Medical Redlining: Demographic and Neighborhood Health Characteristics Associated with Hospital Closures in U.S. Cities

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Abstract

Since 1970, the number of hospitals in the United States has declined dramatically. Previous small scale studies, and research using data from the 1970s-80s demonstrated that hospital closures occurred at disproportionately higher rates in low-income and minority communities. This paper expands these findings, and analyzes whether they hold today. Using data on hospital closures over the last two decades compiled from Medicare cost reports and demographic and health data from the census and CDC, we examine whether hospitals closed in demographically disadvantaged and high health need neighborhoods, in the twenty most populous U.S. cities. We then study how access to hospitals has changed as a result of the shifting urban hospital landscape, and the implications of these changes for health inequality.

1 Introduction

Hospital closures have been widespread in the United States in recent decades. The closure of a hospital may reduce access to acute emergency and outpatient hospital services and accelerate the movement of physicians out of an area where the hospital was located, resulting in a significant reduction in access to care in those neighborhoods (Sager 2017). Previous studies suggest that the geographical distribution of these closures may disproportionately affect high poverty areas, areas with more non-white residents, and areas with higher health care needs, however these studies are often dated or small-scale (McLafferty 1982; Thomas 2014). In this paper, we update and expand previous research by examining the demographic and neighborhood health characteristics associated with recent hospital closures in the 20 largest U.S. cities to determine whether these closures still occur disproportionately in disadvantaged communities and whether they result in health care deserts.

2 Background and Significance

Between 1975 and 2014, the number of hospitals in the U.S. decreased by approximately 20% (Statista 2018). In urban areas it is estimated that 46% of hospitals in major U.S. cities have closed since 1970, and the majority of federally designated health professional shortage areas are located in high poverty urban areas (Thomas 2014; Sager 2017). The past several decades have seen declining demand for inpatient hospital beds. Total inpatient days in American hospitals in 2012 were 169,860,722, down from 179,043,949 in 2008, and occupancy rates have fallen from 77% in 1980 to just 60% in 2013. Furthermore, the rise in private insurance, Medicaid, and Medicare has likely lowered demand for public hospitals to provide care for the uninsured, possibly fueling the closure of public hospitals in particular. In the 52 largest U.S. cities in 1950, over 30% of all acute care beds were in public hospitals, but by 1980 less than 15% of acute care beds in these cities were located in public hospitals (Sager 1983). Improved drugs and technology, as well as Medicare reimbursement policies, have led to a shift towards outpatient ambulatory care and a corresponding reduction in hospital admissions and length of stay.

Hospital closures can have devastating effects on communities' health and geographic access to care. Minority residents and uninsured individuals experience the most increases in travel time when safety-net hospitals or trauma centers close (Bazzoli et al. 2012; Hsia and Shen, 2011). The closure of a local hospital often significantly reduces a community's access to immediate, life-saving emergency care. Delays in care due to increased transit time have been shown to result in higher mortality rates following out-of-hospital myocardial infarction (Jena et al. 2017). Hospital-based outpatient and ER services often function as safety nets for poor and minority residents, who disproportionately use these services (Kangovi et al. 2013).

Though hospital closures have increased nationally, the uneven spatial distribution of these closures has meant that the impact of closure has not been uniform. Several studies have found that hospital closures are more common in areas with a larger number of non-white patients or patients insured through Medicaid (Sager 1983; Sager 2017; Ko et al. 2014; Joynt et al. 2015). McLafferty (1982) found that hospitals that closed in New York City were located in lower income neighborhoods, neighborhoods with higher infant mortality rates, and neighborhoods where a larger percentage of the population was black. Whiteis (1992) found that the percent black in the communities served was significantly associated with hospital closures. Jervis et al. (2012) found that inner-city hospitals that closed were located in areas which had significantly larger non-white populations.

Work examining factors predicting emergency department (ED) closure and trauma center closure has reached similar conclusions. Closed emergency departments were more likely to be located in counties with a higher proportion of residents who were minorities, living in poverty, and without health insurance (Hsia et al. 2011). Trauma centers located in counties with larger non-white populations are at higher risk of closing (Shen et al. 2009).

Taken together, these findings suggest that hospital closures disproportionately affect minority, low SES, and high health need communities. However, much of the literature on neighborhood characteristics and hospital closure looks at single cities rather than national trends, or rely on data from the 1970s and 1980s. The health and demographic characteristics of neighborhoods and cities more generally have shifted significantly since then, and different patterns may be evident today.

3 Data and Methods

Using data from the American Hospital Association Annual Survey of Hospitals, which tracks hospital openings and closings, costs, and utilization (Annual Survey of Hospitals, 2018), we identify all hospitals in the 20 largest U.S. cities that closed, newly opened, and remained continuously open between 2000 and 2015, along with the years in which they closed or opened. We then geocode the hospitals using the ggmap package in R (Kahle and Wickham 2013). We calculate the distance from each tract centroid to the nearest hospital in each year for which we have data on tract-level characteristics using the sp and rgeos packages in R (Bivand and Rundel 2017; Pebesma and Bivand 2005).

Neighborhood demographic and socioeconomic characteristics at the census tract level are drawn from the 2000 and 2010 censuses, and the American Community Survey for data in intermediate years. Neighborhood characteristics include population size, racial and ethnic composition, educational attainment of adults over age 25, the percent of the population above age 65, percent of the population living below the poverty line, and percent of the population lacking health insurance.

To understand whether the current geographic distribution of hospitals relates to health need, we use data from the 500 Cities Project. The 500 Cities Project is a collaboration between the CDC and the Robert Wood Johnson Foundation with a goal of providing small-area estimates of health for the 500 largest American cities. We use data on the prevalence of several chronic health conditions, whose complications would require immediate access to a hospital, such as coronary heart disease and stroke.

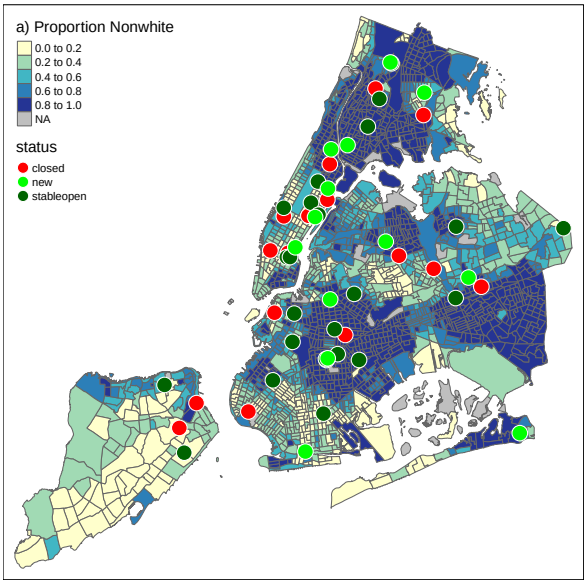
Our analytic strategy is summarized in Equation 1, where *dist* is the distance from the centroid of tract i in year t, and *X* is a sociodemographic characteristic of tract i in year t. We will first examine each sociodemographic characteristic *X* alone and then examine them together. The main effect of time will test if average distance to hospitals has been increasing or decreasing in recent decades. The term for the sociodemographic characteristics will test whether some communities are disadvantaged in terms of their access to hospitals, and the interaction between time and the sociodemographic characteristics will test whether inequalities in access to hospitals have widened over time.

$$dist_{it} = \beta_0 t + \beta_1 X_{it} + \beta_2 t * X_{it} + e_{it} \tag{1}$$

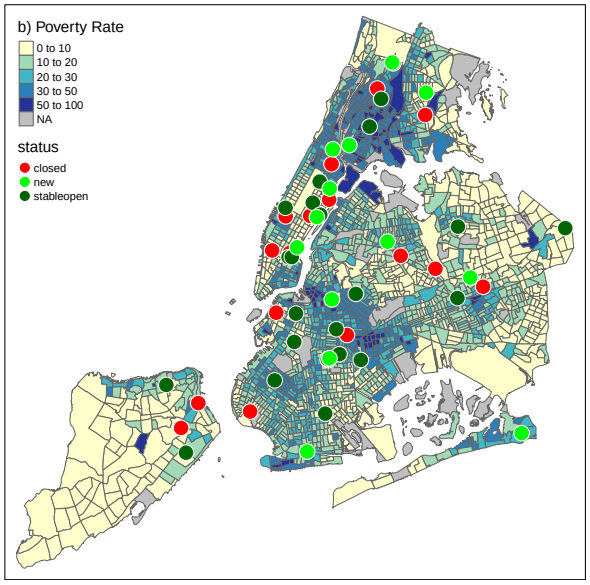
4 Preliminary Results and Expected Findings

Figure 1 reports evidence from exploratory data analysis. It shows continuously open, closed, and newly opened hospitals in New York City between 1997 and 2017. We overlay these geocoded hospitals with demographic characteristics at the census track level in 2000. From these maps, it appears that there are pockets of inequality throughout the city, suggesting that any changes in the hospital landscape are likely to impact neighborhoods differentially. In addition, the net change in the number of hospitals is negative, confirming the general trend of hospital closures.

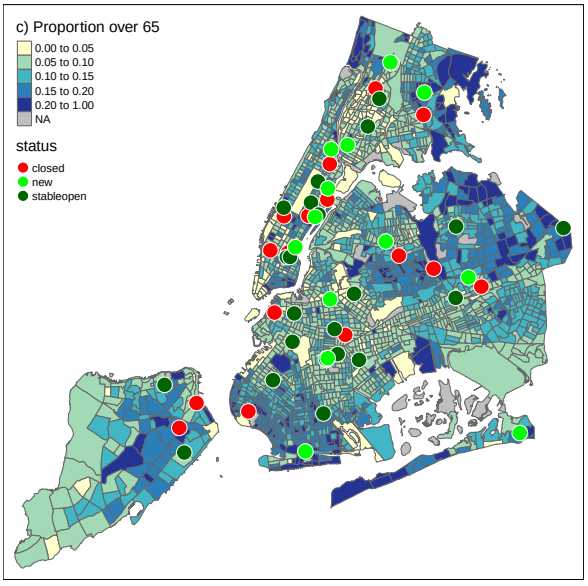
Future analyses will formally test the effect of hospital closures on neighborhood health inequality and expand the geographical scope to the twenty most populous American cities. In particular, we expect to find an overall trend of hospital closures, resulting in less access to hospitals, as measured by distance. This metric is particularly crucial for health conditions demanding time-sensitive interventions. Moreover, based on previous studies, we expect that closures will disproportionately affect minority and high poverty areas, and areas with higher health needs.



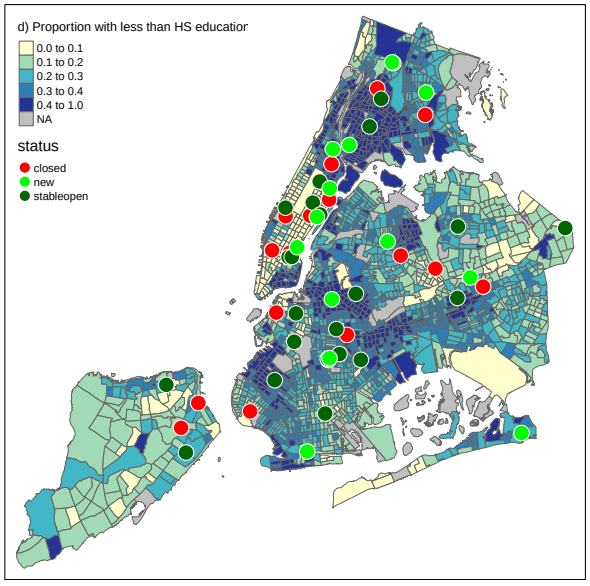
(a) Nonwhite population



(b) Poverty rate



(c) Population over age 65



(d) Adults with less than High School education

Figure 1: Hospital closures overlaid with demographic characteristics

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