Measuring Geographical Accessibility to Healthcare Facilities in Peri-Urban Dwellers of Mbeya City, Tanzania

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Abstract
The spatial arrangement of Healthcare Facilities implies the organization of the facilities across the geographical space. This concerned with the response to series of locational factors include: availability of approachable roads, easy access to facility from other nearby settlement, mode of transport or impediments like forest, water bodies, rough terrain etc. Healthcare services are powerfully subjective to the type and quality of services available in the native area and the time, distance, cost and easy of travelling or walking to reach those services. This paper highlights a method for approximating the geographical accessibility to Healthcare Facilities in peri-urban dwellers in Mbeya city, Tanzania. ArcGIS Network Analyst was used to build a road network dataset and measure the shortest network distance and shortest travel time to closest Healthcare via road network. The analysis was applied to approximately 2,143 households in Mbeya city peri-urban allowing geographical access to be interconnected to native dwellers. The population was not distributed evenly across the subwards, the subwards centroids were considered as a demand points and the Healthcare Facilities were considered as supply points. The study concludes that, there is poor spatial accessibility to Health Facilities and wellbeing among resident in the peri-urban area, whereby among the six studied wards, only 3 wards, Iziwa, Itagano and Mwasenkwa had only one public dispensary, and there is one doctor, two nurses and one midwife from the public dispensary but lack some diagnostic equipment, drugs and an insufficient number of skilled staff of which all have an effect on utilization and demand for Healthcare.

Keywords: Accessibility, Geographical accessibility, Healthcare, Network analysis, Population
1. Introduction

Healthcare is a broad range of Health Services provided by professionals in the community. It is an authoritative approach to providing “health for all” and is usually recognized as a universal key for improving population wellbeing in the world (World Health Organization and UNICEF 1978). ‘Geographical accessibility’ refers to the physical accessibility one possesses to a chosen location or the easiness at which people in one place can reach another place (Guagliardo, 2004). The main goal of Health Service delivery is to provide equitable utilization and access to health care services.

According to Guagliardo (2004), accessibility can be described as travel impedance (travel distance or travel time) between patient location and health care service points. Accessibility and availability are not similar terms and that accessibility may depend on availability of the services. In urban areas, where multiple service locations are commonly available, accessibility and availability should be considered simultaneously. Distance and time are both important factors of accessibility. The health of a population affected negatively by the distance to Health Service (Matthew, 2012). Information about the impact of distance to Healthcare is limited due to lack of quantitative information pertaining to that. The ability of a population to achieve a set of Healthcare services is mostly concerned with the availability of access to Health Services. The World Health Organization recommends travel time rather than distance to access geographical accessibility.

Provision of and access to Health Facilities and services in Tanzania has been a challenge for so long more significant in rural and peri-urban areas as it is embedded on spatial variations. This trend is one of the most disturbing in contemporary Mbeya city peri-urban and there are fears of the gap widening because of inequalities among groups in access to basic services especially Healthcare services, which result for many untimely deaths now common in the city.

Mbeya is among other fast growing cities in the country, with a population growth rate of 4.2%, which has been experiencing a significant variation in Health Facilities distribution between urban and peri-urban areas. Different studies attempted to cover spatial accessibility to Healthcare services in peri-urban urban areas. However, the studies on the spatial accessibility on the Healthcare Facilities and ultimately Health Service are limited.

Some of Researchers have used basic cartographic representations to map the availability of Healthcare Facilities and highlights promising inequalities and statistical methods to disclose the existence of issues or obstacles that distress the population to Healthcare services (Guagliardo, 2004 & Nael et al., 2015). Other researchers, for example: Ozus (2004) Şentüırk et al., (2011) and Dokmeci (2002) have studied the distribution of different types of Healthcare Facilities (hospitals, physician offices and pharmacies) in Istanbul. Using a regression analysis, they establish that the most important elements that influence the distribution of these health care facilities are population income and education level.

Moreover, they found that, while state hospitals are more evenly distributed, private hospitals tend to concentrate in high income districts (Şentürk et al., 2011).
2. Study Area
This study was carried out in Mbeya Region in peri-urban Mbeya city. Mbeya city is situated in the southwestern part of Tanzania. It is located between latitudes $8^\circ 50'$ and $8^\circ 57'$ south and longitudes $33^\circ 30'$ and $35^\circ 35'$ east. It has a total land area of $214 \text{ km}^2$ and borders Mbeya Rural District on all sides. Mbeya City is the headquarters of Mbeya region. Strategically the city is located in a Rift valley between two high mountain ranges (i.e. Mbeya Peak / Loleza and Uporoto Mountains) (Figure 1.1).

![Location of Peri-Urban Areas in Mbeya city](image)

3. Methodology
To measure geographical accessibility to Healthcare Facilities to peri-urban dwellers in Mbeya city, three types of data were needed; location of population/Settlements, location of Health Facilities and road network. However, physical access as important factor in obtaining quality care services was taken into consideration to health care as lack of spatial access can result in delayed treatment and poor health outcomes. ArcGIS Network Analyst was used to build a road network dataset and measure the shortest network distance and shortest travel time from each ward centroid.
to its closest facilities.

Three facilities were selected from this study: Public Dispensaries located in their neighborhood (study area) as Primary Healthcare, Regional and Referral Hospital located at Mbeya city. Travel time and distance or time service catchment area, Origin and Destination Cost Matrix Network analyst tool were used in Measuring geographical accessibility to Healthcare from Mbeya city peri-urban centroids via the road network analysis.

The analysis was done to evaluate physical accessibility to Healthcare Facilities by local communities, in peri-urban areas by measuring the travel time and travel distance between the Healthcare Facilities and the locations of a local resident (Mbeya city peri-urban). (Apparicio et al., 2008) debate that, the shortest network travel time is more accurate than any other distance measures. Link impedance was measured in meters and all possible shortest routes to the nearest Health Facilities and accumulated total road length were identified for all wards centroid to the study area (Apparicio et al., 2008).

Geographical accessibility to service facilities from population points have been determined using travel time (Burt & Dyer, 1971) where travel time is frequently measured using the existing road network, the distance is transformed to travel time by using appropriate conversion procedure and the travel time is dependent on the approach of transportation used (Ahmad 2012).

GIS-Based Network Analysis setting and Optimization routes to evaluate service provision Delamater et al., (2012) required a road network dataset built in the Arc catalog (Arc Map environment). The shapefile was integrated into ArcGIS after it was projected to Arc 1960 UTM Zone 36S. Systems and infrastructure data for the study area were extracted from it using a Clip tool (Extract Toolset under the Analysis of Toolbox).

The shapefile acted as base data for determining how accessible transport infrastructure was for the community in the peri-urban area given the location of their home. The raster /scanned data, for example, Mbeya city and ward boundaries were digitized by overlapping with a current Satellite image of 2017 for making it up to date.

The public transportation network (e.g. bus routes) was also collected to better understand the spatial layout of the transportation network across the study area. Furthermore, other spatial datasets were also required to provide arealistic geographical context or spatial framework of the study area. Data on road network and associated speed limits were collected to measure travel distance and travel time between Health Facilities. This comprised of Mbeya city road network, major, minor combined roads network were cleaned, and built-in Arc-Catalog workstation, to rebuild the topological relationships amongst the network links, based on the length of road segments and Healthcare Facilities and settlements points for the network to participate.

The road hierarchy were allotted an average vehicular speed (Km/hour), National Highway, Regional Roads/Highway, District Roads, Village/Street Roads and Pedestrian (Ahmad 2012).

Travel time was calculated using the following formula:
Length/Speed*60. Length of the roads was divided by the speed of the roads and it is multiplied by 60 (Minutes).

Travel speed was assigned in two ways; walking speed was assigned as 3 Km/hr throughout the whole network. Secondly, public transport speed limit of 30 km/hr was assigned based on Mbeya city roads speed limits without considering road condition and topography. Network settings allow U-turn at the intersection at endpoint. The total of 70 Healthcare Facilities and 95 households settlements points (incidents) were loaded as input in ArcGIS analyst tool. GIS estimates travel time to the nearest Healthcare Facilities and derive Healthcare Facility boundaries (Briggs & Elliott, 1995).

All datasets were imported into geodatabase for supporting subsequent mapping and analysis. The closest facility solver measures the time, distance of traveling between demands point and supply point, and determines which are nearest to one other.

In this study, accessibility was assessed by measuring the distance from residence to the health care facility or by estimating travel time (Arcury et al., 2005; Love & Lindquist, 1995). The closest facility solver measured the time and distance of traveling between demands point and supply point and determined which were nearest to one another.

Based on the speed, traveling time and traveling distance closest facilities both in terms of distance and time were calculated (Wang, 2009). The population of different shortest routes of Healthcare Facilities was calculated. For Health Facilities, a driving time between 3, 5, 10, 15 and 20 minutes was used on the speed limit of 30km per hour. Network analyst tools were used to create the service area of these facilities. Using a recommended distance away from any Healthcare Facilities of 4km as recommended by the WHO (1997), the appropriate drive time was estimated.

Several digital and non-digital data sets were collected and transformed into GIS data. Spatial analysis tools, including symbols, overlay operations; buffer operations and raster calculator were used during analysis. ArcGIS based network analysis (Time and Distance Service Catchment Area were considered.

In the study, Origin and Destination cost Matrix was used to denote output areas as the origin (Demand) and Hospital as (Supply) using ArcGIS Based Network Analysis. This calculates distance and travel time of different impedance. OD Cost Matrix was employed in this study to find and measure the least cost paths along the network from multiple destinations. The straight lines connect origins and destinations, but the attributes Table stores the network impedance (Minutes or distance). The origin-destination Matrix solver does not output lines that follow the network; the values are stored in the lines of attributes by indicating destination ranks.

The output areas were first converted from feature to point to get the centroids. However, some output areas were not located due to poor road network connectivity, for example, Itagano and Mwansenkwa wards, so their position was adjusted around the closest road near the centroid area. The output areas that were less than or equal to 5,00 m, 1,000 m, 3,000 m, 5,000 m, 10,000 m and greater than 15,000m were obtained.
The Origin and Destination cost Matrix generated the results more quickly but cannot return the true shapes or routes or their driving direction.

Settlements point/residential location (Origin/Demand) and Health Facility point (Destination/Supply point) were loaded from the analysis to measure accessibility. It also generated the results more quickly but could not return the true shapes or routes or their driving direction (Longley et al., 2010; Delamater et al., 2012). This calculated distances and travel time at different impedance.

In addition, descriptive and inferential statistics were used; descriptive statistics used include Tables and percentages to depict the distribution patterns of Healthcare providers. The distance traveled to a Healthcare Facility, transport attributes and social-economic characteristics of the peri-urban population to Healthcare providers in the study area were analyzed. The spatial concentration of people, Levels of services/attractiveness of Healthcare Facilities (Ahmad, 2012) were included in analysis. The generated data were presented in the form of Maps, Tables, and Figures.

Measures of accessibility also involved measures based on a number of facilities within specified areas; a buffer analysis was applied to define the proximity to the Healthcare Facilities. The number of facilities within a specified travel impedance (for example, travel distance, travel time or travel cost) is a commonly used method to measure spatial accessibility.

The distance was measured either from the supply perspective, for example; catchment area for a specific health care service, or from the individual users perspective, e.g. distance to the closest Healthcare service facility. Apparicio et al. (2008) explains measures of spatial accessibility as: the number of facilities within a specified distance, average distance to 3 closest services; average distance to 5 closest services, and average distance to all services.

Buffers were created around all facilities in the study area by using Mbeya city planning standards with a radius of 1km in the catchment area of the Healthcare Facility. Areas beyond 1000m accessibility zone were used as reference for determining a potential location for additional Healthcare center by using Multi-criteria evaluation (Arcury et al., 2005; Love and Lindquist, 1995).

Similar to the measurement of travel distance, measurement of car/vehicle-based travel time along the road network between Healthcare Facilities locations and all wards centroid were estimated using road length and travel speed. The road network dataset created for measuring the travel distance was also used to measure car based service area (Ahmad, 2012). Travel impedance was measured in meters with break distance values set 500 m, 600 m, 1000 m, 3000 m, 5000 m, 1000 m, 15,000 m and 20,000 m.

Among them 500 m, 600 m, 1000 m and 5000 m were used to identify areas that were accessible by walking and 20,000 m was set as maximum distance to avoid errors in the computation of service area. Likewise, in measuring travel distance, U-turn was permitted at any road junction, while the direction was measured away from the Healthcare Facilities (Ahmad, 2012).
based on car travel time measured in break time values of 3 min (minutes), 5 min, 10 min 15 min and 20 min were generated for each type of facility.

Spatial information was used to establish service or catchments based on travel distance using spatial analyst tool. Data were displayed visually before the exploration of some likely patterns that were generated after analysis (exploration of data after network/proximity analysis). Simple descriptive data analyses were then applied. Spatial exploratory techniques were used to identify and explain the variations in physical access of the population to the existing Health Facilities in the study area and identify disadvantaged population using the closest facility measures using ArcGIS (Arcury et al., 2005; Love and Lindquist, 1995).

Spatial accessibility from residential locations to locations of Healthcare Facilities and Street/sub ward, Service area for each facility was determined using a classification based on literature and WHO standards as the limitation for determining the extension of catchment areas. A network service area was defined as a region that encompasses all accessible streets (that is streets that are within a specified impedance) used to visualize and measure accessibility.

4. Results and Discussions

4.1. Travel (driving) Distance to Healthcare Facilities

The use of Network Analysis, travel distance to the closest Healthcare Facility from Mbeya city peri-urban centroid (as proxies of communities) via the road network was measured using Closest Facility in ArcGIS.

Table 4.1 shows the minimum, maximum, average and standard deviation of travel distances (measured in meters). It was noted that the total length of travel to the closest facilities ranged between 0.497 km and 19.263 km. According to Briggs and Elliott (1995) GIS estimates travel time to the nearest Healthcare Facilities and derive Healthcare Facility boundaries. Some respondent had to travel over 20 km or even more to access Health Services at Regional or Referral Hospital located in Mbeya city Centre where equipment and Specialists are available. Table 4.1 shows nearest Health Facilities distance in meters.

Table 4.1
Mbeya city Centroid to the Nearest Health Facilities Distance (Meters)

<table>
<thead>
<tr>
<th>Healthcare facilities</th>
<th>Minimum (m)</th>
<th>Maximum (m)</th>
<th>Average (m)</th>
<th>SD (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispensary</td>
<td>497</td>
<td>5,980</td>
<td>3,238</td>
<td>2,741</td>
</tr>
<tr>
<td>Regional Hospital</td>
<td>13,578</td>
<td>18,151</td>
<td>15,864</td>
<td>2,286</td>
</tr>
<tr>
<td>Referral Hospital</td>
<td>14,659</td>
<td>19,263</td>
<td>16,961</td>
<td>2,302</td>
</tr>
</tbody>
</table>

Source: Field Survey (2018)

The findings show that most Health Facilities are not easily accessible by walking. There is no planned route for public transport services in the study area. Therefore, the local residents have to organize their own transport in order to access the Healthcare facilities. The proximity to the Healthcare provider in Mbeya city peri-urban largely determines the degree of patronage by people who need medical help.

The average distance traveled by respondents in Mbeya city peri-urban to dispensaries was 3.238km and 16.962km by the patient to private or public hospital medical centers. According to
Arcury et al. (2005) and Love and Lindquist (1995) the closest facilities displayed the best route to or from them, return the travel cost for each route, and display directions to each facility. Figure 4.1 shows closest facility concentration.

**Figure 4.1**

**Closest Facility Analysis**

![Closest Facility Analysis](image_url)

**Source:** Field Survey (2018)

Figure 4.1 reveal that a large number of Healthcare Facilities are concentrated in the urban area. The pattern of distribution area is widely spread or randomly dispersed. The network analysis of the Healthcare available shows that some residents travel more than 4km specified by WHO. The ratio of health officers to the patient was very low which implies a shortage of health officers in the peri-urban areas. Moreover, it was discovered that there is only one doctor that is serving each ward of the study area.

Mwaniki et al. (2002), argue that, the effect of distance on the use of Health Services is affected by the time and cost of travel, compounded by topography and poor road conditions and by a shortage of public transport.

The total 95 households selected from the study area versus Healthcare facilities, the results of OD Cost Matrix analysis (Longley et al., 2010 and Delamater et al., 2012) demonstrated the nature of peoples’ access in terms of distance to Health Facilities in order to analyse geographical accessibility of people to specialist hospital.
The reality of this observable spatial pattern was logically presented. Table 4.2 displays the results of OD Cost Matrix computed for distances between each origin and destination in line with proximity limit conditioned by working criteria. Network analysis was used since it considers all road networks, without considering only a straight distance from Healthcare Facilities (Wang, 2006).

Table 4.2
Network Analysis Travel Time (Speed Limit 30Kmph)

<table>
<thead>
<tr>
<th>ObjectID</th>
<th>Shape</th>
<th>Name</th>
<th>OriginID</th>
<th>DestinationID</th>
<th>DestinationRank</th>
<th>Total DriveTime</th>
</tr>
</thead>
<tbody>
<tr>
<td>272</td>
<td>Polyline</td>
<td>Location 4 - Location 28</td>
<td>4</td>
<td>27</td>
<td>66</td>
<td>51.285</td>
</tr>
<tr>
<td>3740</td>
<td>Polyline</td>
<td>Location 58 - Location 28</td>
<td>58</td>
<td>27</td>
<td>66</td>
<td>50.342</td>
</tr>
<tr>
<td>204</td>
<td>Polyline</td>
<td>Location 3 - Location 28</td>
<td>3</td>
<td>27</td>
<td>66</td>
<td>49.838</td>
</tr>
<tr>
<td>3506</td>
<td>Polyline</td>
<td>Location 54 - Location 18</td>
<td>54</td>
<td>18</td>
<td>66</td>
<td>48.899</td>
</tr>
<tr>
<td>1904</td>
<td>Polyline</td>
<td>Location 30 - Location 28</td>
<td>30</td>
<td>27</td>
<td>66</td>
<td>48.548</td>
</tr>
<tr>
<td>271</td>
<td>Polyline</td>
<td>Location 4 - Location 60</td>
<td>4</td>
<td>58</td>
<td>67</td>
<td>48.521</td>
</tr>
<tr>
<td>270</td>
<td>Polyline</td>
<td>Location 4 - Location 30</td>
<td>4</td>
<td>29</td>
<td>66</td>
<td>47.902</td>
</tr>
<tr>
<td>612</td>
<td>Polyline</td>
<td>Location 10 - Location 18</td>
<td>10</td>
<td>18</td>
<td>67</td>
<td>47.710</td>
</tr>
<tr>
<td>3739</td>
<td>Polyline</td>
<td>Location 58 - Location 60</td>
<td>58</td>
<td>58</td>
<td>67</td>
<td>47.584</td>
</tr>
<tr>
<td>269</td>
<td>Polyline</td>
<td>Location 4 - Location 36</td>
<td>4</td>
<td>35</td>
<td>65</td>
<td>47.488</td>
</tr>
</tbody>
</table>

Source: Field Survey (2018)

Table 4.2 shows that in the study area the longest and shortest travel time from settlements location to Healthcare Facilities was 51.285 minutes (drive time), 25.64km) (drive distance) and 0.125 minutes’ drive time (0.0625 km) drive distance respectively. The shortest drive time (0.125 minutes) was only limited to Healthcare Facilities available to the neighborhood (Public dispensary) where most services were inadequate and sometimes unavailable. But drive time from 30-51 minutes was used by the most peri-urban people to secure Health Service from Regional or Referral Hospital located in city center.

Furthermore, the findings from Figure 4.2 shows that Origin (settlement point from Iziwa wards centroids) to destination point or Health Facility point (Mbeya Specialist Consultant Hospital) the origin and destination Matrix solver measures 16 minutes (8 km) values stored in the lines of attributes by indicating destination ranks of 3. Figure 4.2 shows origin and destination cost matrix demonstrated the nature of peoples’ access in terms of distance to Health Facilities.

Figure 4.2
Origin and Destination Cost Matrix Analysis
The results of drive time analysis indicate a clear marked disparity in terms of geographical access to Healthcare Facility among the people in the study area. The facility is a specialist center has a profound impact on the lives of the people in the study area. The basic fact is that, according to Wang (2006) since everyone makes regular visit through referral services the research considered a large proportional of the people to be underserved with drive distance of just 58% within 25.6 km.

4.2. Travel (Driving) Time to Healthcare Facilities
The findings, from network dataset, solve Travel (driving) Time to Healthcare facilities, shows the minimum, maximum, average and standard deviation of minutes it takes to reach to Healthcare facilities.

It should be noted that spatial accessibility indicated by travel (driving) time might not represent actual spatial accessibility of the resident in the study area since many residents may not have a car or may not be able to drive a car at the time they need to visit a specific Healthcare Facility. In addition, the poor road condition influenced the use of 30Km/hour according to the nature of topography of Mbeya region. Table 4.3 shows the nearest Health Facilities travel time in minutes.
Table 4.3
Nearest Health Facilities Travel Time (Minutes)

<table>
<thead>
<tr>
<th>Healthcare facilities</th>
<th>Minimum (minutes)</th>
<th>Maximum (min)</th>
<th>Average (min)</th>
<th>SD (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispensary</td>
<td>0.9</td>
<td>6</td>
<td>3.45</td>
<td>2.55</td>
</tr>
<tr>
<td>Regional Hospital</td>
<td>27</td>
<td>36</td>
<td>31.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Referral Hospital</td>
<td>29.2</td>
<td>38.6</td>
<td>33.9</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Source: Field Survey (2018)

The findings show that 0.9 minutes’ drive time polygon around a Health Facility can determine which residents are able to reach the facility within 0.9 minutes. For instance, the 6 minute’s service area for a point on a network includes all the streets that can be reached within 6 minutes from those points as shown in Figure 4.2. From the findings, it was discovered that there were variations in physical accessibility to Healthcare facilities, because of variation in the services area.

This can be justified by Ahmad (2012) that, due to spatial variation of population distribution, transportation infrastructure, as well as distribution of Healthcare Facilities, there exist spatial variation in accessibility to Healthcare Facilities and locations where accessibility to Healthcare Facilities is relatively poor. Figure 4.3 shows variation in the served area of Healthcare Facilities based on drive time.

Figure 4.3
Variation in the Served Area of Healthcare Facilities Based on Drive Time

Source: Field Survey (2018)

More so, the study discovered that the minimum driving time for the people within peri-urban to access to the closest facility was a minimum of 0.9 and 6 minutes to access the Healthcare services.
to the public dispensary located to their neighborhood, and 27 and 29.2 minutes to access the Health Service from Regional or Referral Hospital, respectively.

4.3. Healthcare Facilities Service Area Based on Driving Distance
The findings show that Service area based on recommended driving distance generated at a distance of 500 m, 1000 m, 3,000 m, 5,000 m, 10,000 m, 15,000 m and 20,000 m away from the facilities. Service areas from the studied wards were within 4 km as recommended by WHO standards.

Figure 4.4
Map of Variation in the Served Area of Healthcare Facilities Based on Travel Distance

WHO stipulated that each service area should cover 4 km catchment area with a population of 60,000 for primary health care. Concentric service areas show how accessibility varies with impedance. From this study, the creation of service area was used to identify how much land, how many people, or how much of anything else is within the neighbor or region. The findings reveal that total population density was estimated to be 13,407 person/km$^2$ and the average population density per ward was 2,234 people/km$^2$.

4.4. Walking Service Area and its Implication
Walking remains a major way of traveling in Mbeya city peri-urban, walking service area was thus created at a distance of 1, 3 and 5 km away from all Healthcare services in Mbeya city peri-urban. The average walking speed was 5km/hr. This implies that the patient living within the buffered
zone will spend between 15-60 minutes to get to a public dispensary with the exception of the effect of barriers such as the terrain. Figure 4.5 shows proximity to Healthcare Services in the study.

Figure 4.5  
Proximity to Healthcare Services

The findings from figure 4.5 indicate that there were existing spatial variation in the distribution of its population and associated demographic and socioeconomic characteristics. The majority of residents from peri-urban for instance, Iduda, Mwasanga, Tembelo, Itagano and Mwasenkwa walking more than 5km more to procure Health Services from the public dispensary from their neighborhood.

5. Conclusion
Proper Healthcare reflects healthy population and access to Healthcare services are significant factors reducing poverty. Network analysis is the best method for describing the realistic geographical accessibility to Healthcare facilities. This is because service area is demarcated on the basis of time and distance hence it is supportive to calculate travelling distance from demand points (subward centroid/settlements) to service or Health Facility. In fact, absolute equal spatial accessibility is not always attainable but it is likely to plan and built a system of Healthcare Facilities in such a way it permits the highest spatial accessibility for maximum number of the populace.

In the study 96.9% of the total population nearly 2,076 households) out of 2143 household were living in disadvantaged location (low spatial accessibility) that is beyond 4kms which is more than
the recommended distance by WHO (2015). Whereas, some residents had to travel over 15-25 km (drive distance) or 30-51 minutes (drive time) by most of peri-urban to secure Health Service from Regional or Referral Hospital located in the city center.

Based on the observed spatial distribution of Health Facilities, settlement services and population patterns, there is need for optimized Healthcare system especially in peri-urban areas. Thus, the local government authority is advised to improve the road infrastructures, add a number of health personnel and other related resources.

It should also focus on reducing shortage of health personnel including specialized doctors, medical doctors, clinical officers and nurses. Such shortage limits the provision of quality Health Services and in turn, aggravates risks of having unhealthy society higher mortality rates and poor participation into production activities.

References


