Neighborhood Characteristics and Influenza Vaccination Rates in Medicare Beneficiaries over age 65 years:

A Study of North Carolina Residents

By

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I. INTRODUCTION

Influenza epidemics have been responsible for approximately 36,000 deaths per year in the United States from 1990 to 1999. This number has risen since the 1976-1990 estimate of 19,000 influenza associated deaths per year. This alarming statistic might in fact not be due to rising death rates from influenza infection, but instead due to the increasing number of elderly persons in the United States. However, strains of influenza associated with higher mortality (serotype A [H3N2]) predominated in 90% of influenza seasons from 1990-1999, compared to 57% of seasons from 1976-1990. Persons over age 65 years and those with illnesses placing them at risk for complications from infection have the highest rates of death and serious illness from influenza. Rates of infection with the influenza however are highest among children.

Influenza vaccination, the primary method for preventing influenza and its complications, is recommended annually for target groups defined by the Advisory Committee on Immunization Practices (ACIP). These groups include, first, those at increased risk for influenza-related complications. These are persons age 65 years or older, residents of nursing homes and chronic care facilities, and persons of any age with chronic pulmonary cardiovascular conditions. Secondly, the ACIP recommends vaccination of all persons age 50-64 because of the elevated prevalence of high-risk chronic medical conditions. Approximately 29% of all persons in the U.S. in the year
2000 had at least one high-risk medical condition. Lastly, persons who live with or care for persons at high risk are recommended for vaccination due to their ability to transmit influenza to other persons at high-risk for complication. This includes health care workers, employees of chronic care facilities, home health workers and household contacts of high risk persons.¹⁰

**Influenza Vaccination Rates**

Influenza vaccination rates have been steadily increasing, but have not reached the recommended 90% coverage level recommended by Healthy People 2010. In persons age 65 years and over influenza vaccination levels have risen from 33%¹¹ in 1989 to 68% in the year 2000¹². These data represent the percentage of adults reporting influenza vaccination within the last year and who participated in the National Health Interview Survey (NHIS), and represent a “proxy measure” of actual influenza vaccine coverage levels.¹³ Current data for the year 2001 show that rates had dropped slightly to 64%, however this was likely due to delays in vaccine supply. Estimated rates for the year 2002 (67%), when fewer vaccine delays occurred, are similar to the year 2000 rates. Improvements in influenza vaccine coverage have been attributed to (1) greater public acceptance of preventive medical services; (2) improved vaccination administration by both health care providers and by sources other than medical providers; (3) additional information regarding vaccine safety; and (4) changes in Medicare reimbursement for influenza vaccination in 1993.
For persons aged 50-64 years, rates have also increased, and in the year 1999 reached a high of 38%. After a similar decline in rates in the year 2000 due to vaccine delays, rates are estimated to increase to 35% in the year 2001, from 32% in the year 2000.  

Improvements in the influenza vaccine coverage rates are needed in all populations, however, they are mostly needed in high risk persons aged 50 to 64 years, and among Black and Hispanic persons over the age of 65 years. Although influenza vaccination rates reached an all time high in 1999, vaccination rates for Black and Hispanic populations are substantially lower than for the white population. 15 16 In 2001, the estimated influenza vaccination rates for non-Hispanic white persons over age 65 was 70%, for non-Hispanic blacks was 52%, and for Hispanics was 47%. 17

**Disparities in Vaccination Rates**

The differences or disparity in vaccination rates for influenza between minority populations are clear. Blacks especially are less likely than whites to receive influenza vaccinations. 18 The reason or reasons for this disparity are less clear. Factors that may contribute to lower vaccination rates include poverty, lack of health insurance, education, lack of community support, as well as any language or culture barriers. 19

In a study by Marin et al (2002) of 2,309 persons using Medical Expenditure Panel Survey (MEPS) data, vaccination rates in blacks were seen to be significantly less than in whites. The influenza vaccination rate was
68% among whites and 47% among blacks with an odds ratio (OR) of 0.42 (95% CI 0.29-0.61). Factors that were seen to be significant determinants of both current influenza vaccination and were seen to be associated with race in persons over age 65 included: age, health risk, perceived health status, family size, poverty category, and number of provider visits. Stratification of data by each variable using Mantel-Haenszel chi-squared in each case failed to alter the association of race and current vaccination status. The authors were therefore not able to attribute lower vaccination rates in Blacks to these factors, and hypothesized that other factors were involved in creating the disparity.²⁰

A previous study by Mark and Paramore (1996) using data on 9,425 adults from the Medicare Current Beneficiary Survey showed a significant association between influenza vaccination and education, marital status, income, insurance status, poor health status, and being interviewed in Spanish in persons over age 65 years. These factors were also shown to be more common in minority groups as compared to whites. This study did not examine, however, whether these factors were confounders of the relationship between race and vaccination status.²¹

In a 1998 study of 26,469 adults using Behavioral Risk Factor Surveillance System (BRFSS) survey data, factors found to be correlated with influenza vaccination levels included education, length of time since last check up, and self-reported index of health. The influenza vaccination rate for whites over age 65 years was 67%, while for blacks it was 50%. Lower
vaccination rates in blacks were not found to be explained by differences in age, sex, education level, health care access, or perceived health status.  

The most recent study to date by Egede et al used National Health Information Survey (NHIS) data to study 1,906 individuals with diabetes mellitus to assess whether differences in access to care, health insurance coverage and socio-economic status (SES) explained racial differences in vaccination rates. This study by Egede et al is unique among studies of vaccination rates in that more than 2 racial categories were used. Although a total of 4 racial/ethnic groups were compared, it was shown that disparities in influenza vaccination rates between whites and non-whites are largely due to differences between whites and blacks. Influenza vaccination rates for whites were 55% and 39% for blacks. Odds ratio for influenza vaccination for whites compared with blacks was 1.6 (95% CI 1.1, 2.3). Race was found to be an important predictor of influenza vaccination, independent of access to care, health coverage, and SES. These results suggest that race is a proxy for a currently unmeasured or unidentified variable, which may be difficult to identify without additional data on race/ethnicity, social and cultural factors that may potentially affect health outcomes. Recent discussion in the literature has suggested that disparities in vaccination rates may be caused by either unequal access to care, social/cultural values that result in differing acceptance of vaccination services, and/or unequal rates of recommendation of vaccination by physicians. The study by Egede et al effectively shows
that disparities in vaccination rates (in diabetics) are independent of access to care.

**Neighborhood Characteristics and Health**

Recent studies have linked neighborhood risk factors and health outcomes. For example, O’Campo et al (1997) linked both individual risk factors (maternal age, education, insurance, prenatal care) and neighborhood or community variables (home ownership, crime rates, community activism, unemployment) to low birth weight, and showed that individual level risk factors behaved differently depending on neighborhood characteristics.\(^\text{25}\) In fact, individual level factors have only been able to explain a small proportion of the overall variability seen in birth weight.\(^\text{26}\) Increasingly, it is being recognized and more research is focusing on community and environmental factors that contribute to risk in both low birth weight\(^\text{27}\) and overall health.

Overall mortality risk has also been linked to neighborhood characteristics. In a study by Yen and Kaplan (1999) using data from the Alameda County Study (n=1,129), mortality risk was found to be significantly higher in neighborhoods with low social environment (OR 1.6, 95% CI 1.2, 2.2). When components of the neighborhood social environment (income, occupation, population crowding, housing, commercial stores) were examined separately, each was found to be associated with a higher mortality risk independent of individual risk factors. This supports the notion that
characteristics of the individual cannot fully describe the characteristics of the physical and social environment.

**Neighborhood Characteristics and Influenza Vaccination**

The amount of research in this area is minimal, but some studies have focused on the rates of influenza vaccination among different neighborhoods. Millar et al (1998) found that vaccination rates were higher in urban practices in the U.S.\(^{28}\) A Dutch study found that the level of urbanization was a strong predictor of vaccination rates in the Netherlands, \(^{29}\) with vaccination rates being lower in urban areas. In diabetic persons over age 65 years, odd ratio for influenza vaccination in urban (large city) areas was 0.45 (95% CI 0.3, 0.66) and in (small) urban areas was 0.60 (95% CI 0.41, 0.87) when compared to rural areas. This difference is likely due to differences in vaccination practices between the United States and The Netherlands, with the Dutch carrying out immunizations primarily in small family practices throughout the country, versus the more centralized approach taken in the U.S. The study outcomes were not adjusted for socio-economic status due to lack of data, however, in The Netherlands no disparities in vaccination rates have been found. \(^{30}\)

A large body of literature suggests that many health come are influenced by characteristics of individuals. Some of these relations are so pervasive and persistent that certain individual-level characteristics such as race, gender, age, and education are frequently included as confounding and
explanatory variables in public health research investigating relations between risk factor exposures and disease. However, this is not the whole story. Groups of individuals form populations that have their own unique characteristics determined by culture, environmental exposures, health systems, political conflict, race, inequalities, economics, and social support to name a few. Many of these population-level or contextual factors have been shown to influence health in a manner that is statistically independent of individual-level characteristics. So health is influenced not only by who you are but also by where you live.

In practice, it is impossible to completely separate the effects of individual-level and population-level factors on health because they operate in a mutually dependent and interactive manner. Studies performed at the level of the individual examining only characteristics of individuals may miss important contextual determinants of health. Ecologic studies have the strength of measuring the health effects of individual characteristics modified by neighborhood environment.

A consideration of the joint effects of individual-level and contextual factors is especially relevant to the study of racial disparities in health. It has been suggested that race is a social construct without clear biologic meaning. Furthermore, in a society economically and socially stratified by race, race is a powerful determinant of individual characteristics such as income and education. Investigations of racial disparities in health examining only individual-level characteristics will fail to account for powerful social factors
that result from discrimination, prejudice, and the geographic and/or economic segregation of relatively disadvantaged racial groups.

The studies cited previously demonstrate that Black persons are substantially and persistently less likely to receive influenza vaccinations compared to their Caucasian counterparts. It has been shown in the current literature that individual level factors such as sex, education level, income, health care access or perceived health status, access to care, health insurance status, and SES do not account for differences in vaccination rates between whites and blacks. Thus, the question remains, what accounts for these striking disparities. They may be explained by racial disparities in yet-to-be determined individual-level risk factors. But it also is quite likely that these disparities are related to characteristics of the different neighborhoods where these race groups tend to reside. Neighborhood factors help “shape individual vulnerability and resistance to risk factors for health.”

In this study we aim to explore the relationship of potential community or neighborhood factors to influenza vaccination rates in North Carolina. We hypothesize that neighborhood characteristics – specifically income, wealth, education and employment – influence the vaccination rates of individual living within that community. This is the first study to examine such factors and how they relate to racial disparities in influenza vaccination. It is our aim to determine whether community characteristics are related to existing disparities. Such community or neighborhood factors are in part the sum of individual level factors of persons living in the community, however have
meaning only at the population level. In this study we use socio-environmental indicators from census data to characterize neighborhoods and relate these to neighborhood influenza vaccination rates and examine the extent to which they are associated and provide insight into the underlying reasons for disparities in influenza vaccination rates between black and white populations.

METHODS

Influenza vaccination status and address were determined from data from Medicare administrative data on individual enrollees. Addresses were placed in census tracts through geo-coding. Commonly used indicators of socio-environmental conditions were determined from U.S. Census data according to Census tract and assigned to individuals based on their places or residence.

Medicare Data

All Medicare data were accessed within Medical Review of North Carolina (MRNC). These data are routinely provided to MRNC from the Centers for Medicare and Medicaid Services (CMS) as part of MRNC's contract as the state's Medicare Quality Improvement Organization (QIO). Data from the 2001 North Carolina Medicare denominator file was used to identify enrollees, their demographic characteristics, and their address. Influenza vaccination status was determined by the presence of at least one
administrative claim filed by health care providers on behalf of these beneficiaries for re-imbursement of this service during the year 2001. Flu shot administration was defined as having a paid flu vaccination claim from July 2000 to June 2001. Medicare enrollees were then geo-coded to U.S. Census tracts using their primary mailing address with MapInfo (Troy, NY).

Race categories used in this study were based on those currently used by the Centers for Medicare and Medicaid Services (CMS) formerly known as the Health Care Financing Administration (HCFA). In 1994 HCFA expanded its race categories from three categories (Black; White; other – and unknown) to six (Black; White; Hispanic; Asian American or Pacific Islander; North American Indian; other – and unknown). 32

Census Data

Tract level neighborhood information was obtained from the 2000 U.S Census file. For the purposes of this paper, we will refer to U.S. Census tracts as neighborhoods. Data elements included population size, race, income (median household income, per capita income, median household value), educational attainment (percent completing high school), and unemployment. These data were obtained from the 2000 U.S. Census long-form CD created by Geolytics, Inc. (East Brunswick, NJ).

All information regarding U.S Census variables was provided by the 2000 U.S. Census of Population and Housing, Summary File 3 Technical Document.33 Household income related to total income of persons 16 years
and older in 1999, reported as the sum of wage or salary income, self-employment income, interest received, social security, retirement, welfare or public assistance, or disability income. Excluded from household income are: income from sale of property, food stamps, loans, tax refunds, gifts or inheritance. Median household income is based on the total number of households including those with no income and is computed on the basis of a single standard distribution.

Household value was based on specified owner occupied and vacant for sale housing units and included only 1-family houses on less than 10 acres without a business or medical office on the property. Mobile homes and multi-unit buildings were excluded. Values were obtained from census survey respondents estimating the value of the house and lot if it were for sale and vacant for sale property values.

Educational attainment was reported for persons 25 years or older and the highest level or degree reported was recorded. Educational attainment of the neighborhood was assessed by taking the total number of males and females over 25 years reporting less than a high school education divided by the total number of males and females over age 25 years in the census tract. Missing values were assigned the educational attainment of persons of the same age, sex, race and occupation living in the same area, if possible.
Linkage of Medicare Data and Census Data

Medicare enrollee data including individual flu vaccination status was linked to U.S. Census neighborhood characteristics data by U.S Census tract number. Those with a geo-coded outcome of ‘single close match’ were defined as being reliably geo-coded. ‘Single close match’ indicated that the record was matched to a single address candidate from the Address Dictionary. Records not identified as ‘single close match’ included those with no direct match, those with more than one close match candidate address, and those matched to P.O. Box or rural route addresses. Beneficiaries were then assigned characteristics corresponding to their neighborhood socio-environmental characteristics such as wealth, income and educational attainment which was obtained from U.S. Census data.

Statistical Analysis

All data was analyzed using SAS v8.2 (Cary, NC). Neighborhood variables were chosen based on both individual level factors currently used in influenza vaccination studies and widely used indicators of socio-environmental conditions previously related to health outcomes and health services in non-flu studies. Pearson and spearman correlation coefficients were computed for relationship between influenza vaccination and neighborhood variables. Stratified analyses were done using ordinal variables created from equal intervals based on the ranges of continuous variables.
RESULTS

Medicare Population

The study population included approximately 1 million North Carolina residents enrolled in Medicare in the year 2001. After excluding persons younger than age 65 years (n=169,203) (17%) and those without a single close match during the geo-coding process (n=134,924) (14%), 720,312 residents were remaining. These individuals resided in 1,555 of the 1,563 possible census tracts within North Carolina. The mean tract population of Medicare beneficiaries was 466 (median 426) with a range of 1 to 3159.

The baseline population characteristics are presented in Table 1. Overall 63% of the North Carolina Medicare beneficiary population resided in an urban setting, while 37% in a rural setting. Approximately 60% of the population was female and 40% was male. The mean age was 74.9 years. The majority of the population was white, 84%, with blacks constituting 15%, Asians 0.4%, Hispanics 0.1% and Native American 0.1%. Due to small overall numbers in racial groups other than whites or blacks, all races except white and black were excluded from the analysis. The remaining population used for analysis was 711,675 or 71% of the original Medicare population.

The overall influenza vaccination rate based on Medicare beneficiary claims of all races was 43% (Table 1). That includes 308,610 persons over age 65 years who received an influenza vaccination in the 2001 influenza season. The influenza vaccination rate for white beneficiaries was 46% and
for black beneficiaries was 24%. The vaccination rate for the white population was almost twice that of the black population. No confidence intervals are reported because there is 100% sampling of the Medicare population. The risk ratio (RR) for influenza vaccination for black beneficiaries is 0.52 and the risk difference (RD) 0.22. The overall vaccination rate for the other racial groups excluded from analysis was 27.2%.

Neighborhood characteristics obtained from the 2000 U.S. Census are summarized in Table 2. Average median household income for all North Carolina neighborhoods was approximately $39,000. Average median household value was approximately $108,000. The average number of persons with less than a high school education (educational attainment) was 23% of neighborhood residents.

**Stratified Analysis**

Vaccination rates were determined for tracts grouped with strata of tract-level income, wealth, educational attainment, employment rate and level of urbanization. For each of these socio-environmental indicators, tracts were categorized using ordinal variables based on 10 equal intervals within the range of their statewide distributions. In the rare case of inadequate numbers of observations, the strata were either combined with adjacent strata or dropped.

Overall vaccination rates when stratified by neighborhood median household income showed that as income increased influenza vaccination
rates ranged from 0.28 to 0.49 (Figure 1). For the overall population and for whites, vaccination rates increased monotonically with median income for low to medium income ranges ($14,000-$86,000). Vaccination rates changed little or declined slightly with increasing income at higher income levels (0.49 to 0.47). There is no clear relation between vaccination rates and median income for Blacks. At income levels of $86,000 or less, vaccination rates for Blacks varied little (0.22 to 0.23). Vaccination rates for this population were higher than average in the highest three median income strata.

After stratification by neighborhood median household value, an indicator of population wealth, (Figure 2) overall influenza vaccination rates increase from 0.31 to 0.50 as median household value increases, however, this only holds true for low to medium median household value ranges ($61,000 to $244,000), at which point vaccination rates plateau. Within median household value strata, influenza vaccination rates differ substantially by race and large racial disparities persist at all levels of median household value. At higher median household value ranges ($427,000-$549,000) influenza vaccination rates begin to increase from 0.48 to 0.58 for whites, however there are too few African Americans in these higher household value strata to evaluate this relationship at the highest values.

Neighborhood educational attainment is directly related to overall influenza vaccination rate except for the two strata of lowest educational attainment. (Figure 3). As the percent of the population with less than a high school education increases, overall influenza vaccination rates decrease.
Influenza vaccination rate decreases from 48% to 25% as percent with less than a high school education increases from 0% to 54%. This relationship holds true for all neighborhoods except the highly uneducated communities (>54% with less than high school education). No clear trend is seen in the Black population, however, and substantial disparities between black and white populations persist in each strata.

**DISCUSSION**

The results of this study demonstrate that disparities continue to exist in the utilization of medical services, specifically influenza vaccination, among Medicare beneficiaries in the year 2001. This is the first study known to examine neighborhood factors in relation to influenza vaccination among Medicare beneficiaries in North Carolina. In our study, neighborhood or community variables do not seem to fully explain the differences in influenza vaccination rates between blacks and whites. There is therefore some other factor or factors which contribute to lower influenza vaccination rates among black beneficiaries.

These results are consistent with current literature that have examined individual level characteristics such as income, education, access to care, and other individual level variables and found that disparities exist despite adjusting for these factors. After adjusting for similar neighborhood level characteristics we have found that disparities in vaccination rates between blacks and whites persist. Current studies of neighborhood and community
factors have found that these variables do influence health, i.e. all-cause mortality\textsuperscript{34}, low-birth weight\textsuperscript{35}, depression\textsuperscript{36} and perceived health status\textsuperscript{37} among others. We have found that persons living in areas of low income/wealth and areas of low educational attainment are less likely to receive an influenza vaccination. Black persons are more likely to live in areas of low wealth and education in North Carolina and are therefore expected to have lower influenza vaccination rates. Therefore if neighborhood socio-environmental characteristics were the only cause of disparities and they were controlled for the differences in rates would vanish or be greatly reduced in both wealth and poor neighborhoods. This is not the case. It is evident that disparities in influenza vaccination rates persist in all strata of median income, wealth and educational attainment. Therefore this study shows that neighborhood conditions as measured by our socio-environmental indicators are not substantially related to disparities in influenza vaccination rates. Although they may be somewhat related, the disparities are occurring for other unknown reasons.

This study uses Medicare influenza reimbursement claims to assess vaccination levels and more importantly the differences in vaccination rates between blacks and whites. Other studies have also used non-HMO, Medicare part B forms to examine influenza vaccination rates of populations in the United States. Studies using Medicare claims forms typically report lower overall vaccination rates than studies using survey data. Reasons for lower overall vaccination rates include the possibility that not all providers
submit claims for Medicare reimbursement upon vaccination and that some potential recipients of influenza vaccination are not covered by Medicare. The failure to submit claims to Medicare for influenza vaccination reimbursement however is not known to differ between blacks and whites. Therefore, examining the vaccination rates among Medicare beneficiaries should accurately measure the disparities evident between blacks and whites.\textsuperscript{38}

This study found that the difference in vaccination rates between blacks and whites was 22\% (\pm SE 0.19). Recent studies using survey data have found similar differences. Marin et al using the 1996 Medical Expenditure Panel Survey (MEPS) (n=2,309) found a 21\% difference. Edege and Zheng found a 16\% difference between blacks and whites using the 1998 National Health Interview Survey (n=1,906). Using the 1996 Medicare Current Beneficiary Survey (MCBS) (n=13,674), Schneider et al found a 22\% difference in vaccination rates. The largest study used the 1997 Behavioral Risk Factor Surveillance System (BRFSS) survey (n=26,469), where researchers at the Centers for Disease Control and Prevention (CDC) found a 17\% difference in vaccination rates between blacks and whites. Although overall vaccination rates using claims data fall short of the reported rates from survey studies, the difference in vaccination rates between racial groups is similar.

Although Medicare has in effect removed the financial barriers to physicians and hospital services, it is unclear why disparities persist in this population. First, it is apparent that disparities in health outcomes by race are
not a feature unique to the Medicare population. Studies of the use of services in the Department of Veterans Affairs (VA) programs show similar disparities. There is evidence that Medicare managed care enrollees have higher rates of influenza vaccination than Medicare enrollees in fee for service plans. However the racial disparity in vaccination among those in the managed care plan is not reduced, indicating that the type of Medicare insurance is not a significant factor in creating disparities.

In addition, the cost-sharing that is required by some Medicare programs is not likely a factor affecting influenza vaccination rates due to the lack of coinsurance required for vaccination in the elderly.

It is known from current research that the difference in vaccination rates between blacks and whites is independent of education, access to care, health insurance coverage and socio-economic status. Factors that may contribute include social or cultural factors resulting in unequal acceptance rates between races. These include limited awareness of the need for vaccination, misconceptions regarding vaccination costs, adverse affects, risks, and/or benefits of vaccination. Other factors include the knowing or unknowing failure of physicians to recommend vaccination based on race, and as yet unknown factors for which race is a proxy.

Barriers to influenza vaccination are likely dependent on both the individual and the social/cultural background of the community where individuals live. The most common explanations cited by Medicare beneficiaries for not receiving an influenza vaccination include: not knowing
it was needed (21%); thought vaccination could cause the flu (18%); thought
the vaccination could have adverse affects (15%); did not think the
vaccination would prevent the flu (15%); and did not remember or forgot
about it (13%). Lack of recommendation by the physician (6%), and
specific recommendation against vaccination by the physician (6%) were also
cited but not as common. Cost of vaccination and difficulty reaching areas
providing vaccinations were listed by < 2% of beneficiaries. Racial/ethnic
differences were apparent in three of eight categories cited by > 10% of
beneficiaries who did not receive vaccination. Minority groups were more
likely than whites to cite not being aware of need for vaccination (OR 1.8
95%CI 1.3, 2.3) and lack of physician recommendation (OR 0.5 95%CI 0.2,
0.9). These differences were only significant however for Hispanics and other
minority groups in relation to pneumococcal vaccination.47

Attitudes and beliefs of individuals no doubt play a significant role in
the choices and preferences made regarding health care. Anecdotal evidence
suggests that individuals who are poor and minority groups are more
suspicious of the value and safety of vaccines compared to more advantaged
persons.48 Historical reports regarding the Tuskegee experiment may
contribute to this sentiment among some black persons toward the medical
establishment.49 Other notions such as the ‘culture of poverty’ where pain is
seen as more of a part of life, fatalism is a more accepted outlook, and self-
initiated services are utilized less may contribute, at least partly, to lower rates
of vaccination in addition to lower health outcomes.50 The complementary
theory of the 'culture of advantage' where socially advantaged individuals expect the best medical services and utilize networks of socially advantaged peers to obtain information on medical practitioners, institutions, and diagnostic tests and procedures, may also contribute to disparities.\textsuperscript{51}

The health care system and specifically the behavior and recommendations of physicians likely play a role in health outcomes. Documented disparities in physician recommendation of cardiac revascularization by racial group exist and are one example of the influence physicians have in the health care system and how they contribute to creating disparities in health outcomes.\textsuperscript{52} The differing recommendations made by physicians are influenced by stereotypical beliefs regarding the behavior of minority and disadvantaged persons regarding for example their likelihood to return for follow up appointments or their ability to adhere to a complex course of treatment or recommendation.\textsuperscript{53} The culture of physicians, however, is changing from mostly upper middle class, white males trained only in the treatment of disease to a more representative demographic with training in and assistance from interdisciplinary fields.

Recommendations for the elimination of disparities in health care outcomes include the need for broad based research and experimentation with a focus on data development. The ability to assess health care service utilization and health care outcomes lies on the ability to identify and monitor vulnerable subgroups. Increased awareness of disparities in health care is needed by leaders in the medical community and in the major professional
societies and their recommendations on how best to eliminate disparities. Finally with little knowledge of the reasons that create differing health outcomes between races it is difficult to know what changes to recommend, however it is clear that initiatives need to be aimed at both the beneficiaries as well as all those who provide health care.\textsuperscript{54}

An important feature of this study was the linkage of Medicare claims data identifying those beneficiaries whom received influenza vaccinations and whom had residences which allowed geo-coding to specific U.S Census tracts. The limitation inherent with this ability is that not all beneficiaries residences' were able to be geo-coded to Census tracts with complete certainty. However, for those that were geo-coded and linked to U.S. Census tracts, studies have shown it to be very accurate and suitable means for epidemiological research.\textsuperscript{55} Studies have also validated the use of aggregated information of socioeconomic status obtained from the census as a proxy for data on the socioeconomic status of both individuals and the areas in which they live.\textsuperscript{56, 57, 58, 59} Other strengths of this study include the 100\% population sampling which translates to no sampling error and therefore no need for hypothesis testing or p-values. Both the large number of individuals included in this study as well as the large bi-racial population living in similar geographic conditions are a strength of the study. The cross-sectional design of the study allows for detection of both population level and individual factors.

Limitations of this study include the under-reporting of overall influenza vaccination rates due to using Medicare claims data. This should
not affect the difference in vaccination rates seen between blacks and whites. The small number of Hispanic as well as Asian and Native American beneficiaries enrolled in Medicare within North Carolina did not allow observations of differences in rates between these races to be made. The cross-sectional design of this study does not allow independent effects of population level and individual level factors to be distinguished. In addition, potential confounding/explanatory factors related to disparities such as individual patient co-morbidities, are not considered here. This analysis included only bivariate relationships. Future research such as multi-level modeling techniques using both individual level and contextual data would better explore these relationships, however, such individual level data is not readily available for Medicare beneficiaries. Census data on neighborhood characteristics was obtained through sampling a small number of individuals in each tract. Sampling error of census data was not controlled for in this study. Data from North Carolina Medicare beneficiaries may not be generalizable to other populations within the United States or to younger populations under age 65 years.

In conclusion, it is clear that black Medicare beneficiaries over 65 years old in North Carolina were significantly less likely to receive influenza vaccinations relative to whites. This is consistent with both the current literature as well as previous studies examining Medicare beneficiary influenza vaccination rates. Racial disparities in influenza vaccination rates are still substantial after controlling for neighborhood income, wealth as well
as educational attainment. These findings together with those of previous studies suggest that the low vaccination rates of black Medicare beneficiaries are better explained by barriers to care other than those typically associated with individual and population level income, wealth and education. Further studies are needed to better characterize these barriers and explore the cultural and ethnic differences between races which may contribute to differing health outcomes.
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<td>Native Am</td>
<td>21.61</td>
<td>268</td>
</tr>
<tr>
<td>Other</td>
<td>25.74</td>
<td>753</td>
</tr>
<tr>
<td>Unknown</td>
<td>34.15</td>
<td>305</td>
</tr>
</tbody>
</table>
Table 2: Descriptive characteristics of Census tracts.

<table>
<thead>
<tr>
<th></th>
<th>Tract Means</th>
<th>std dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>5149.9</td>
<td>2,614</td>
</tr>
<tr>
<td>Urban</td>
<td>62.60%</td>
<td>41.8</td>
</tr>
<tr>
<td>White</td>
<td>68.80%</td>
<td>25.5</td>
</tr>
<tr>
<td>African Am.</td>
<td>24.10%</td>
<td>24.1</td>
</tr>
<tr>
<td>Mean Tract Influenza Vaccination Rate</td>
<td>40.70%</td>
<td>11</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>$38,996.00</td>
<td>15,709</td>
</tr>
<tr>
<td>Per capita Income</td>
<td>$20,058.00</td>
<td>8,622</td>
</tr>
<tr>
<td>Poverty Rate</td>
<td>13.80%</td>
<td>9.6</td>
</tr>
<tr>
<td>Median Household Value</td>
<td>$108,286.00</td>
<td>55,778</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>3.70%</td>
<td>3.2</td>
</tr>
<tr>
<td>Level of Urbanization</td>
<td>62.60%</td>
<td>41.8</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>&lt;HS 23.20%</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>HS 28.40%</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>&gt;HS 48.40%</td>
<td>18.3</td>
</tr>
<tr>
<td></td>
<td>(&gt;College) (21.90%)</td>
<td>(17.1)</td>
</tr>
</tbody>
</table>

*<HS – Less than High School Education; HS – Obtained High School Diploma; >HS – More than a High School Education; >College – More than a College Education*
Figure 1. Neighborhood Median Household Income and Influenza Vaccination Rate among Medicare beneficiaries over age 65 years (unadjusted).
Figure 2. Neighborhood Median Household Value and Influenza Vaccination Rate among Medicare beneficiaries over age 65 years (unadjusted).
Figure 3. Neighborhood Educational Attainment and Influenza Vaccination (unadjusted). Educational Attainment measured as percent with less than High School Education.
Neighborhood Characteristics and Influenza Vaccination Rates in Medicare Beneficiaries over age 65 years: a Study of North Carolina Residents.

Figure 4: Possible pathway for neighborhood socio-economic conditions to disparities in influenza vaccination rates.
Ed Bridgeford, University of North Carolina, Chapel Hill, NC

**Objective:** To examine whether neighborhood characteristics are related to disparities in influenza vaccination rates among older black and white Medicare beneficiaries.

**Methods:** All North Carolina Medicare beneficiaries at least 65 years of age in 2001 were identified and linked to administrative claims for influenza vaccinations from their health care providers. Those with valid street addresses were geo-coded and located in Census tracts. Tract-specific influenza vaccination rates were determined and associated with neighborhood socio-environmental characteristics obtained from the 2000 Decennial Census.

**Results:** 720,321 Medicare beneficiaries over age 65 years were reliably geocoded to U.S. Census tracts in North Carolina. The influenza vaccination rate for whites was 46% (± SE 0.06%) and was 24% (± SE 0.13%) for blacks. The influenza vaccination rate was significantly lower for blacks. Adjustment for neighborhood characteristics including median household income, median household value, educational attainment, unemployment rate and level of urbanization failed to change this difference in vaccination rates.

**Conclusion:** In 2001, black Medicare beneficiaries over 65 years old in North Carolina were significantly less likely to receive influenza vaccinations relative to whites. Racial disparities in influenza vaccination rates were not explained by differences in neighborhood factors.
REFERENCES

18 Schneider EC, Zaslavsky AM, Epstein AM. Racial Disparities in the Quality of Care for Enrolles in Medicare Managed Care *JAMA* 2001;287(10):1288-94(9-15)
29 Tacken M, Braspenninck J, Spreeuwenberg P, van den Hoogen H, van Essen G, de Baker D, Grol R. Patient Characteristics Determine Differences in the


38 Centers for Disease Control and Prevention *MMWR* 1995 44:24-27,33.


40 Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM Racial Disparity in Influenza Vaccination: Does Managed Care Narrow the Gap Between African Americans and Whites? *JAMA* 2001;286(12):1455-60.

41 Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM Racial Disparity in Influenza Vaccination: Does Managed Care Narrow the Gap Between African Americans and Whites? *JAMA* 2001;286(12):1455-60.


45 Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM Racial Disparity in Influenza Vaccination: Does Managed Care Narrow the Gap Between African Americans and Whites? *JAMA* 2001;286(12):1455-60.


