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Mortal Realities of Health Care: The Relationship between Health Care Resources and Mortality

Spatial patterns of mortality in the U.S. have been established in previous research (Cossman et al. 2007). Race, income, and other shared characteristics of a geographical area have been investigated as potential covariates of mortality rates in attempts to explain this spatial autocorrelation (Cossman et al. 2003; James and Cossman 2006; McLaughlin and Stokes 2002; Shi et al. 2005; Yen and Kaplan 1999; Zenk et al. 2005). Areas with higher income inequality are more likely to have higher mortality rates than areas with lower income inequality (McLaughlin and Stokes 2002). Mortality rates are also more likely to be higher in areas with a higher concentration of African-Americans (Cossman et al. 2003; McLaughlin and Stokes 2002).

Access to resources has been identified as influential to health, and it has been argued that spatial patterns of health inequalities are based on the unequal distribution of resources (Macintyre and Ellaway 2000). I apply this argument to spatial patterns of all-cause mortality as it is viewed as a general indicator of health (Lynch et al. 2004; Starfield et al. 2005). In order to expand upon spatial covariates of all-cause mortality, I examine the distribution of healthcare resources, namely primary care physicians, nurse practitioners, specialists, and pharmacies, as these are economic and institutional indicators of the social environment (Bernard et al. 2007).

The unequal distribution of physicians across the U.S. has been well-established (Goodman and Grumbach 2008). Lower mortality rates have been found in areas with a greater number of primary care physicians than areas with higher mortality rates, yet this association does not hold true when examining the number of specialists (Starfield et al. 2005). Primary care providers, namely primary care physicians and nurse practitioners in this study, serve as the infrastructure of the healthcare system (James and Cossman 2006), and are therefore key when considering access to healthcare resources. Primary care physicians refer to physicians who specialize in general medicine, family medicine, internal medicine, pediatrics, or obstetrics/gynecology. Nurse practitioners are essential to primary care as they provide care in areas with fewer physicians and thus help minimize access to care issues (Krein 1997). Specialists account for more than one half of the physician workforce and are more likely to be practicing in non-rural areas, therefore minimizing access (Starfield et al.

2005). It is also necessary to examine specialists for two additional reasons, namely that a referral from a primary care physician is not always needed by patients who wish to seek care from a specialist, particularly in areas where managed care health plans are prevalent (Mobley et al. 2006) and that many specialists provide care specific to chronic diseases, such as heart disease, cancer, and kidney disease, that are also top causes of death. Pharmacies, or drug stores, are a necessary economic aspect of an area as they engage in the sale of prescription and non-prescription medications and in the education of their appropriate use.

The primary objective of this study is to examine the relationship between county-level measures of health care resources and standardized age-race-sex all-cause mortality rates. Guided by previous research on spatial patterns and mortality, controls for socioeconomic measures, such as income, income inequality, education, and unemployment are included in the analysis (Jerrett et al. 2005; Shi et al. 2005). Controls for population characteristics, such as percent black and percent rural, are also included. Four measures of health care resources are included in the analysis, specifically primary care physician-to-population ratios, nurse practitioner-to-population ratios, specialists-to-population ratios, and pharmacies per capita.

Mortality data were obtained from the Compressed Mortality File (CMF) produced by the National Center for Health Statistics (NCHS). Five-year rates for the years 2001-2005 of all-cause mortality rates were calculated by county, and these rates were age-sex-race adjusted in order to be compared across counties (James and Cossman 2006; Walker 2009). Using the standard deviation, counties were categorized into one of three measures of mortality—high, average, or low (Cossman et al. 2007). Counties with mortality rates within one standard deviation of the mean are categorized as average; counties with mortality rates more than one standard deviation greater than the mean are categorized as high; and counties with mortality rates more than one standard deviation lower than the mean are categorized as low (Cossman et al. 2007).

County-level socioeconomic and population characteristics were obtained from the 2005 Area Resource File (ARF), developed and maintained by the Health Resources and Services Administration (HRSA). From here, four indicators of socioeconomic status are used—per capita income, percentage of population with a high school education, unemployment rate, and percentage of female-headed households—

and two indicators of population—percentage black and percentage rural. Each of these measures is from the year 2000. A fourth indicator of socioeconomic status—household income—is obtained from the ARF for the year 1999. This is used to calculate the Gini coefficient as a measure of income inequality based on 90^{th}:10^{th} percentile share ratio (McLaughlin and Stokes 2002).

Data regarding health care workers—primary care physicians, nurse practitioners, and specialists—were obtained from the ARF. Primary care physicians are defined here as the sum of actively practicing physicians who identified general medicine, family medicine, internal medicine, pediatrics, and obstetrics/gynecology as their primary specialty for the year 2000. Specialists are defined here as actively practicing physicians who specialize in an area other than the five specialties of primary care physicians, also for the year 2000. Nurse practitioners are defined as such in the ARF and are from the year 2000. In order to measure across counties, each of these measures is standardized by the county population for the year 2000 and are expressed as number per 100,000 persons.

Data regarding the number of pharmacies and drug stores by county were obtained from the 2000 County Business Patterns, maintained by the U.S. Census Bureau. In order to calculate pharmacies per capita, expressly the number of pharmacies per 100,000 persons, corresponding county population data was obtained from the ARF.

Spatial patterns of standardized age-sex-race mortality rates—categorized as high, average, or low—will be assessed in relation to socioeconomic and population characteristics as well as health care resources using geographic information systems (GIS). The Moran's I statistic is a measure that will allow for identification of areas with positive spatial autocorrelation as well as negative spatial autocorrelation.

Lastly, weighted least squares regression models will be used to examine interactive effects of income inequality and health care resources on standardized age-sex-race all-cause mortality as well as account for variances in counties with small populations (McLaughlin and Stokes 2002).

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