Application of spatial analysis tools to assess the dynamics in utilization of public health facilities in northern Botswana

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Abstract

Generally, there is a high flow of patients to certain public healthcare facilities compared to those otherwise within their threshold accessible reach in Botswana. This results in overburdening of those facilities having an influx of patients from outside their respective catchment areas. However, public health facilities are accessibly placed within the communities they serve, which make it difficult to understand why some public health facilities are preferred over others. Therefore, the objective of this research is to assess the geospatial dynamics in utilization of public health facilities in Maun. Purposive sampling technique was used to select 4 out of 11 public health facilities in Maun across the 6tier system in Botswana. A total of 30 households were randomly selected around the chosen healthcare facilities for primary data collection using a questionnaire to capture the dynamics in public healthcare usage. Geographic locations of the chosen facilities and households were recorded using a GPS. Additionally, secondary quarterly patient flow data was collected from the respective facilities. A distance measurement tool was used to determine the travel distance to health facilities utilized by the households. The Kernel density was used to identify the hotspot public health facility in Maun. It was found that the levels of preference for public health facilities decline as one goes down the tier system. The study revealed that facilities are located within patients' accessible reach in Maun as most can be reached by walking and the average travel distance to facilities was 5.45 kilometers, safely within WHO threshold of 8 kilometers. Graduated symbols representation revealed the healthcare facility with high frequency of visitation or degree of preference by our respondents. And Letsholathebe II Memorial Hospital is the hotspot healthcare facility in Maun based on the number of patients that utilize it, which is clearly revealed by results from Kernel Density. This study provides a synopsis on the geospatial dynamics in utilization of public healthcare in Botswana, which is a paramount contribution to decision-making for a sound distribution of health centers in the country and beyond.

Keywords : Kernel density, health facilities, travel distance.

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Application d'outils d'analyse spatiale pour évaluer la dynamique d'utilisation des établissements de santé publics dans le nord du Botswana

Résumé

En général, il y a un flux élevé de patients vers certains établissements de santé publics par rapport à ceux qui sont dans leur rayon d'accessibilité au Botswana. Il en résulte une surcharge de ces établissements ayant un afflux de patients en provenance de l'extérieur de leurs zones de couverture respectives. Cependant, ces établissements de santé publics sont accessibles dans les communautés qu'ils desservent, ce qui rend difficile de comprendre pourquoi certains établissements de santé sont préférés à d'autres. Par conséquent, l'objectif de cette recherche est d'évaluer la dynamique géospatiale dans l'utilisation des établissements de santé publics à Maun. La technique d'échantillonnage raisonnée a été utilisée pour sélectionner 4 des 11 établissements de santé publics de Maun dans le système de santé du Botswana. Un total de 30 ménages ont été sélection de façon aléatoire autour du centre de santé choisi pour la collecte de données par l'utilisation d'un questionnaire permettant de capter les dynamiques d'utilisation des centres de santé publics. Les emplacements géographiques des établissements de santé et des ménages choisis ont été enregistrés à l'aide d'un GPS. De plus, les données trimestrielles secondaires sur le flux des patients ont été recueillies dans les établissements respectifs. Un outil de mesure de la distance a été utilisé pour déterminer la distance parcourue par les ménages pour rejoindre les établissements de santé utilisés. La densité de Kernel a été utilisée pour identifier l'établissement de santé le plus prisé de Maun. Il a été constaté que les niveaux de préférence pour les établissements de santé diminuaient au fur et à mesure que l'on descend de niveau dans le système. L'étude a révélé que les établissements sont situés à portée de main des patients à Maun car la plupart peuvent être atteints à pied et la distance moyenne pour atteindre les établissements était de 5,45 kilomètres ; ce qui se trouve dans le seuil de 8 Km de l'OMS. La représentation des symboles gradués a révélé l'établissement de soins de santé de forte fréquentation ou degré de préférence de la part de nos répondants. Letsholathebe II Memorial Hospital est l'établissement de santé le plus prisé à Maun en se basant sur le nombre de patient qui le fréquente ; ce qui est clairement révélé par la densité de Kernel. Cette étude fournit un aperçu de la dynamique géospatiale dans l'utilisation de d'établissements de santé publics au Botswana, ce qui est une contribution primordiale à la prise de décision pour une saine distribution des centres de santé dans le pays et au-delà.

Mots-clés : densité de Kernel, établissements de santé, distance.

1. Introduction

Performance of public services is considerably determined by the spatial distribution of facilities and resources that provide the service of which three measures of performance are applied: efficiency, effectiveness, and equity (Savas, 1978). Equity is regarded as of paramount importance with regard to dissemination of services (Savas, 1978) although (Cohen & Lee, 1985) argue that health care planning is predominantly based on population based utilization forecasts. The need to critically consider adequate planning for health facilities at community and regional scales cannot be overemphasized since the health status of communities cannot be achieved simply by expansion of health services, but rather by equal distribution using available resources (El-Bushra, 1989). Inequitable distribution and increased cost of access to healthcare result with dissatisfaction among users (Dökmeci, 1977). For instance, there is a tendency to have a favorable distribution of health care services in urbanizing and industrialized centers (Stommes & Sisaye, 1980). Furthermore, (Rahman & Smith, 1999) asserts that "health care is one of the most widespread applications of location-allocation modeling, since it is a universal need, which must be provided throughout a nation, with demand (roughly) in proportion to the population".

Underlying demands for healthcare services and the expenditure forgone need to be adequately scrutinized as they bear importance to both consumers of health services and policy makers. For example, based on circumstantial factors such as social structures a health plan for a certain community may differ in context from another subsequently resulting in multivariate styles of medical treatment across divergent societies (Dowd *et al.,* 1991). Decision by policy makers may also be influenced by urgent developmental priorities in certain sectors of the economy other than health, ultimately causing regional discrepancies in healthcare provisions (Stommes and Sisaye, 1980). In such instances the chosen interventions could greatly affect health outcomes (Frankenberg, 1995). Therefore, it can be deduced that regional and community healthcare disparity is significantly a function of demographic factors, encompassing age, gender, ethnicity, education status, race, and household income levels (Foley, 1977; Malat and Hamilton, 2006) as well as politico-socio-economic factors cutting across social structure and cultural practices (Sachdeva *et al.,* 2007). The political influence of health care service dissemination can be captured as said by Rahman and Smith (1999), "In the absence of any formal analysis and generation of alternatives, the final decision may be made on political or pragmatic considerations."

Generally, policy makers and administrators are much interested in physical accessibility of medical care (McGuirk and Porell, 1984) and expanding population needs (Bashshur *et al.,* 1970). The issue of inequitable distribution of health care services usually manifests in two ways, as either in health care facilities or healthcare staff. Facilities such as hospitals may be inappropriately placed in urbanized centers with robust technologies and services (USAID, 1974; Kaplan and Leinhardt, 1975) where actually the population is much lesser than the neglected marginal communities who are vulnerable to incidence of disease (Stommes and Sisaye, 1980). For healthcare staff, Cohen and Lee (1985) discern that there is a role played by physicians in health resource consumption and hospital selection although they (physicians) are also influenced to practice in affluent communities. However, a correlation can be deduced from the fact that where medical facilities are of a higher tier, employed staff is more qualified and competent as compared to that of low key areas (Logan, 1985). This then ultimately calls for a need to make healthcare available to a broader class of consumers for total utility of services (Kamien and Schwartz, 1973). For rural communities, basic facilities either do not exist or if they do are shoddy resulting in disproportionate levels of disease burden for the disadvantaged groups (Harris, 2010). In rural places, if any healthcare facilities exist, they are dilapidated or obsolete due to increased consumption beyond initial threshold of their implementation (Mountin and Hoenack, 1946). Within each setting, rural or urban, the distance to medical facilities and the cost of visitation will influence the choices and preferences of customers (Lee and Cohen, 1985). Although these may not be the most crucial determinants (Frankenberg, 1995), they influence per capita physician/population ratios (Eisenberg and Cantwell, 1976). Spatial distribution of health care services cuts across both the private and public sector health care provision systems with the former having tendency to be influenced by income levels of target customers (Dokmeci,1977). The latter is coined on the notion of commonality of services provided by the state (Savas, 1978) and largely seeks to prioritize on affording health services to large population of consumers as well as utilization and need of the services (Eisenberg and Cantwell, 1976).

On the other hand, healthcare planning by policy makers seems to neglect the social background of communities and healthcare development is rather centralized than participatory. Policy makers and healthcare planners are heavily influenced by prioritization for highly populated areas and

urban areas so as to aggregate development. Although this is the case, there seems to be a contradiction based on the fact that marginal rural communities are usually densely populated but with no emphasis on medical care and are therefore vulnerable to disease burden (Stommes and Sisaye, 1980). In the luckily healthcare serviced communities, the input of the society is marginal. Psychosocial perceptions of the serviced communities are neglected, which brings about a discrepancy of inaccurate placement and delivery of healthcare services to these communities (Bour, 2004). This means the disregard towards community input by policy makers results in uninformed decisions which in the end do not address the needs of a community. The community is mostly informed about what has been already planned for them without initial consultation, if there is any consultation, it will be to satisfy formality as the final prerogative usually rests with the policy makers. Although most of the time, the electorates through their political representatives guide the development of their communities, there are compromises with regard to what they really need, especially with improvising economic situations (Mountin and Hoenack, 1946). In the end compromises such as these only result in customer dissatisfaction, as well as service capacity much less than the existing demand. When health care developments are initiated or implemented within communities, the discrepancies eventually manifest themselves with time.

Because healthcare facilities are fixed in nature, they become overtaken by demographic dynamics or depending on customer experiences may have a changed threshold of patient inflow, whether declines or surges. In low densely populated areas, the distance of reach may be a wide stretch, although according to NORAD (2012) and WHO (2016) the average recommended distance of a healthcare facility should at most be at eight kilometers, a significant threshold. Some areas have distinct epidemiological needs which should be primarily targeted, in this regard avoiding the use of blanket developmental policies by taking into account the diversity of the Botswana society (MoH, 2010). Therefore, this case study aims at evaluating geospatial dynamics in utilization of public healthcare facilities in Maun using geospatial analysis approach.

2. Materials

2.1. Study Area

Maun is the administrative capital for the North West District in Botswana (figure 1a) with a population of 60257 people (CSO, 2011). It has a total of 11 public healthcare facilities which have an elaborate hierarchy ranging from health posts to the District referral hospital. These facilities are, Letsholathebe II District Referral Hospital, Maun 24 hour General Clinic, Moeti 24 hour Martenity Clinic, Matshwane Clinic, Maun Clinic, Disaneng Clinic, Sedie Clinic, Thito Health Post, Shashe Health Post, Kubung Health Post and Disaneng Health Post (figure 1b).

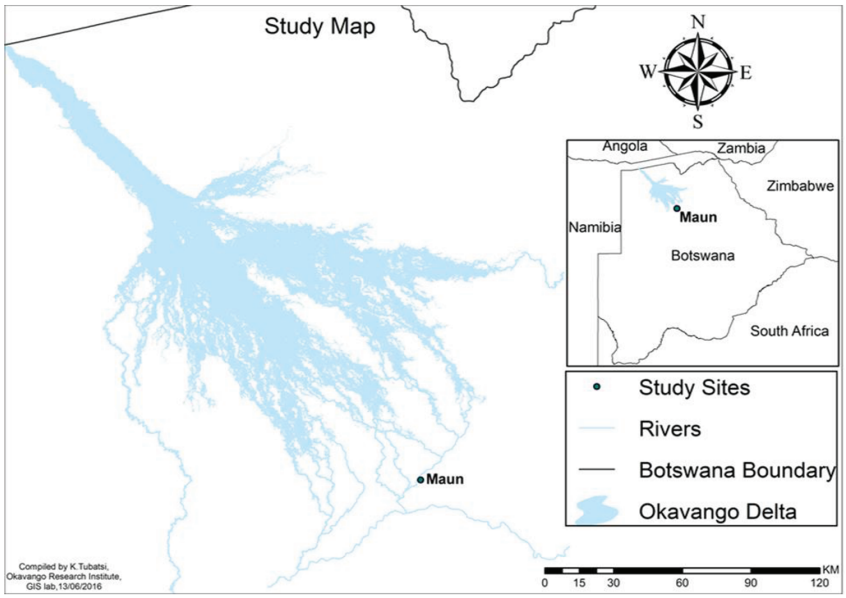

Figure 1(a). Geographic Location of Maun, Botswana

These health facilities vary according to the staff they employ and the magnitude of support facilities they have. Four facilities were chosen using purposive sampling after classifying them into different levels on the hierarchical order of the 6tier system.

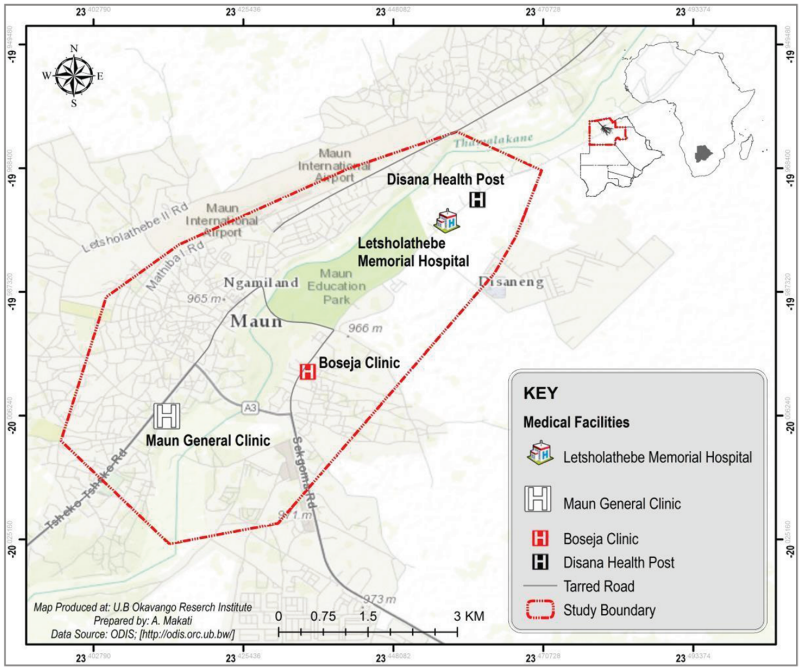

Figure 1(b). Geographic Location of Study Area Showing Medical Facilities in Maun

3. Data Collection and Analysis

Our study used both primary and secondary data. The primary data was generated from point data collected from sampled households using a GPS, and GPS locations of the selected public healthcare facilities in Maun. Secondary data composed of the visitation records derived from quarterly reports from public healthcare facilities in Maun.

3.1. Sampling Methods and Techniques

The sampling frame of 40 497 people 16 years or older (CSO, 2011) exist in Maun from whom a sample was collected using random sampling design. A sample of 30 people from 30 households was randomly selected at 18 percent marginal error as well as 95 percent confidence interval representing 30 households in Maun. The selected people were 16 years or older because at the age of 16 one has personal consent to visit medical facilities without guardianship. The public healthcare facilities purposively selected were Letsholathebe II Memorial Hospital, Maun General Clinic, Boseja Clinic and Disana Health Post, which all fall within different categories of Botswana's 6 tiered healthcare systems (Campbell, Kereng, & Malmborg, 2012; Ingstad, 1995). A minimum of 10 respondents were chosen around each facility to determine if there is any trend on usage pertaining to the facilities near them. Open interviews and a questionnaire were used to capture their views on utilization of health facilities.

3.2. Location of Public healthcare facilities

Regarding the healthcare facilities, a sampling population frame of 11 facilities across the 6 tier system of public medical facilities exists in Maun. In this case, 4 healthcare facilities were sampled using purposive sampling technique across the 6 tiers to consider their geospatial locations by means of GPS point data collections, and utilization from quarterly visitation records.

GPS points were collected from the selected 4 public healthcare facilities in Maun in order to identify their geographic locations and how they are spread within the community space they serve. Similarly, GPS points of the participant households were collected in order to establish if there is any spatial relationship between households and the utilization of public healthcare facilities within their domain. After the coordinate points were collected, they were added as an independent layer to the ArcMap 10.2 of ArcGIS software and thereafter superimposed on an existing topographic map of Maun (figure 1b). An arbitrary boundary that specifically covers the study sites was created for ease of analysis.

3.3. Data Analysis

Geospatial information analysis method was used to establish if there is a spatial relationship between the geographic location of public healthcare facilities and the respective communities they serve. In this case, pattern analysis was used to assess the degree of the spatial relationship. The Kernel Density mapping tool in ArcGIS gives an estimation of the proportion of total incidents which can be expected to occur in a given area of interest. This tool uses location based incident data to show disproportionate incidences of events across geographical space. It is an exploratory method used to identify locations of clusters of a given occurrence or incidence, which in turn shows hotspot areas or cold spot areas. It creates a probability surface by smoothing or averaging neighboring cell values based on the tendency of neighboring objects to be of similar characteristics, otherwise known as spatial autocorrelation. The Kernel Density estimate calculates the density of incidence in each grid cell away from

the point of interest limited by a specified bandwidth or search radius. Simply disposed it counts the number of events around the location where the estimate is to be made. As the distance increases away from the reference point, the estimate of occurrences or incidents decreases therefore there is a greater probability of an incident occurring in a location, the closer it is from the point of interest. The estimate weights neighboring events more heavily as a result. This tool is used in many applications such as in Wildlife Ecology, Epidemiology and Criminology.

The collected GPS points were entered into the ArcMap 10.2 Software with the Maun ground shape file. The analysis tool employed was the Kernel Density Estimate, which identifies significant spatial clusters of high values (hot spots) and low values (cold spots). The tool automatically groups data within a given location and aggregates it through its chosen analysis scale. In this case, GPS point data on healthcare and household locations were interrogated to produce an optimal hot spot analysis on usage of healthcare facilities within respective catchments. The output show the density of incidences or utilization of various chosen facilities based on quarterly patient flow data. Graduated symbols were used to represent the levels of preference of chosen public health facilities by respondents. In this case graduated circles were used, which differ in size according to preference frequencies.

The distance measurement tool was also used to determine the distances from input respondent point features to all nearby points within a specified health facility search radius. In this case the tool was used to measure the distance of a given healthcare facility from respondent households falling within its catchment threshold that utilize the facility.

4. Results

This section presents the results and discussions derived from geospatial pattern analysis on utilization of public healthcare facilities in Maun.

4.1. Geospatial analysis of public healthcare facilities in Maun

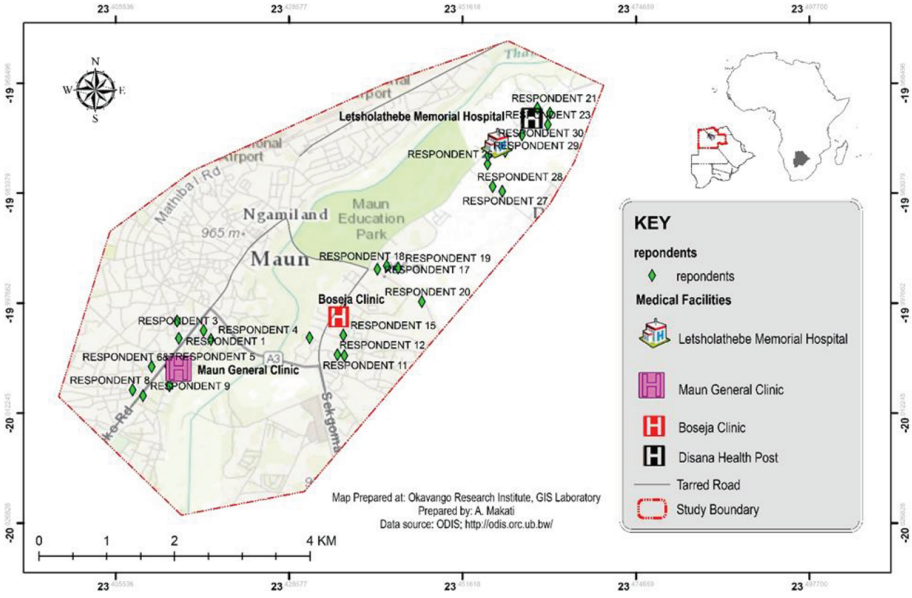

Figure 2(a). Spatial Distribution of Study Participants.

Figure 2a above reveals a distribution of respondents across the study's geographic location. Graduated circles were used to represent the frequency of visitation or degree of preference of the facilities by the respondents. As seen in figure 2b the circles enlarge in size as the frequency increases hence the smallest circle represents the smallest figure and the largest circle represents the largest number of frequencies. The graduated symbology analysis in the present study is premised on the number of respondents voting in preference for each public health facility. However, in the figure 2b below, it appears the total number of respondents is 27 instead of 30. This is because there are 3 sets of respondents who share the same location. Therefore, their coordinate points are identical and the ArcMap 10.2 tool does not capture them differently.

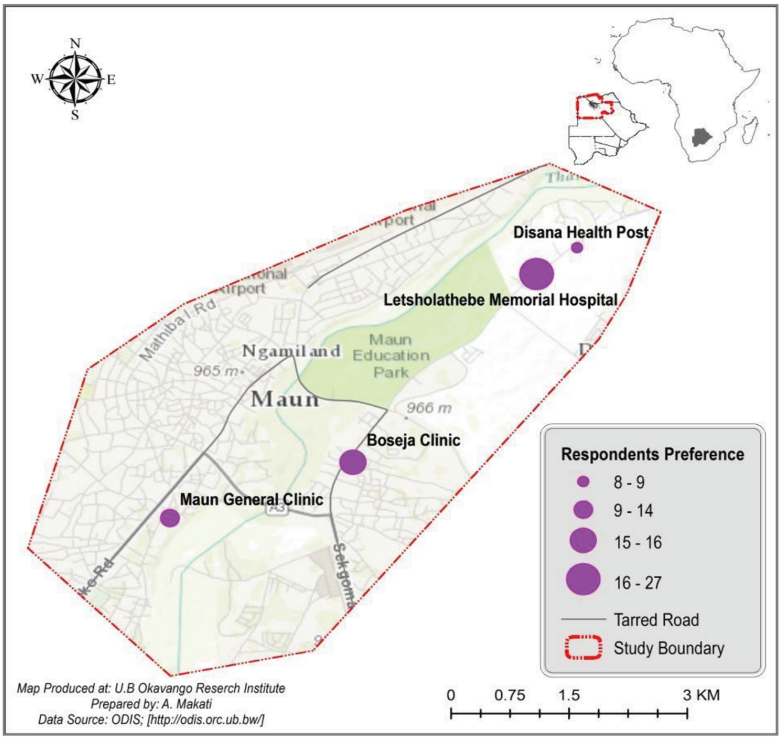

Figure 2(b). Graduated Symbols Representation of Study Participants Preferences.

The largest circle at Letsholathebe II Memorial Hospital reference point represents the number of respondents who prefer to go to utilize this public health facility. In this case all the 30 respondents use Letsholathebe II Memorial Hospital. The nature of this hospital is such that it is a district referral hospital with 270 beds servicing areas around Ngamiland, Gweta and Ghanzi. Although it is not intended to be a facility of first instance, there are cases of self- referrals and emergency visitations in addition to highly prioritized in-patients. Most respondents (83.3%) opined that accessibility to public healthcare facilities in their community is easy, which is also supported by travel distance calculations (table 1) although there are transport fees to be considered in certain instances.

Table 1. Average distance travelled by respondents (km)

Facility	Average distance travelled by respondents (km)
Letsholathebe	6.18
Maun General	4.68
Boseja Clinic	5.99
Disana H/Post	4.96
Average of total	5.45

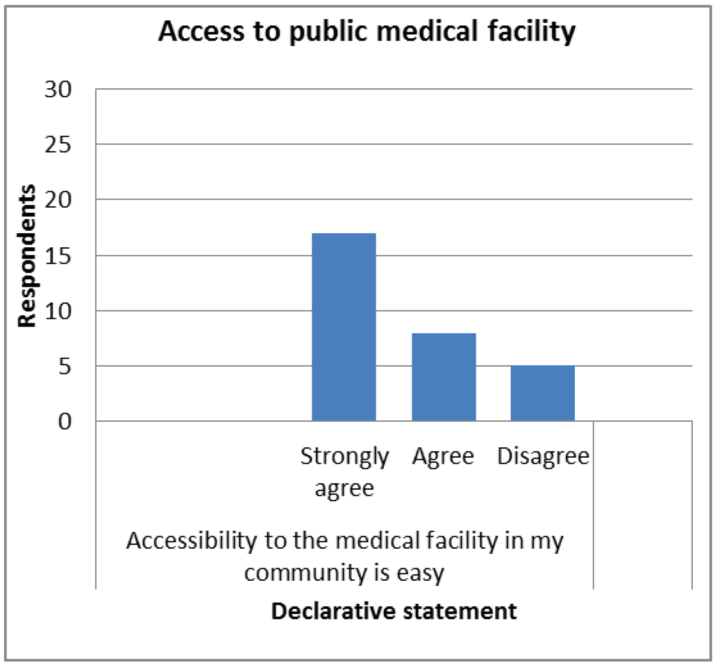

Figure 3. Psycho-social perception on public access to public medical facility in Maun

The Letsholathebe II Memorial Hospital boasts of an elaborate human resource pool with specialist doctors and nurses in various medical diaspora and permanent general doctors as well. This hospital also leads with hi-tech infrastructure and equipment in various wards as well as those who operate and maintain these machines. Based on these facts, it is not surprising to see such a high number of respondents voting in preference of this public medical facility. The reflection of this is visible in the utilization analysis results, for example, 76.7% of the respondents give preference towards facilities with full time doctors and specialists while 93.3% are in favor of facilities operating 24 hours. All these characteristics are apparent in Letsholathebe II Memorial Hospital. The next preferred medical facility is the Boseja Clinic, which to a large extent is preferred by those within its proximity and a few other respondents from Maun General Clinic and Disana Health Post catchments. A total of fifteen respondents (figure 4) preferred Boseja Clinic and likewise the main

reasoning was that the facility was easily accessible from places of residence. Similarly other respondents pointed out that they use the facility based on referral advices from other facilities in case of shortage of medicines and drugs. The Boseja Clinic is therefore a facility of first instance to the community which it serves.

The third preferred public medical facility according to respondent preference is the Maun General Clinic. Although this facility is a little above the Boseja Clinic in the healthcare hierarchy, respondents' main outcry was that the facility is dilapidated perhaps the reason why Boseja Clinic has a higher preference frequency. There were complaints of the clinic always having shortage of essential drugs such as hypertension treatment. Ironically, the facility is said to be always overcrowded since it always has visiting doctors on a daily basis therefore gets overwhelmed by referrals from other mainstream clinics. Otherwise this facility received appraisals from the community it serves for it is the only 24 hour clinic in Maun.

The least preferred public health facility is the Disana Health Post since only 8 respondents whom were solely from its catchment voted in favor it. This public health facility is the lowest in the hierarchy of the chosen public health facilities. The structure is quite small and there is one active nurse in-residence although in some cases it is able to manage referrals to Letsholathebe II Memorial Hospital. The facility mainly services infants with monthly immunization and nutrition. Since this facility is proximate to Letsholathebe II Memorial Hospital, respondents around its catchment prefer the former and majority of respondents who use this facility use it only sometimes. The main outcry was that there are no doctors in this facility since it is a health post only there to serve its somewhat rural catchment threshold.

Trends in respondents' affinity towards public health care facilities diminish with decreasing healthcare hierarchy level. The Letsholathebe II Memorial Hospital tops the respondent preference margin and this margin falls downwards the two clinics, Boseja and Maun General Clinic respectively and the Disana Health Post. The levels of preference are embedded in the community psychosocial perceptions of public healthcare facilities which are guided by healthcare planning. Analysis on individual preferences of the facilities indicates that 76.7% of respondents preferred facilities with full time doctors and a further 80% agreed that some ailments require specialist doctors while 93.3% preferred 24 hour facilities. This traits are all characteristic of Letsholathebe II Memorial Hospital hence the highest respondent preference level. Looking at the human resources and infrastructural planning of facilities along the

hierarchy, there is a downward decrease in the number of healthcare staff, which in turn influences preference by respondents. Otherwise most respondents (83.3%) agree that public healthcare facilities are strategically placed within their accessible reach as 56.13% of them said they can reach the facilities within their community by simply walking there.

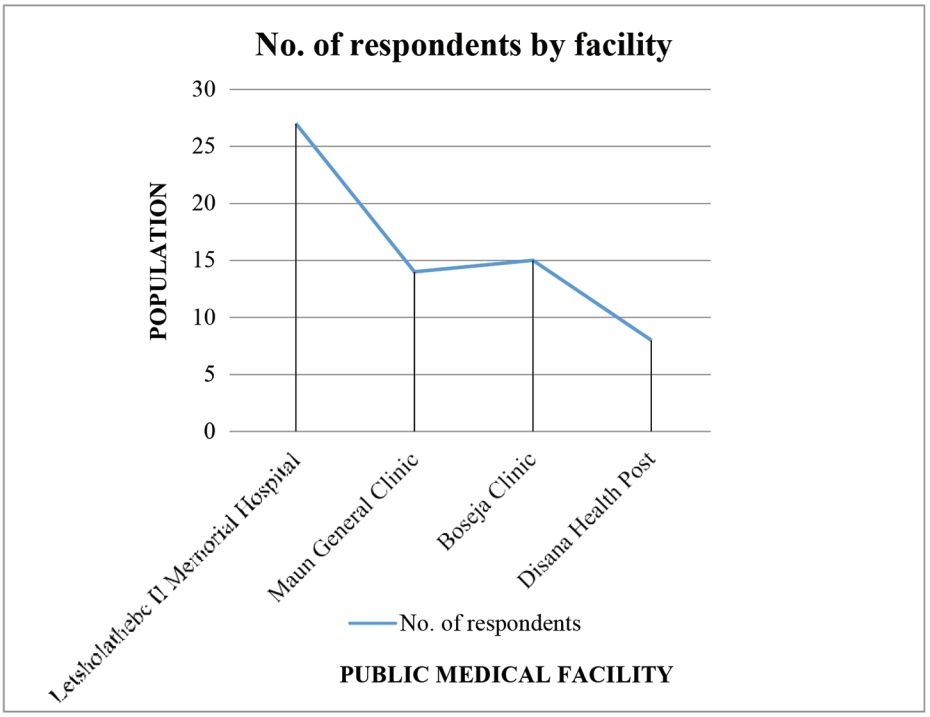

Figure 4(a). Respondents' preferences by facility across the tier system in Maun.

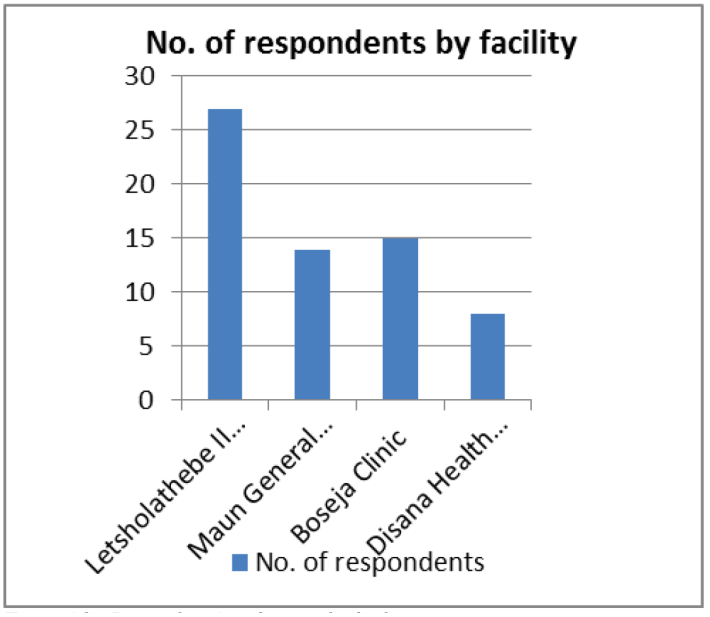

Figure 4(b). Respondents' preferences by facility.

Figure 4(a), (b) show respondents preferences by facility. The graphs reveal that Letsholathebe, which is the main hospital, is visited by most people and Disana health post receives the least number of patients' visitation.

4.2. Kernel Density Mapping

In the present study, the Kernel Density estimate tool was applied to discern the degree of use or preference of public healthcare facilities based on quarterly patient flow numbers for each facility as seen in Figure 5 below. According to patient flow records in the first quarter of 2016, January to March there were 9500 patients for Letsholathebe II Memorial Hospital, 7900 for Maun General Clinic, 3000 for Boseja Clinic and 650 for Disana Health Post. The minimum number of occurrences is 38 incidents per square mile while the maximum is 380 incidents per square mile, which means based on inflow numbers, the least number of patients to a facility is 38 while the highest number can be 380 patients per square mile.

Results illustrates that Letsholathebe II Memorial Hospital has the highest number of patient flow showed by a denser red gradient especially at or near the location. This means the there is a higher density of occurrences as bandwidths of incidence are much closer to each other hence the heavier red gradient. There is little variation between neighboring cells of incidence around the location of Letsholathebe II Memorial Hospital. Therefore there is high probability of patients visiting Letsholathebe II Memorial Hospital the closer they are from this hospital.

Consistent with quarterly patient flow numbers, Maun General Clinic is the next most used public health facility. The facility has a maximum of 228 incidences per square mile and further away has the least number of 76 chances of patient visitations. Boseja Clinic follows after Maun General Clinic with a maximum of 190 visitations per square mile and minimum of 76 per square mile. Disana Health Post has the lowest number of incidences and has been subdued by Letsholathebe II Memorial Hospital as they share the same locality. The minimum number of incidences or visitations to this facility is only 38 visitations per square mile. Table 2 summarizes psychosocial perceptions on public healthcare by communities in Maun. With regard to the psychosocial perceptions of the community towards public medical care, embedded perceptions may exist but people still choose to use public medical care. The community remains with no choice but to continue to use public medical care since a good state of wellbeing is necessary for them. However, it should be noted that perceptions vary from one individual to another. In this case there can be no wrong answer but there is a likelihood of consistency of thought since opinions are gathered from the same society.

Table 2. Maun Community Psychosocial Perceptions on Public Helathcare Facilities

SN	Declarative Statement	SA[1]	A[2]	N[3]	D[4]	SD[5]
i	The medical facilities in my community are good enough, so I use them.	9 (30%)	10 (33.3%)	4 (13.3%)	5 (16.7%)	2 (6.7%)
ii	I do not think I trust the medical personnel at the healthcare facility in my community, so I do not seek their service.	4 (13.3%)	5 (16.7%)	1 (3.3 %)	10 (33.3%)	10 (33.3%)
iii	It is not part of my culture to allow people whom I do not know to treat, me, so I do not use public healthcare facilities.	4 (13.3%)	0	1 (3.3%)	5 (16.7%)	20 (66.7%)
iv	The medical personnel in my community's healthcare facilities are hostile so I do not consult them.	2 (6.7%)	3 (10.0%)	1 (3.3%)	11 (36.7%)	13 (43.3%)
v	I do not think those who attend people in my community's medical facility are well trained	0	3 (10.0%)	6 (20.0%)	6 (20.0%)	15 (50.0%)
vi	Drugs and medicines are not always available at the healthcare facility in my community so I go elsewhere.	14 (46.7%)	7 (23.3%)	1 (3.3%)	2 (6.7%)	6 (20.0%)
vii	Accessibility to the medical facility in my community is easy.	17 (56.7%)	8 (26.7%)	0	5 (16.7%)	0
viii	I believe in the healing power of my religious faith so I do not use public healthcare.	4 (13.3%)	4 (13.3%)	6 (20.0%)	9 (30.0%)	7 (23.3%)
ix	The healthcare staff at public medical facilities is too judgmental and chastises me when offering services so I do not seek medical attention.	5 (16.7%)	4 (13.3%)	1 3.3%)	10 (33.3%)	10 (33.3%)
x	I am fearful of the surgical procedure in healthcare facilities therefore I do not use them.	3 (10.0%)	3 (10.0%)	5 (16.7%)	8 (26.7%)	11 (36.7%)
xi	I would rather resort to death than go for healthcare treatment.	0	0	1 (3.3%)	5 (16.7%)	24 (80.0%)
xii	Because of awareness and health education I am compelled to visit public healthcare facilities anytime.	18 (60.0%)	11 (36.7%)	0	1 (3.3%)	0

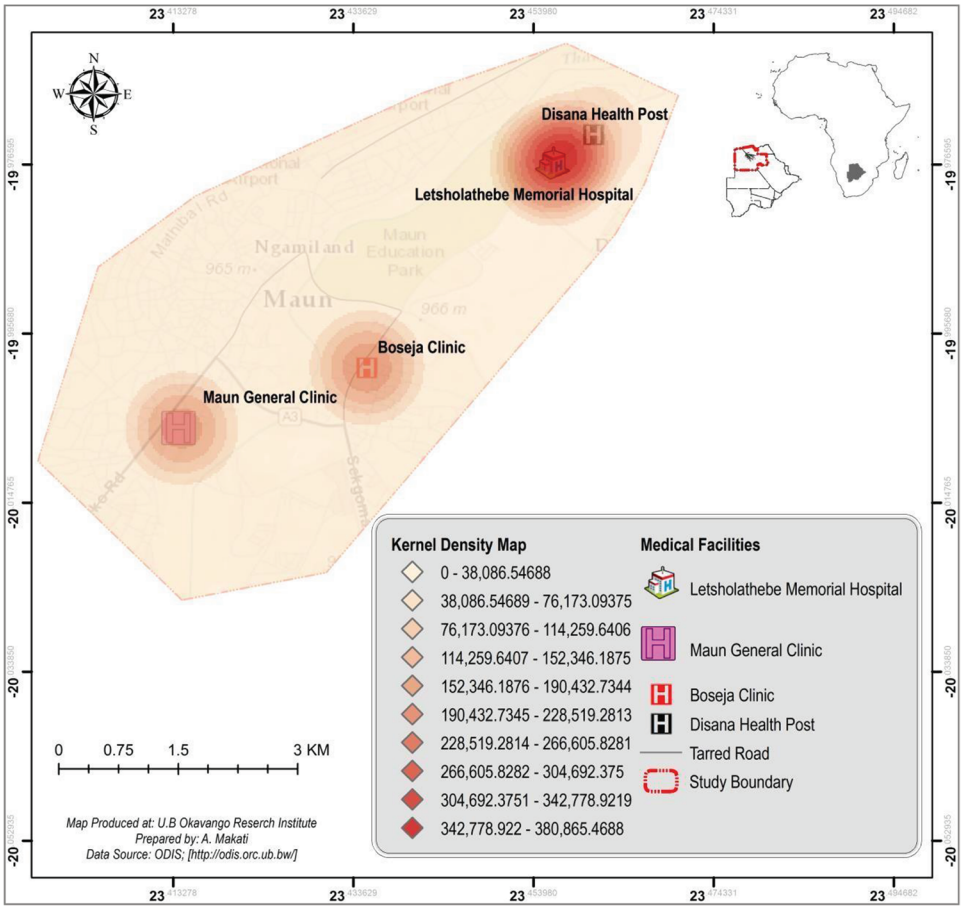

Figure 5. Kernel Density Mapping

Figure 5 above reveal kernel density estimates for the study area. The results show Letsholathebe heatlh facility being the main hotspot area. This is not surprising because it is the main hospital in town and hence receives more patients.

5. Discussion

Medical care services are dynamic depending on their location and nature of the services they provide. For instance, they may be based on specialty, epidemiology or target population. A patient may use trial and error or absolve to hearsay from others who have used the services in order to decide on the best medical facility of last resort. In this case, personal experiences influence the choice of best alternative that exists in areas where health care services are most adequate or above par as compared to the rest. Previous studies assets that an individual is a microcosm of the macrocosm (Gobalet and Thomas, 1996) whom exists within a natural setting. The results from Kernel Density estimates reveal that people chose where to go for medical attention in Maun, with Letsholathebe hospital being the most preferred healthcare facility. Therefore, spatial analysis methods used provide an insight on how people access and utilize public healthcare facilities.

Application of GIS and related spatial analysis tools in describing and understanding provision of healthcare is essential in order to explore how health care can be improved by decision makers (McLafferty, 2003).

Traditional medical practices and believes have been in existence in Botswana before the arrival of Western medicine (NORAD, 2012, p.35). Critically so, depending on subjective cultural belonging, there can be vehement condemnation of the Western medical practices (Suchman, 1964). However, with modernization and globalization, inclination to cultural dominance is slowly dying out as new generations have a new perspective of things and view culture differently as compared to those who came before them (Bour, 2004). Similarly, the stratification of the new society gives little regard to cultural beliefs and practices as community ties continue to weaken and the common voice of cultural advocacy dwindles.

Although this may be the case, rural communities where ties are relatively strong, emphasis on cultural beliefs and practices is advocated for without colloquiums; especially that little or no medical care exists within their setting (Bour, 2004). Generally the regard for medical health care is a purely subjective issue along different cultural backgrounds in Botswana. The issue of perception also draws down to the individual, depending on their age, gender, income level, distance from healthcare facilities, level of risk aversion, fearfulness of medical procedure, level of education and awareness, trust on medical personnel or personal experiences from past encounters. These guide the disposition of choice to select the medical facility or reject a given medical facility or medical procedure in its totality.

Physicians are also primary in healthcare services provision, since they practice relieving disease burden. However, it is proven that they have a tendency to be attracted to highly affluent areas leading to brain drain of rural healthcare systems (Smith, 1976). These are some of the underlying factors that give rise to inequitable distribution of healthcare facilities in Botswana making Maun no exception to such. Although other studies exist on the same subject, there has been a high tendency to use the quantitative approach fluxed with statistical rigor aiming to validate the existence and magnitude of healthcare disparities (Isabel and Paula, 2010). Therefore, our study uncovered preliminary perceptions of communities in order to guide in addressing their needs thereby limiting the existence of 'white elephants' only to be shunned by those whom they are supposed to serve.

6. Conclusions

According to GIS mapping and analysis, public healthcare facilities are strategically placed within the catchments they serve, and are within patient's accessible reach in Maun; as they are easily accessed within walking distance and in some instances by other forms of transport that have financial implications. Community accounts also echo the same sentiments since they can easily reach their facilities by simply walking and this confirms that facilities are adequately placed within their accessible threshold reach. Although this is the case there are instances where other modes of transport such as taxis are used, better even; there are adequate transport arteries to easily reach this facility by walking, taxi or private cars. The public healthcare facilities also serve each other with those higher in the hierarchy relieving those lower than them. This behavior follows on Christaller's Central Place Theory, which explains that a nearby facility services its immediate customers as well as those of the external hinterland. According to GIS calculated travel distances to each of the facilities by each respondent; the average distance of travel to a medical facility in

Maun is 5.45 kilometers, which is within the WHO threshold distance of 8 kilometers. Graduated symbols representation revealed the healthcare facility with high frequency of visitation or degree of preference by our respondents. And Letsholathebe II Memorial Hospital is the hotspot healthcare facility in Maun based on the number of patients that utilize it, which is clearly revealed by results from Kernel Density estimates. Although there are embedded psychosocial perceptions on healthcare in Maun community, public healthcare facilities remain highly utilized.

Acknowledgments

This study was sponsored by Ministry of Tertiary Education, Research, Science and Technology, Gaborone Botswana. Secondary data on patients 'quarterly visitations to health facilities was provided by Ministry of Health and Wellness' health facilities in Maun.

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