Oakland SEER area includes five counties (Alameda, Contra Costa, Marin, San Francisco, San Mateo) the Atlanta SEER area includes five counties (Clayton, Cobb, DeKalb, Fulton, Gwinette) and in the Detroit SEER area there are three counties (Macomb, Oakland, Wayne).

poverty measures we use indicate areas where there is a spatial pattern of economic distress and social segregation (Jargowsky, 1997).

Another obstacle is the inability to measure the impact of community characteristics on individual health while controlling for both individual and family level socioeconomic status (SES). If we had this ability, we could estimate the true "contextual effect" of neighborhood SES on late-stage cancer diagnosis. We would expect individual and family SES characteristics to provide additional information about the determinants of late-stage diagnosis. MacIntyre et al. (1993) reviewed the literature on the relationship between area and health and, as a result, advocated directly studying the local physical environment. Further, they found that different health profiles from two areas could be explained by comparing health outcomes in light of differences in the social and physical environments. Because we do not have data on individual and family level SES and cannot control for their effects, we conceptualized our area-based indicators as ecological measures and estimated the effect of neighborhood SES on late-stage cancer diagnosis.

Diagnostic stage as a proxy for screening services

Early detection of cervical and breast cancer requires medical intervention in the form of screening tests, clinical examination, and systematic monitoring of women who present positive or ambiguous test findings (CDC, 1993). Cervical cancer is largely preventable though screening with the inexpensive Pap smear test, followed by timely treatment. The disease is less common than breast cancer and has a lower mortality rate. While cervical cancer incidence in the US is low (fewer than 9 cases per 100,000 women in 1990), it is considerably higher among blacks (13/100,000) than whites (8/100,000). Statistics show that after age 25, the incidence of invasive cancer in black women increases, while the incidence rise is much slower for white women. In addition, poverty is associated with a higher incidence of invasive cervical cancer (McWhorter et al., 1989).

Poverty also explains much of the racial difference found in breast cancer incidence (McWhorter et al., 1989). In 1990, breast cancer was the most common cancer diagnosed among women in the US (108 cases per 100,000 women), with a higher incidence among white than black women (113 cases per 100,000 versus 96/100,000). Incidence of breast cancer is also higher among upper-income than low-income women. However, women of low SES are less likely to be diagnosed with early stage disease and are more likely to die of breast cancer (Farley and Flannery, 1989). Women diagnosed with early or local (stage 1) breast cancer have a 94% chance of surviving 5 years after diagnosis; this falls to 73% with regional (stage 2) and to 18% with distant (stage 3) cancer at diagnosis.

We could not directly measure whether women living in disadvantaged areas in 1990 were getting adequate screening for breast or cervical cancer. However, by 1990, mammography and Pap smear screening were widely used in the US and relatively few women were diagnosed with late-stage breast cancer or invasive cervical cancer. Because mammography and Pap smear screening are so effective in detecting early stage breast and cervical cancer, respectively, we believe it is reasonable to infer that in areas where late-stage diagnosis of breast cancer or invasive diagnosis of cervical cancer was more common, screening was not being used (Burstin et al., 1992). Based on earlier studies, we also believe that those who were diagnosed with late-stage cancer, especially those living in disadvantaged areas, may have had problems accessing medical care (Calle et al., 1993). Studies have found that area of residence, income, differential access to and use of the health care system all contribute to the racial differences in diagnosis, survival, and mortality rates for breast and cervical cancer. Other studies from that period suggest that differences in cancer incidence (McWhorter et al., 1989) and survival rates (Dayal et al., 1982) among blacks and whites may largely be due to racial differences in SES.

We eliminated 1003 women from our breast cancer sample who were unstaged in the SEER data.[2] The lack of staging suggests to us that these women may not have received consistently high quality medical care. Despite our interest in this group, which represented over 7% of the total sample of breast cancer cases, we did not include unstaged cases in the regression analysis. Excluding unstaged cases allowed us to distinguish the remaining breast cancer cases into prognostically meaningful stages as defined by AJCC (1988).

Indicators of economically and socially distressed neighborhoods

We chose several independent variables from SEER, including individual measures of race, age, marital status, and city of residence. We then matched these variables to our three area-level identifiers: underclass, extreme poverty, and medically underserved.

[2] In examining the unstaged women by race and ethnicity, we found that non-Hispanic blacks were significantly over-represented relative to their overall numbers in the staged sample. Black women represented 18.6% of the unstaged versus 14.6% of the staged-sample. Black women living in the cities of Detroit and Atlanta were especially more likely to be unstaged relative to their overall representations for those cities. In Atlanta, 29% of the unstaged cases were non-Hispanic black women as compared to being 20% of the staged sample. In Detroit, 23% of the unstaged cases were non-Hispanic black as compared to being 17.5% of the staged sample.

Underclass

Our underclass measure adapted the method developed by Ricketts and Sawhill (1988). A Census tract is flagged as underclass if all of the following proportions are at least one standard deviation above the 1990 national mean: (1) 16–19 year olds not enrolled in school or not a high school graduate, (2) males age 16 and older out of work for more than 26 weeks; (3) households receiving public assistance income; and (4) female-headed households with children. This residential index allows us to connect the diverse factors involving education, family composition, social support, and connections to the labor market.

Extreme poverty

We used Jargowsky and Bane's (1991) concept, which defines extreme poverty as Census tracts in which more than 40% of the population live in poverty. Nationally, Jargowsky (1997) found that the margin of error for an estimate of a true poverty rate of 40% in an average size tract is ± 3.8 percentage points at a 95% confidence interval.

In the empirical analysis, we chose San Francisco as the reference because it is a relatively affluent city in a very large and diverse state. Jargowsky (1997) found that more blacks and Hispanics reside in extreme-poverty neighborhoods in Atlanta and Detroit than in San Francisco. In 1990, San Francisco had only 13 extreme poverty tracts, Atlanta had 36, and Detroit had 149 (Jargowsky, 1997). He also found that the poor are more likely to be concentrated in poor neighborhoods in Atlanta and Detroit, especially in Detroit. A more recent study of Detroit reported that in 1990, it was more racially segregated than any other US metropolis (Farley et al., 2000). The authors found that the typical black resident of Detroit lived in a neighborhood where 83% of the other residents were black. In Atlanta, the average black lived in an area where 69% of other residents were black. Another study of Atlanta reports that the number of poor blacks living in extreme poverty neighborhoods increased from 42% in 1980 to 49% in 1990 (Sjoquist, 2000).

Medically underserved

Areas designated as medically underserved are determined by an index developed by the Health Resources and Services Administration (HRSA), the federal agency responsible for many programs that provide care for the indigent. This Index of Medical Underservice (IMU) is scaled from 0 (completely underserved) to 100 (best served). Under established criteria, each service area showing economic or cultural barriers to health care that has an IMU of 62 or less qualifies for designation as a MUA. To determine the IMU, equally weighted indicator scores are assigned to the following parameters: (1) the ratio of primary care physicians to population; (2) the infant mortality rate (5-year average); (3) the percentage of the population with income below the federal poverty level; and (4) the percentage of the population over age 65 (NARA, 1993).

In rural areas MUA designations are usually made by HRSA at the county or metropolitan statistical area level because Census tracts are generally too small to be considered as efficient sites for service delivery. In rural areas, HRSA computes the infant mortality rate and physician to population ratio used in the IMU from county-level data. The exception to this is in metropolitan areas where infant mortality data were collected at smaller units, such as city health districts or community areas, with sub-county data supplied by the applicant in the MUA request. In urban areas, HRSA calculated the number of primary care physicians per 1000 population, as based on the number of primary care physicians identified by the applicant as practicing in a sub-county service area, such as an urban neighborhood comprising a group of Census tracts. The calculation of MUA indicators at the Census tract rather than at the county-level meant that we could investigate the geographical association between those areas that are designated as a MUA and those areas we describe as being underclass or extreme-poverty areas.

In our study only MUAs designated previous to 1994 are used in order to make them congruent with the time frame of our SEER data. We looked at disparities among women in three SEER urban areas. MUAs in these urban areas are available on the HRSA website at the Census tract level from 1994 to the present (http://bphc.hrsa.gov/databases/newmua). In addition to the data on the HRSA website, HRSA staff provided us with additional MUAs designated earlier. (List of Medically Underserved Areas, 6/30/01 thru 6/38/93: HRSA, Bureau of Health Care Delivery and Assistance, currently Bureau of Primary Health Care). It is notable that MUAs (unlike Health Professional Shortage Areas or HPSAs) are not updated annually. As a result, HRSA staff recommended we include any Census tract or county listed as an MUA previous to 1994 on either the website or the list on file at HRSA.

We tested the underclass variable, the extreme poverty measure, and the MUA variable in all analyses using the study sample from all three cities. We did not use the extreme poverty and underclass measure in the same estimation together because of multicollinearity problems (the correlation between the poverty and underclass measures was over 0.50 in both the cervical and breast cancer samples).

The first estimating equation of our model takes the following form:

$$Pr(P)_i = \alpha + \beta_{ij}E_{ij} + \gamma_{ik}R_{ik} + \lambda_{il}M_{il} + a_{im}X_{im} + \varepsilon_i,$$

where $P_i = 1$ if ith woman is diagnosed with late-stage cancer and 0 otherwise;

E_{ij} = area-level indicator; $j = 0, 1$ representing not underclass area, underclass area, respectively; or in alternative models $j = 0, 1$ representing not extreme poverty tract or extreme poverty tract, respectively;
R_{ik} = race and ethnic group membership; $k = 0$, 1, 2, and 3, representing non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic Asian or Pacific Islander, respectively;
M_{il} = medically underserved area; $l = 0$, 1 representing not MUA, or MUA, respectively;
X_{im} = a vector of individual characteristics related to age, marital status, and city of residence.

We used logistic regression to estimate whether residence in an underclass neighborhood, an extremely poor Census tract or a MUA site is significantly associated with later-stage cancer diagnosis.

Results

Sample characteristics

Characteristics of both the breast and cervical cancer samples are shown in Table 1. Five percent of the cervical cancer samples lived in underclass areas and 6% in extremely poor tracts. Thirteen percent lived in MUAs. About 3% of the total breast cancer sample lived in underclass neighborhoods, about 4% lived in extreme-poverty tracts and approximately 10% lived in MUAs.

For cervical cancer, the dependent variable measures invasive cancer versus in situ (early stage) cancer. For breast cancer, the dependent variable measures stages 3B and 4 versus all other staged diagnoses. Both dependent variables reflect late stages of the disease. Disease at these late stages should not occur if women are routinely screened and receive appropriate follow-up.

Of the 5401 cases of cervical cancer matched to Census data, 4398 women were diagnosed with in situ cervical cancer, and 1003 or (18.6%) with invasive disease. Invasive cervical cancer is a growth with a tendency to invade and destroy nearby tissue and spread to other parts of the body. Once microinvasion and invasive cervical cancer occur, the tumor grows rapidly and can cause death within 2–3 years (AJCC, 1988; Holleb et al., 1991).

Of the 12,395 cases of breast cancer from 1989 to 1990 SEER data matched to 1990 Census data, 11,416 women were diagnosed at early stages and 979 (7.9%) women were diagnosed with stages 3B or 4 of breast cancer.

Table 1
Sample characteristics

Variables	Cervical cancer	Breast cancer
	Percentage	Percentage
Invasive	18.6	
Stages IIIB or IV		7.9
Age[a]	37.5 (14.6)	60.9 (14.3)
Atlanta	19.8	18.6
Detroit	45.8	42.2
San Francisco	34.4	39.2
Unmarried	55.9	45.8
White	71.9	79.4
Black	19.5	14.6
Asian	2.6	3.2
Hispanic	6.1	2.8
MUA	12.6	9.7
Underclass	4.7	2.8
Poverty 40% +	6.3	4.2
	$n = 5401$	$n = 12,395$

Source: 1989–1990 SEER reporting areas for Atlanta, Detroit and San Francisco and 1990 Census Summary Tape File 3A.
[a] Mean (standard deviation).

The SEER cancer registries use the American Joint Committee on Cancer staging system, which is based on tumor size, nodal status, and metastases (AJCC, 1988) Stage 3B breast cancer is characterized by large tumors with extension into the lymph nodes. Stage 4 is metastatic breast cancer in which the cancer has moved beyond the breast to other organs of the woman's body.

Logistic regression findings

Tables 2–5 present logistic regression estimates from the cervical and breast cancer samples. The effects of the regressors on the dichotomous variables are given as odds ratios and confidence intervals. We discuss only statistically significant findings (those results for which the 95% confidence interval does not include an odds ratio equal to one).

Cervical cancer results

The first two columns of Table 2 present results for all three cities. The log odds ratios were significant and of similar magnitude for the extreme poverty and the underclass variables. The MUA variable was not significant in either regression run. In Atlanta and Detroit, women had significantly increased odds of late-stage diagnosis compared with San Francisco. Both black and Hispanic women in all three cities faced increased probabilities of an invasive diagnosis. Age was

Table 2
Logistic regression results for stage of diagnosis among women with cervical cancer by city

Independent Variables	All cities		Atlanta		Detroit		San Francisco	
	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass (RR CI)
Atlanta	**1.389** (1.099–1.756)	**1.419** (1.22–1.793)						
Detroit	**1.301** (1.066–1.588)	**1.326** (1.089–1.615)						
Age	**1.077** (1.071–1.083)	**1.077** (1.071–1.082)	**1.064** (1.052–1.076)	**1.064** (1.052–1.076)	**1.082** (1.073–1.090)	**1.081** (1.073–1.090)	**1.079** (1.069–1.089)	**1.078** (1.069–1.088)
Unmarried	0.978 (0.833–1.149)	0.980 (0.835–1.151)	1.148 (0.808–1.630)	1.152 (0.811–1.636)	0.977 (0.769–1.241)	0.972 (0.765–1.234)	0.902 (0.681–1.194)	0.902 (0.682–1.194)
Black	**1.263** (1.019–1.566)	**1.308** (1.061–1.614)	**1.116** (0.749–1.662)	**1.114** (0.750–1.656)	**1.370** (1.002–1.873)	**1.407** (1.041–1.901)	1.225 (0.780–1.925)	1.256 (0.799–1.975)
Asian	1.257 (0.798–1.981)	1.271 (0.806–2.002)			0.856 (0.143–5.126)	0.838 (0.142–4.933)	1.266 (0.781–2.053)	1.261 (0.778–2.044)
Asian & Hispanic			**6.332** (1.730–23.183)	**6.345** (1.733–23.231)				
Hispanic	**1.457** (1.031–2.059)	**1.468** (1.038–2.075)			1.420 (0.423–4.763)	1.325 (0.392–4.477)	1.306 (0.886–1.926)	1.337 (0.909–1.968)
MUA	1.113 (0.868–1.427)	1.145 (0.897–1.460)	**2.038** (1.145–3.625)	**2.076** (1.245–3.460)	0.981 (0.660–1.458)	0.982 (0.667–1.444)	0.981 (0.660–1.459)	1.018 (0.676–1.534)
Poverty 40% +	**1.519** (1.096–2.105)		1.136 (0.492–2.622)		1.409 (0.943–2.103)		**3.438** (1.175–10.059)	
Underclass		**1.534** (1.084–2.171)		1.581 (0.378–6.625)		**1.673** (1.120–2.499)		1.189 (0.467–3.031)

$n = 5401$.
Note: Dependent variable is probability of an individual woman being diagnosed with in situ versus late-stage cervical cancer. Relative risk ratios and confidence intervals are shown with ratios in bold being significant with 95% confidence.

Table 3
Logistic regression results for stage of diagnosis among women with cervical cancer by race

Independent variables	White		Black		Asian & Hispanic	
	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)
Atlanta	**1.344**	**1.351**	1.352	1.432	**6.767**	**6.661**
	(1.014–1.782)	(1.019–1.791)	(0.846–2.161)	(0.898–2.282)	(1.798–25.460)	(1.772–25.031)
Detroit	**1.291**	**1.278**	1.368	1.494	1.027	0.987
	(1.026–1.626)	(1.015–1.608)	(0.871–2.146)	(0.974–2.292)	(0.344–3.060)	(0.320–3.043)
Age	**1.085**	**1.085**	**1.064**	**1.064**	**1.066**	**1.066**
	(1.078–1.092)	(1.077–1.092)	(1.054–1.075)	(1.054–1.075)	(1.049–1.084)	(1.048–1.083)
Unmarried	0.847	0.842	1.331	1.357	1.095	1.062
	(0.694–1.034)	(0.689–1.028)	(0.941–1.882)	(0.962–1.916)	(0.666–1.802)	(0.646–1.747)
MUA	1.241	1.220	1.006	1.063	1.515	2.914
	(0.801–1.924)	(0.793–1.876)	(0.716–1.413)	(0.766–1.475)	(0.835–2.746)	(0.699–12.156)
Poverty 40% +	1.550		1.350		**4.059**	
	(0.791–3.037)		(0.909–2.004)		(1.028–16.029)	
Underclass		**1.918**		1.218		1.524
		(1.073–3.431)		(0.775–1.914)		(0.837–2.776)

Note: Dependent variable is probability of individual woman being diagnosed with in situ versus late-stage cervical cancer. Relative Risk and Confidence Intervals significant with 95% confidence are given in bold.
Source: 1989–1990 SEER reporting areas for Atlanta, Detroit and San Francisco and 1990 Census Summary Tape File 3A.

a significant predictor of late-stage diagnosis, but marital status was not.

Regression results by city in columns 3–8 show that the probability of late-stage diagnosis was consistently higher for older women. In Atlanta, age and Hispanic/Asian ethnicity were significant predictors. Residence in an MUA was a significant predictor of late-stage diagnosis for women living in Atlanta Black women were at greater risk of a late-stage diagnosis if they lived in Detroit, especially in an underclass area. In San Francisco, residence in an extreme-poverty tract increased the odds of a late-stage diagnosis.

Fig. 1 indicates the percentage of late-stage cervical cancer cases residing in either underclass or extreme poverty tracts. For ease or presentation, we label these tracts as economically or socially distressed areas. In Detroit, 14% of the sample lived in economically or socially distressed tracts. In San Francisco, only 3% of the sample lived in these tracts Atlanta registered 4% of the sample as living in economically or socially distressed neighborhoods. San Francisco had the largest percentage of cervical cancer cases living in federally designated MUAs (16%), with both Detroit and Atlanta registering 11%.

A breakdown of the data by racial-ethnic groups revealed that the rate of invasive cervical cancer for non-Hispanic blacks and Asians was especially high at 26%, for non-Hispanic whites it was 16%, and for Hispanics, 19%. Table 3 shows results using sub-samples of non-Hispanic white, non-Hispanic black, and Asian and Hispanic women.[3] For non-Hispanic whites, living in Detroit or Atlanta increased the odds of invasive diagnosis significantly, as did age and living in an underclass area. For non-Hispanic blacks, age was the only significant explanatory variable. For Hispanic and Asian women, increasing age, residence in Atlanta, and residence in an extreme-poverty neighborhood were important factors.

Breast cancer results

The first two columns of Table 4 present results for all three cities. It shows that increased age, black or Asian race, being unmarried, and living in a MUA are all determinants of late-stage breast cancer diagnosis in women. Residence in an underclass neighborhood or an extremely poor neighborhood also contributes to a late-stage diagnosis. Column 1 shows that after controlling for extreme poverty, residence in Detroit is no longer a significant determinant of diagnostic stage, although it is significant when the underclass indicator is included in the model (column 2).

Fig. 2 shows the percentage of breast cancer cases residing in economically or socially distressed areas. San Francisco had 1%, Detroit registered 10% and Atlanta

[3] We combined the Asian and Hispanic samples to increase the robustness of the results in the regressions by race group. The cervical cancer sample included 468 Asian and Hispanic women; the breast cancer sample included 743 Asian and Hispanic women. Atlanta registered the smallest numbers of both groups.

Table 4
Logistic regression results for stage of diagnosis among women with breast cancer by city

Independent variables	All cities		Atlanta		Detroit		San Francisco	
	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)
Atlanta	1.041 (0.855–1.268)	1.052 (0.864–1.281)						
Detroit	1.152 (0.986–1.346)	**1.166** (1.000–1.360)						
Age	**1.012** (1.007–1.017)	**1.012** (1.007–1.017)	**1.015** (1.003–1.026)	**1.015** (1.003–1.026)	**1.013** (1.006–1.021)	**1.013** (1.006–1.021)	**1.010** (1.002–1.018)	**1.009** (1.002–1.017)
Unmarried	**1.427** (1.241–1.641)	**1.430** (1.244–1.645)	**1.556** (1.105–2.190)	**1.557** (1.106–2.191)	**1.583** (1.285–1.951)	**1.595** (1.294–1.965)	1.198 (0.956–1.502)	1.196 (0.954–1.500)
Black	**1.510** (1.243–1.835)	**1.543** (1.276–1.865)	**2.300** (1.573–3.364)	**2.312** (1.580–3.384)	1.269 (0.951–1.693)	**1.368** (1.037–1.804)	1.384 (0.953–2.010)	1.334 (0.916–1.943)
Asian	**1.556** (1.089–2.223)	**1.564** (1.095–2.235)			0.939 (0.122–7.248)	0.900 (0.116–6.957)	**1.518** (1.049–2.196)	**1.542** (1.065–2.232)
Asian & Hispanic			0.891 (0.117–6.798)	0.891 (0.117–6.794)				
Hispanic	1.429 (0.971–2.105)	1.427 (0.969–2.102)			2.068 (0.687–6.221)	2.151 0.722–6.409)	1.308 (0.854–2.003)	1.287 (0.839–1.974)
MUA	**1.336** (1.079–1.656)	**1.361** (1.103–1.679)	1.119 (0.657–1.908)	1.089 (0.666–1.781)	1.349 (0.962–1.892)	**1.459** (1.051–2.025)	**1.506** (1.085–2.091)	1.402 (0.999–1.969)
Poverty 40% +	**1.388** (1.042–1.848)		0.871 (0.391–1.940)		**1.588** (1.128–2.235)		1.375 (0.452–4.187)	
Underclass		**1.473** (1.076–2.016)		0.770 (0.256–2.311)		1.422 (0.982–2.060)		**2.414** (1.158–5.032)

$n = 12{,}395$.
Note: Dependent variable is probability of an individual woman being diagnosed with Stages IIIB and IV of breast cancer. Relative risk ratios and confidence intervals are shown with ratios in bold being significant with 95% confidence.
Source: 1989–1990 SEER reporting areas for Atlanta, Detroit and San Francisco and 1990 Census Summary Tape File 3A.

Table 5
Logistic regression results for stage of diagnosis among women with breast cancer by race

Independent variables	White		Black		Asian & Hispanic	
	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)	Poverty RR (CI)	Underclass RR (CI)
Atlanta	0.963 (0.763–1.215)	0.969 (0.768–1.223)	1.288 (0.850–1.951)	1.350 (0.894–2.038)	0.628 (0.082–4.824)	0.627 (0.082–4.822)
Detroit	1.176 (0.989–1.399)	1.175 (0.989–1.397)	1.095 (0.746–1.607)	1.179 (0.818–1.700)	1.236 (0.416–3.675)	1.422 (0.513–3.938)
Age	**1.014** (1.008–1.020)	**1.014** (1.008–1.020)	1.006 (0.996–1.016)	1.006 (0.997–1.016)	1.008 (0.990–1.027)	1.009 (0.991–1.028)
Unmarried	**1.498** (1.268–1.771)	**1.498** (1.267–1.770)	1.270 (0.939–1.718)	1.287 (0.952–1.739)	0.953 (0.564–1.611)	0.968 (0.575–1.630)
MUA	**1.450** (1.032–2.037)	**1.472** (1.055–2.054)	1.233 (0.912–1.666)	1.284 (0.958–1.721)	1.690 (0.907–3.152)	1.710 (0.915–3.196)
Poverty 40% +	1.668 (0.948–2.935)		1.382 (0.974–1.959)		2.884 (0.457–18.189)	
Underclass		**1.798** (1.063–3.040)		1.367 (0.917–2.038)		1.535 (0.302–7.804)

$n = 12,395$.
Note: Dependent variable is probability of an individual woman being diagnosed with Stages IIIB and IV of breast cancer. Relative risk ratios and confidence intervals are shown with ratios in bold being significant with 95% confidence.
Source: 1989–1990 SEER reporting areas for Atlanta, Detroit and San Francisco and 1990 Census Summary Tape File 3A.

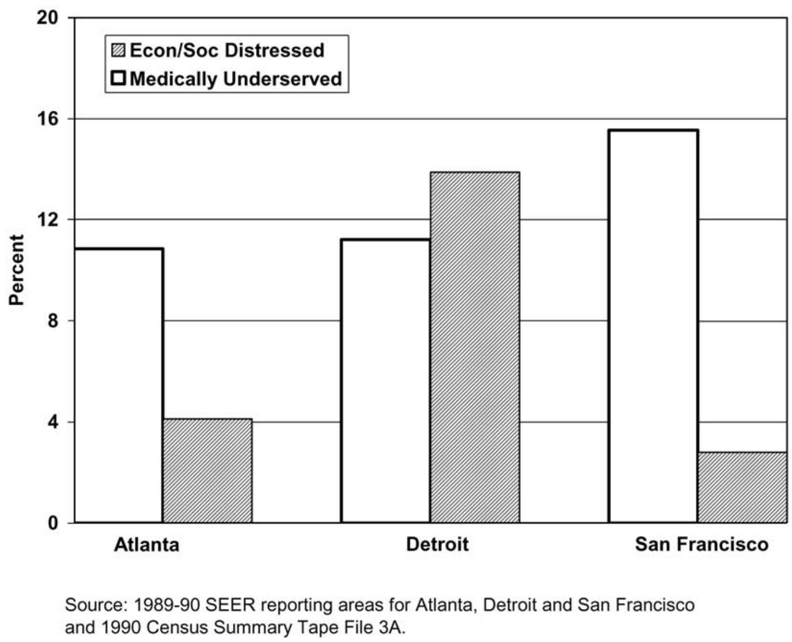

Fig. 1. Percentage of cervical cancer cases residing in medically underserved and economically/socially distressed areas.

had 3% of the sample living in economically/socially distressed tracts. San Francisco registered the highest percentage (10%) as living in MUAs, with both Detroit and Atlanta having 9% of the sample living in MUAs.

Table 4 shows that age is a consistent predictor across the model specifications. Marital status and being black both contribute to late-stage diagnosis in Atlanta. In Detroit, being unmarried, being black, and residing in an area of extreme poverty were all significant. When the underclass indicator is controlled for, MUA was significant. Asian women were at higher risk in San Francisco. Residence in an

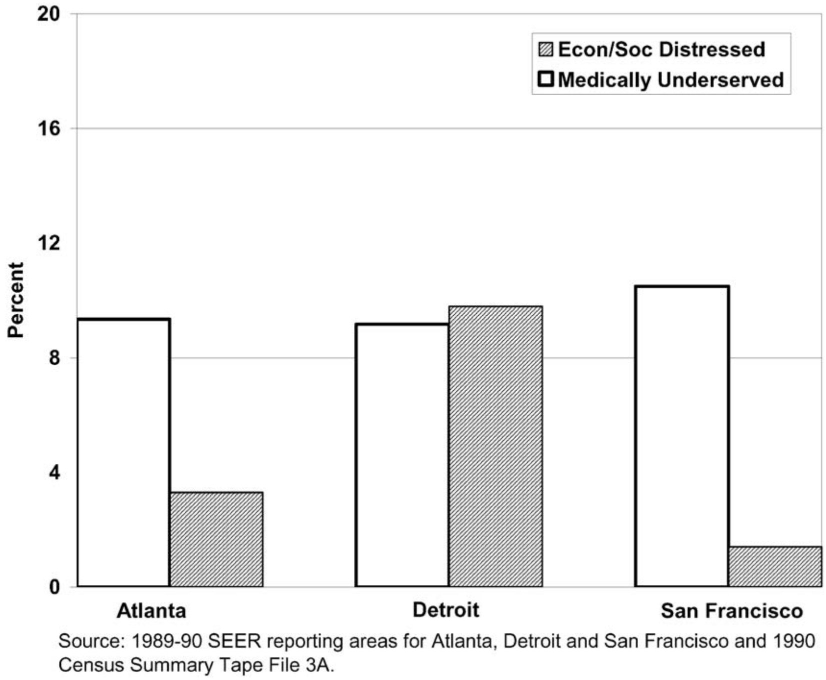

Fig. 2. Percentage of breast cancer cases residing in medically underserved and economically/socially distressed areas.

MUA for women living in San Francisco increased the late-stage probability, as did residence in an underclass tract.

Finally, in an identical fashion to the corresponding cervical cancer data, we separated the sample by racial-ethnic group into categories of non-Hispanic white, non-Hispanic black, and a grouped sample of Asians and Hispanics. About 7% of the white women in the sample were diagnosed with breast cancer at a late stage, compared to 11% for black women and 9% for Hispanic and Asian women combined (data not shown). The results by race in Table 5 show that residence in an MUA or underclass neighborhood contributes significantly to the increased risk of a late-stage diagnosis for white women, as does age and marital status. None of the variables in the model was significant in explaining the variation in disease stage among blacks or Asians/Hispanics.

Discussion

The results for these breast and cervical cancer samples show that place of residence predicts the likelihood of a woman receiving a late-stage cancer diagnosis. Underclass and extreme poverty areas were associated with later-stage diagnoses, with residence in underclass neighborhoods being particularly unfavorable for white women. Residence in an MUA was a positive predictor of stage at diagnosis in the breast cancer sample, but was only significant in the cervical cancer sample for women living in the city of Atlanta. For the other cities, it appears that because Pap smear screens are part of most routine check-ups and prenatal care, women living in MUAs are as likely to receive this screening test as other women.

City of residence was also important in our study. Characteristics specific to Detroit and Atlanta made these cities contributors to late-stage diagnosis in the cervical cancer sample. Detroit was also a predictor in the breast cancer sample. Swanson et al. (1990) also found significant differences in the early detection of breast cancer among blacks and whites in Detroit.

Of the three cities studied, Detroit was hardest hit by deindustrialization and job loss in the 1980s. It remains the most impoverished and racially segregated of the three cities in our study (Farley et al., 2000).

Our results indicate that all three neighborhood measures are useful for identifying women who may lack cancer screening services and medical follow-up in Detroit and San Francisco. In Atlanta, however, race and ethnicity were more important than residence in disadvantaged areas. There, black women in the breast cancer sample and Asian and Hispanic women in the cervical cancer sample were more likely to receive a late-stage diagnosis. In San Francisco, being Asian increased the risk of late-stage diagnosis of breast cancer. In Detroit, black women were more likely

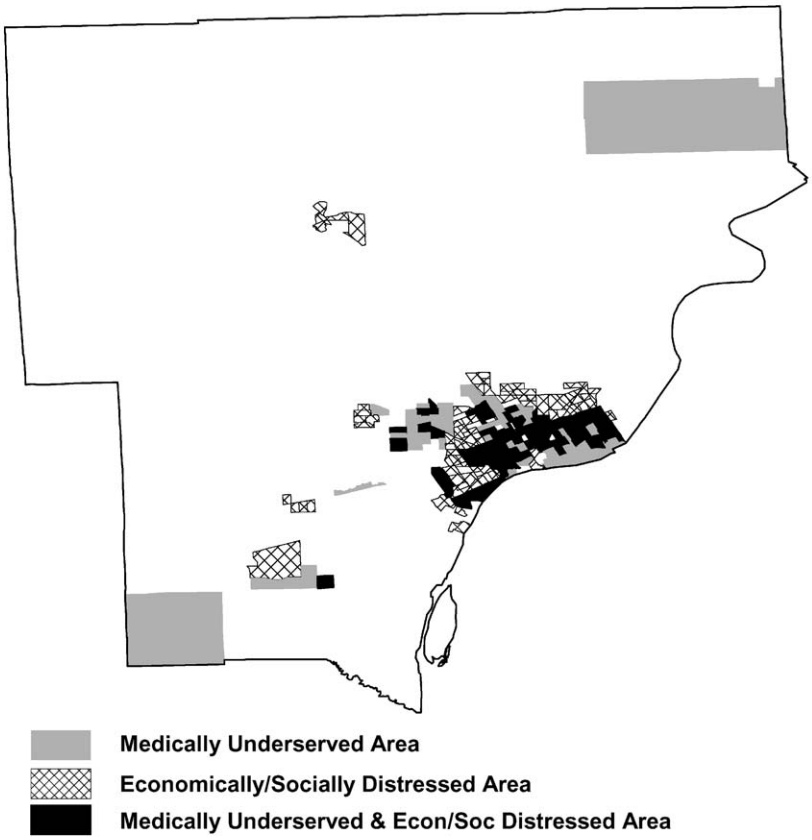

Fig. 3. Metropolitan Detroit medically underserved and economically/socially distressed areas.

to receive late-stage diagnoses for both cancers. How race/ethnicity plays an independent role in determining diagnostic outcomes depended on the city of residence. More research is needed to examine differences in the availability and delivery of health care and possible discriminatory practices against minority populations.

The logistic regressions by race and ethnicity show that city and neighborhood of residence explain a significant amount of the variation in diagnostic stage between the white sample and the grouped Hispanic/Asian sample. However, neither city nor neighborhood location of black women in our study predict the stage at which their cancer is diagnosed. The lack of significance of all variables in the black women's breast cancer sample and all variables except age in the cervical cancer sample suggests lack of variation or the "truncation of range on certain neighborhood characteristics within the black sample" which may reduce the predictive power of the variables we included (Duncan et al., 1997, p. 240).

Our paper also shows that not all areas that deserve the federal MUA designation receive it. For example, Fig. 3 shows that many Detroit Census tracts designated by our indicators as economically or socially distressed are not officially designated as MUAs. Our findings suggest they should be.

Detroit had geographically specific health care market failures, whereas San Francisco obtained federal funding for health services, including MUA designations, in excess of its economically/socially distressed neighborhoods. In this sense, San Francisco serves as a model for other cities and it would be useful to understand what systems San Francisco has in place to obtain its federal funding for underserved areas.[4]

For an area to be designated as an MUA, local or state officials must apply to HRSA on behalf of populations lacking medical resources. The designation is based on demographic data. Community and federally qualified health centers located in MUAs can use the designation to obtain grants for planning, developing, or operating their centers and/or to obtain cost-based reimbursements for medical services provided. In 1998, revisions to the criteria for designating MUAs were

[4] Detroit may reflect the "inverse care law," in which fewer resources are being provided to areas with the greatest health need (Congdon, 1995). Census-tract maps for each city are available from the authors by request.

suggested in order to incorporate major changes in the structure of the health-care market (supply side forces) and in the demographic composition of the population (demand-side forces) (US GPO, 1998). However, due to the large number of public comments concerning the changes received by HRSA, these revisions have yet to be finalized.[5]

In the cities we studied the MUA designation does not ensure that designated areas have adequate medical services. Wright et al. (1996) have made a strong argument that the population to physician ratio—a parameter in the current and proposed MUA eligibility criteria—may be particularly misleading in urban areas, where hospitals and practitioners abound but few uninsured or Medicaid patients have access to health care services. We believe that if HRSA were to incorporate the underclass and extreme poverty indicators when it revises the MUA eligibility criteria, it would provide a better indicator of health-care market access than does the population to physician ratio. The 2000 US Census data is now available for analysis, and comparison of the neighborhood indices we used in this study can be updated.

Our use of designated MUAs, allowed us to identify geographical areas in inner-cities where women were more likely to get a late-stage breast cancer diagnosis. Results from previous research led us to expect that residence in an MUA would have a negative impact on breast cancer diagnosis. Andres et al. (1996) found that residents in contiguous neighborhoods that functioned as a primary service area for urban-based, community health centers serving medically underserved and minority populations were more likely to present with advanced stage breast cancer tumors. These authors concluded that community health center patients received less intensive and effective treatment for breast cancer. Our study suggests that MUA designation does not guarantee that health clinics will routinely provide mammography services, much less follow-up services (which are outside HRSA's purview).

Analyses of health outcomes at the community and neighborhood level pose unique methodological challenges for researchers. Raudenbush and Sampson (1999) consider various methods for developing integrated measures of ecological settings for individual, family and neighborhood processes that produce less error-prone indicators. Research on the collective properties of social environments and greater use of the community as a unit of analysis for understanding morbidity and mortality are needed (National Research Council, 2001). Krieger et al. (2002), in their study of criteria for best area-based measures for cancer incidence and mortality, found that indices should be measured at the block or tract level, capture economic deprivation, and allow measurement across regions and over time. They found that economic indices and particularly those based on the federal economic poverty threshold are very robust area-based measures. The area-based socioeconomic measures that we used in three US cities meet these criteria.

The data analyzed for this study provide a view of late-stage breast cancer probabilities prior to mammography's nearly universal adoption among women aged 50–64. When screening is first introduced, disparities in cancer outcomes are likely to be exacerbated because knowledge about and access to screening is not widespread. Diffusion curve theory suggests that the extremely poor women who are the focus of our study would not be early adaptors (Viswanath and Finnegan, 1996). These factors make 1990 an especially important time to analyze disparities in late-stage breast cancer. The 2000 Census will allow a follow up analysis of late-stage breast cancer probabilities when mammography screening is already widely disseminated.

In conclusion, our findings confirm that health care markets are not oriented toward serving economically isolated or disadvantaged locations. The low profit margins in inner-city areas discourage physicians and hospitals from locating there. This limits the supply of services. Introduction of managed care capitation into the Medicaid program may exacerbate the problem further by reducing reimbursement rates.

On the demand side of the market, we expect the combination of low income and social disadvantage in the areas we have identified to reduce the health care choices available to women. Based on our findings, we believe that residents of underclass and extreme poverty areas are likely to face constraints in accessing care. Such difficulties lead to lost opportunities for diagnosing cancer early in poor and underserved communities. Targeted screening interventions in economically and socially distressed areas are both necessary and desirable (Anderson et al., 2003).

[5] In the proposed changes, designation scores would be based on the population to primary care practitioner ratio; the infant mortality rate; the percentage of the population that is Hispanic, a racial minority, or linguistically isolated; the percentage of the population residing in an area of low population density; and the percentage of the population with income less than 200% of the federal poverty level. Under the new guidelines, it is estimated that 65% of all urban counties would be designated as MUAs and Health Professional Shortage Areas. Approval of the regulations that would implement the new guidelines has been significantly delayed, however, because of concerns that certain states or localities would lose MUA designation and therefore funding.

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