Cities 58 (2016) 124–136

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Will affordability policy transcend climate change? A new lens to re-examine equitable access to healthcare in the San Francisco Bay Area☆

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ARTICLE INFO

Article history:
Received 3 November 2015
Received in revised form 10 May 2016
Accepted 11 May 2016
Available online 31 May 2016

Keywords:
Healthcare equity
Spatial access
Affordability
Climate change
Network analysis

ABSTRACT

Equal spatial access to healthcare is a primary public policy concern. The debate on access to healthcare facilities, particularly for low-income individuals, has increasingly drawn attention to the interactions between equity, accessibility, and healthcare. However, little is known about the joint effects of affordability issues and environmental constraints. Therefore, this study aimed to re-examine the equity in spatial accessibility of healthcare in the San Francisco Bay Area from a new angle. The study evaluated the potential impacts of climate change on the spatial access to healthcare through network analysis including service area and location-allocation methods. A great loss of accessibility to healthcare occurs owing to financial barriers aggravated by failure of transportation networks induced by climate change. In particular, the consequences of climate change were found to be a serious cause of inequality in spatial access to healthcare for disadvantaged people. In order to secure equitable healthcare in the Bay Area, it is recommended that more efforts be put into geographically redistributing public health resources to deliberately deliver equitable healthcare, particularly to the disadvantaged population. In addition, the government policy intervention on affordability, introduced to improve healthcare equity, is essential for those encountering financial barriers during climate change. The findings will help decision makers and planners to rethink how to enhance equitable access to healthcare, either through the allocation of healthcare facilities planning or through public policy on affordability.

1. Introduction

Accessibility to healthcare refers to the individual's ability to obtain the services of healthcare facilities. Disparities in spatial accessibility to healthcare are critical public issues in the United States. In the U.S., health planning that addresses geographical accessibility to healthcare dates back to the 1930s (Smith et al., 1985). Access to healthcare is characterized into four categories - potential, revealed, spatial and aspatial - according to two dichotomous dimensions (Khan, 1992; Luo & Wang, 2003). Spatial accessibility emphasizes environment barriers, whereas aspatial accessibility addresses socioeconomic disadvantages (Khan, 1992; Luo & Wang, 2003).

Healthcare accessibility varies spatially in a changing environment. The environmental conditions have been defined as spatial factors (Wang & Luo, 2005), or physical barriers. Healthcare accessibility is also diversified owing to socioeconomic dimensions. Households are distinguished widely from socioeconomic characteristics, e.g., income and insurance. Those disadvantaged populations often suffer from poor healthcare access because their lack of economic means limits their mobility (Wang & Tang, 2013). The medically underserved populations can include low-income or minority groups (for example, the uninsured) (Luo & Wang, 2003).

Healthcare equity is an important goal of public policy to maintain healthcare services and ensure public accessibility to them. The majority of policy makers would pursue equal access to healthcare as the most appropriate principle (Wang & Tang, 2013). In particular, good access to healthcare facilities is a key contributor to preserving personal autonomy and social integration (Loo & Lam, 2012). Health equity can be explained as equal access to healthcare, equal utilization of medical services, and equitable health outcomes (Culyer & Wagstaff, 1993). Unequal geographic distribution of healthcare facilities and patients can lead to inequalities in spatial accessibility (Dai & Wang, 2011). Unequal access to health services is a classic issue and can lead to social injustice. Thus, identifying healthcare equity requires assessment of social, economic and environmental considerations. For Americans, accessibility of medical care is impacted multi-dimensionally by economic status, available facilities, and geographical access (Peters et al., 2008). Non-

☆ Research support: This study was based on a former research project that examined transportation inundation impacted by a rise in sea levels in the San Francisco Bay Area, which was funded by the California Energy Commission (CEC-500-2012-040). This study was also supported by RGC Research Grant of the Hong Kong Polytechnic University (Project No.: 1-ZVD1 and 1-ZVBV).

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http://dx.doi.org/10.1016/j.cities.2016.05.014
0264-2751/

Table 1
The San Francisco Bay Area.

Total household	2,592,145	Low-income household	410,230
		Non-low-income household	2,181,961
Total population	7,150,739	Low-income population	1,131,668
			15.83%
Total area (sq. km)	21,206	Non-low-income population	6,019,197
Total census block	109,228		84.18%

spatial influence always interacts with spatial impact (Dai & Wang, 2011). Poor accessibility to healthcare services can change over time in response to socioeconomic status, and changes in service provision and transportation (McLafferty, Wang, Luo, & Butler, 2011). For example, disadvantaged people may have longer travel distances to access medical resources. In other words, equal healthcare access depends not only on the supply of healthcare resources, but also on the ease of travel to access these resources (Luo & Wang, 2003).

Vehicle travel is an important component of a transportation system and the most common daily travel mode for Americans. Geographical accessibility is known as the travel time from the patient to the facility. The location and distribution of medical services associated with the function of transportation networks has been discussed in a number of studies (Paez, Mercado, Farber, Morency, & Roorda, 2010). Well-prepared planning for an entire population's access to medical services must be coordinated with transportation systems (Few, Ahern, Matthies, & Kovats, 2004). Evaluations of healthcare provision and coverage have found that greater distances to service have negative effects on service utilization (Exworthy & Peckham, 2006) and that transportation-related barriers are particularly influential environmental factors (Kang, 2015; Paez et al., 2010). Vehicle travel is often necessary, especially in bad weather, or for those with physically limitations. Hence, the changing transportation network has a critical influence on accessibility of healthcare facilities, especially taking into account the effects of climate change.

Despite many uncertainties about the consequences of climate change, a broad scientific agreement has established that climate change is occurring globally and poses vital challenges to our natural environment (Wilkinson, Clarke, Reichman, & Dozier, 2002). The most serious effects of climate change-related risks to the transportation infrastructure are because of flooding damage, particularly in coastal regions (Koetse & Rietveld, 2009; Suarez, Anderson, Mahal, & Lakshmanan, 2005). According to the analysis conducted by ICF (2008), a sea level rise of 59 cm by 2100, will put substantial parts of road and railway network in Washington D.C. at risk, with Maryland, Virginia and North Carolina also being affected very seriously. It is no surprise that this issue is also critical in developing countries (Dasgupta, Laplante, Meisner, Wheeler, & Yan, 2007). This can increases the risk of transportation being inundated. Disrupted transportation networks have a serious effect on accessibility to fundamental facilities, such as hospitals, which are essential for people's health, safety, security, and well-being.

With climate change as a backdrop, equity in healthcare has deteriorated. Critical public services, including transportation networks and hospitals, are increasingly at risk of inundation, resulting in a greater threat to individuals. In particular, events arising from climate change may lead to poor access to healthcare facilities. These access barriers are exacerbated further by a lack of insurance for low-income individuals. The assessment on disaster and evaluation of risk assist preparedness and response policies in preventing, discovering, planning, mitigating and managing a wide range of challenges (Radke & Mu, 2000). Thus, the need to assess healthcare services constantly in response to changing global climate conditions is clear in government and academic agendas.

The literature has a variety of studies on the planning and geography of measuring medical service accessibility (Hanson & Schwab, 1987; Joseph & Bantock, 1984), geographical distance, and travel time (Wang & Luo, 2005). Methods for measuring spatial access to healthcare have been suggested by Pacheco and Casado (2005) to maximize service coverage, and Boscoe, Henry, and Zdeb (2012) have calculated straight-line distance. However, there have been few studies presenting a comprehensive understanding of equal access, as the existing studies have not measured actual travel distance and neglected to take climate change and affordability into consideration. The interaction between climate change and spatial healthcare inequalities deserves more attention in planning and geographical research. Thus, several questions remain unanswered. Has equitable access to healthcare been fairly enforced? Will the disadvantaged population be the most vulnerable