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A geographical perspective on access to sexual and reproductive health care for women in rural Africa

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ABSTRACT

Utilization of sexual and reproductive health (SRH) services can significantly impact health outcomes, such as pregnancy and birth, prenatal and neonatal mortality, maternal morbidity and mortality, and vertical transmission of infectious diseases like HIV/AIDS. It has long been recognized that access to SRH services is essential to positive health outcomes, especially in rural areas of developing countries, where long distances as well as poor transportation conditions, can be potential barriers to health care acquisition. Improving accessibility of health services for target populations is therefore critical for specialized healthcare programs. Thus, understanding and evaluation of current access to health care is crucial. Combining spatial information using geographical information system (GIS) with population survey data, this study details a gravity model-based method to measure and evaluate access to SRH services in rural Mozambique, and analyzes potential geographic access to such services, using family planning as an example. Access is found to be a significant factor in reported behavior, superior to traditional distance-based indicators. Spatial disparities in geographic access among different population groups also appear to exist, likely affecting overall program success.

Introduction

Utilization of health services significantly impacts health outcomes. It has long been recognized that access to health services is essential to how people utilize such services (Gulliford & Morgan, 2003; Higgs, 2009; Joseph & Phillips, 1984; Meade & Emch, 2010). This is especially true for rural areas of resource-limited developing countries characterized by poor overall health, such as those in rural sub-Saharan Africa (Stock, 1983; Tanser, Gijsbertsen, & Herbst, 2006). Improving accessibility of health services for greater quality of life, enhanced overall health and well-being, reduced health inequities and better service to target populations is a central concern in health resource allocation and program planning. Therefore, understanding and evaluating access to health care and its spatial variation are vital for healthcare planners and policy makers.

Though it is widely acknowledged that access is crucial for healthcare utilization, access is defined differently and has different implications in different settings (Aday & Andersen, 1975; Cromley & McLafferty, 2011; Gulliford et al., 2002; Joseph & Phillips, 1984; Wang, 2012). Generally, access can be measured in two distinct, yet interacting dimensions: geographic/spatial and non-spatial (Donabedian, 1973). Geographic access highlights the spatial separation (distance, rivers, forests, mountains, etc.) between health facilities and the population in need of service. Non-spatial access, in contrast, refers to demographic, social-economical and organizational factors (sex, age, education, income, religion, etc.) that facilitate or hinder the acquisition of healthcare. From the perspective of utilization, two types of accessibility can be distinguished: potential and revealed (Joseph & Bantock, 1982; Joseph & Phillips, 1984). The former describes the opportunity to use health services, whereas the latter refers to actual achievement of potential access, that is, utilization.

Of interest in this study is potential geographic access to sexual and reproductive health (SRH) services, and in particular to family planning in rural Africa. It has been found that geographic access to SRH services is an important factor influencing health outcomes

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such as pregnancy and birth, prenatal and neonatal mortality, maternal morbidity and mortality, and vertical transmission of infectious diseases like HIV/AIDS (Acharya & Cleland, 2000; Rahman, Mosley, Ahmed, & Akhter, 2008; Tanser et al., 2006). As is the case in other types of health care, geographic access to SRH services can be defined in many ways, including travel distance/time/costs (Nemet & Bailey, 2000), gravity-based metrics (Joseph & Bantock, 1982) and more recently, the two-step floating catchment area (2SFCA) (Luo & Wang, 2003; Wang & Luo, 2005). In the context of rural Africa, current research of geographic access to healthcare primarily relies on distance-based measures (Buor, 2003; Noor, Zurovac, Hay, Ochola, & Snow, 2003; Stock, 1983; Tanser et al., 2006). The value of alternative measures is worth further exploration.

Given their capability of managing and processing spatial data, geographic information systems (GIS) are well suited for evaluating geographic access to health services (Cromley & McLafferty, 2011; Higgs, 2004; Meade & Emch, 2010; Rushton, 2003; Wang, 2012; Yao, Murray, Agadjanian, & Hayford, 2012). Desktop mapping makes it easy and straightforward to visualize health data in different spatial representations and under various spatial scales. Also, some spatial operations, such as data aggregation and calculation of travel distance/time/costs, can be easily implemented using readily available functions in GIS. Further, spatial analysis using GIS can provide insights into disparities in geographic access among a population across space, helping identify insufficient health service access and possible influencing factors that otherwise cannot be detected.

The aim of this study is to develop a geographic access index in a GIS environment capable of reflecting important spatial influences and variability to SRH services in rural Africa, using access to family planning in rural areas of Mozambique as an example. The remainder of the paper is structured as follows. The next section provides an overview of current research on access, especially geographic/spatial access, to health services. The study area and data utilized are then described. We then provide a detailed description of the proposed method. An application of the new method to examine geographic access to SRH services is then presented, focusing on variation over space and the impact on actual health care usage by women in rural Mozambique. We conclude with a discussion of the results and implications.

Background

Healthcare access is a multidimensional concept, and in recent years there has been increasing interest and research on access in a number of fields, including hygiene, economics, geography, sociology, and public policy, among others (Cromley & McLafferty, 2011; Gulliford & Morgan, 2003; Joseph & Phillips, 1984). As a result, numerous definitions of access have been proposed in the literature oriented to different academic specialties. One of the earliest definitions explains access in terms of entry to the health care system (Donabedian, 1973). Similarly, Aday and Andersen (1975) suggested that access is more relevant to consumers of health services compared to suppliers, describing whether people can enter the healthcare system, either potentially or actually. Penchansky and Thomas (1981) identified five dimensions of access: availability, accessibility, accommodation, affordability and acceptability, highlighting the match between health providers and their clients. The first two are defined in spatial terms, where availability implies adequacy of healthcare provision and accessibility refers to geographic impedance (travel distance/time) between healthcare supply and demand. It is worth noting that geographic access has long been a major concern in rural health service systems (Arcury et al., 2005; McGrail & Humphreys, 2009; Stock, 1983). The focus of our paper is on spatial aspects of access, so the remainder of this section is limited to specific aspects of geographic access, including provider-to-population ratios, distance-based measures, and gravity-based models.

Provider-to-population ratio, or physician-to-population ratio, has long been used to measure geographical access to health services (Guagliardo, 2004; Wang, 2012). Usually, the ratio can be calculated using population/physician data aggregated by administrative units such as county or city. This traditional measure has raised a lot of criticism mainly because it fails to account for the variation in spatial access within administrative boundaries and the interaction between provider and population (Guagliardo, 2004). Also, it might not be appropriate to define the catchment area of health facilities using pre-specified spatial units because health service areas usually overlap rather than are separated by distinct boundaries. Further, provider-to-population ratios derived on various spatial scales can lead to quite different conclusions on spatial disparities in geographic access, which is well known in geography as the modifiable areal unit problem (MAUP) (Openshaw, 1984).

Distance-based measures can avoid some of the problems associated with provider-to-population ratios (Cromley & McLafferty, 2011). In fact, they are increasingly employed in geographic access evaluation largely thanks to the advance of GIS and increased availability of digitized spatial data (Higgs, 2004; Rushton, 2003). In principle, such measures can be defined using Euclidean distance, distance along road network, travel time or costs. Though straightforward and easy to calculate, Euclidean distance has been considered less than ideal because it ignores physical barriers (e.g. rivers and mountains) and other factors (e.g. road types and transportation modes) that might affect the actual travel distance (Martin, Jordan, & Roderick, 2008). Some studies, however, found it adequate for explaining spatial impedance in healthcare seeking in rural areas (Stock, 1983) and also being a valid proxy for actual travel distance (Cudnik, Yao, Zive, Newgard, & Murray, 2012). To account for actual transportation conditions, distance along road networks and travel time/costs have been used as surrogates for geographic access (Lovett, Haynes, Sunnenberg, & Gale, 2002). Some studies incorporated more complex factors such as transportation modes (e.g. public or private) and timetables (Arcury et al., 2005; Martin et al., 2008). Fortney, Rost, and Warren (2000) compared various distance-based access measures and examined the sensitivity of results obtained from different measures.

Though it has been recognized that distance represented by various measures has a significant impact on the utilization of health service as discussed above, most research fails to consider the characteristics of either health providers (e.g. size of health facility and service quality) or populations, which these providers serve (e.g. access to transportation). In fact, people usually trade off distance and desired health services when making decisions on health care utilization (Rosero-Bixby, 2004). Gravity-based models are methods that can account for such trade-offs. The gravity model originated from Newtonian physics and was extended in economic geography to delineate trade areas (Huff, 1963, 1964). Joseph and Bantock (1982) modified it to measure geographic access to health services, incorporating interaction between supply and demand and considering a nearby healthcare facility more accessible than a distant one. Since then, many extensions of the gravity model have been proposed, such as the two-step floating catchment area (2SFCA) (Luo & Wang, 2003). One limitation of 2SFCA lies in its reliance on the availability measure that is based on provider-to-population ratio. Also, the constant catchment radius used in the model might not reflect the variation among health service provision or community characteristics. Many improvements have been made with regard to the 2SFCA method, such as adoption of varying catchment areas (Luo & Whippo, 2012) and application of different distance decay functions (Luo & Qi, 2009; McGrail & Humphreys, 2009).

In summary, the review above shows that while all the geographic access measures used to date are important in evaluating spatial