Applied Geography 78 (2017) 45–54

Contents lists available at ScienceDirect

Applied Geography

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

How to allocate limited healthcare resources: Lessons from the introduction of antiretroviral therapy in rural Mozambique

Zan M. Dodson [a,*], Victor Agadjanian [b], Julia Driessen [c]

[a] University of Maryland, College Park, Department of Geographical Sciences, 2181 Samuel J. LeFrak Hall, College Park, MD 20742, United States
[b] University of Kansas, Department of Sociology, Lawrence, KS 66045, United States
[c] University of Pittsburgh, Graduate School of Public Health, 130 De Soto Street, A614 Crabtree, Pittsburgh, PA 15261, United States

ARTICLE INFO

Article history:
Received 8 March 2016
Received in revised form
16 November 2016
Accepted 17 November 2016
Available online 25 November 2016

Keywords:
Antiretroviral therapy
Healthcare resources
Location-allocation analysis
Rural populations
Sub-Saharan Africa

ABSTRACT

Proper allocation of limited healthcare resources is a challenging task for policymakers in developing countries. Allocation of and access to these resources typically varies based on how need is defined, thus determining how individuals access and acquire healthcare. Using the introduction of antiretroviral therapy in southern Mozambique as an example, we examine alternative definitions of need for rural populations and how they might impact the allocation of this vital health service. Our results show that how need is defined matters when allocating limited healthcare resources and the use of need-based metrics can help ensure more optimal distribution of services.

1. Introduction

Health as human capital implies that investments in health will generate broader returns, and this link between health and economic performance has been established at both the micro and macro levels. This relationship can also work in reverse, as poor health can inhibit labor force participation and stunt economic growth. The negative implications of poor health in agriculturally-reliant areas have been documented (Canning, 2006; Walker et al., 2006), and illness can deepen and perpetuate poverty traps by stifling economic mobility among resource constrained households. A variety of policy levers have been applied to attempt to disrupt this negative health-wealth relationship in low-income countries (LICs). In LICs, health clinics are commonly used to improve healthcare access and reduce the frequency and severity of adverse health events. Factors such as location and services offered can both affect a clinic's efficacy, as they can a regional clinic system's efficacy, which can affect the value of this policy instrument.

Mozambique is a LIC that has been plagued by high rates of HIV, which disproportionately affects subsistence farmers and imperils their livelihoods (Dodson, Dempewolf, & Silva, 2016). We examine the initial deployment of antiretroviral therapy (ART) in a particularly hard-hit region of Mozambique, and how the optimal allocation of ART services among the existing network of clinics varies depending on how need is defined.

Access has been broadly defined in the healthcare literature as either non-spatial or spatial (Donabedian, 1973). Non-spatial access often refers to societal factors that contribute to or prevent access to healthcare (Yao, Murray, & Agadjanian, 2013). Ideally, all members of society should have equal opportunity to acquire the healthcare that they need (Ricketts, 1994). In practice, however, non-spatial access is often directly influenced by demographic and economic factors, setting up an environment that creates 'winners' and 'losers.' The political ecology of health suggests that these non-spatial factors contribute to this inequity, shaping how people access healthcare (King, 2009; Turshen, 1977). This inequity prevents true access to care—especially for impoverished rural populations such as those in Mozambique and many other parts of sub-Saharan Africa. Non-spatial processes have implications for spatial

* Corresponding author. Present address: University of Pittsburgh, Graduate School of Public Health, 130 De Soto Street, A716 Crabtree, Pittsburgh, PA 15261, United States.
E-mail addresses: zan.dodson@pitt.edu (Z.M. Dodson), vag@ku.edu (V. Agadjanian), driessen@pitt.edu (J. Driessen).

http://dx.doi.org/10.1016/j.apgeog.2016.11.001
0143-6228/

(physical) access. Spatial access often refers to the physical features that impede or facilitate access to healthcare (e.g., physical distance, rivers, forests, mountains, etc.) (Yao et al., 2013). This type of access is often couched in either the ability to use health services or actual utilization of them (Joseph & Bantock, 1982; Joseph & Phillips, 1984). This analysis is primarily concerned with the *ability* to use healthcare and we demonstrate that this ability is highly contingent on how need is defined.

Because access to healthcare plays an integral part in shaping healthcare utilization, facility location and health services offered is a critical issue for urban and regional policy making (Higgs, 2009). The last few decades have seen the development and use of many facility location models for health services (Bennett, Eaton, & Church, 1982; Calvo & Marks, 1973; Osleeb & McLafferty, 1992; Ratick, Osleeb, & Hozumi, 2009; Yao & Murray, 2014). Additionally, allocation models are typically employed to assist with healthcare planning and describe clinic service areas or distribute health services (Cromley & McLafferty, 2011; Yao & Murray, 2014). Thus, facility location models can be combined with allocation models to optimize the distribution of key health services amongst health clinics. Our research adapts location-allocation modeling to understand how varying definitions of need change the optimal distribution of a vital health service—ART.

Using health clinic data from 2009, i.e., when the massive scale-up of HIV services began, we evaluate village access to health clinics and correlate that access with population, economic status, and agricultural intensity. We consider multiple measures of access for this analysis, using distance to nearest clinic, distance to nearest clinic offering ART, and average quality of surrounding clinics. Cost is not considered a barrier to access in this study because of the commitment made by the Mozambican government to provide ART for free through state-run clinics (WHO, 2007; Yao, Agadjanian, & Murray, 2014). To examine the potential implications of limited resources, we construct a village-specific quality score comprised of available resources for each clinic that is then weighted by its distance from the village. We question whether the initial clinics selected to offer ART were optimally chosen to best serve surrounding communities. To examine this, we perform a location-allocation analysis to understand how the initial configuration of clinics chosen to offer ART may be underperforming and offer an optimal configuration solution. We construct multiple metrics for need and then model how access to ART varies as a function of need for initial and optimal configurations. We also evaluate how a reorganization of health services such as ART can improve access for the need-based groups.

This study contributes to the literature on access to care in spatially innovative ways. First, we take advantage of precise spatial information about both villages and clinics. Second, we integrate a comprehensive quality measure into the optimality analysis, considering all clinics within a predefined radius of each village rather than just the closest one. And third, we examine how improvements in access may correlate with changes in livelihood sustainability.

2. Study area

Mozambique, a sub-Saharan country with a population of 27 million and GNP per capita of 525 USD (World Bank, 2015), has long been striving to contain such diseases as malaria, cholera, and tuberculosis. Mozambique is also among the sub-Saharan countries most severely affected by the HIV/AIDS epidemic, with adult HIV prevalence estimated at 12% nationwide, and as high as 25% in southern Gaza province, where our data are collected (Ministry of Health, 2009). In 2004, ART was rolled out nationwide but through a very limited number of health clinics; less than 25% of the population with advanced HIV were actually enrolled in ART as of 2007 (Audet et al., 2010). Additionally, Mozambique, and its southern region in particular, is prone to natural disasters such as devastating flooding and severe drought (Klinman & Reason, 2008; Matyas and Silva, 2009). Thus, households in this region may be further disadvantaged by the occurrence of a natural disaster, forcing them to deal with many disease vectors, thereby eroding household human capital by creating unhealthy landscapes. Fig. 1 depicts the location of health clinics surveyed and surveyed villages in the area.

Agriculture is a vital part of the Mozambican economy, where just over 85% of the population engages in this livelihood strategy (FAO, 2015). Most of those engaged are subsistence farmers and are more vulnerable to poor health as they often have a small or no social safety net to rely on. The government of Mozambique has identified cash cropping as a poverty alleviation strategy and has placed a growing emphasis on these types of crops (PARPA, 2007; Silva, 2008).

Subsistence agriculturalists are by definition highly vulnerable to shocks that affect their livelihood. They are also highly vulnerable to health shocks and, in turn, highly dependent on the clinical services that, if accessible and adequate, may help cushion these shocks. Chronic illnesses such as diabetes, cancer, and hypertension plague older generation subsistence agriculturalists, while communicable diseases such as HIV/AIDS, sexually transmitted diseases (STDs), and cholera, to name a few, typically affect the younger generations (Hawkes & Ruel, 2006; Negin, 2005). Additionally, subsistence agricultural households have limited economic mobility and are thus limited in livelihood diversification in the face of health declines (Ulrich et al., 2012). Poor health and disease are capable of diminishing household stocks of human capital, have far-reaching consequences for those reliant on physical labor, and are felt more acutely in households that are subsistence-reliant; these types of households will often resort to farming less land as a coping strategy for dealing with poor health, thus further jeopardizing their well-being (Dodson et al., 2016; Obrist et al., 2007). Therefore, access to vital healthcare services is essential to helping these households resume their livelihood activities.

As part of the government's poverty alleviation strategy, investments in health infrastructure are cited as a top priority (PARPA, 2007). The government of Mozambique uses state-run health clinics as a platform to roll out high-quality services such as ART, prevention of mother to child transmission of HIV (PMTCT), maternal and child health (MCH) services, and immunizations (PARPA, 2007; WHO, 2007). Importantly, in an effort to support the poverty alleviation strategy, the government provides certain services to the general public for free; these services include HIV testing, ART, services for pregnant women (e.g. prenatal, delivery and counseling services), immunizations, and care to children under five (WHO, 2007). The use of state-run health clinics as a platform for extending vital health services is where this research seeks to make a meaningful contribution; it seeks to help inform policymakers in the approach needed to address equity in access to healthcare.

3. Data and methods

The data used in this analysis comes from wave two (2009) of a longitudinal household-based survey of rural women's health, as well as a parallel survey of health clinics. The data collection was