Spatial Accessibility of Colorectal Cancer Patients to Health Care Facilities in Kelantan State: A Study on Medical Geography

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Abstract: Medical Geography (or Health Geography) is the application of geographical information and methods to the study of disease, ill health or aspects of health care, primarily facility location, accessibility and utilization. With the advance of Geographic Information System (GIS) and Spatial Analysis techniques, geography of health care has become useful in planning and managing health care deliveries. This study focused on geography of health care where network analyst functions of GIS was used to investigate the accessibility of colorectal cancer patients to health care facilities in Kelantan State, Malaysia. Information was obtained from patients' notes from Universiti Sains Malaysia Hospital and the locations of colorectal cancer patients' homes and health care facilities were mapped using Global Positioning System. Network analysis functions in ArcGIS 10.0 software was utilized to measure geographical accessibility of colorectal cancer patients to hospitals. Accessibility was measured based on 2 km multiple buffer distance from hospitals, service area of the hospitals and origin-destination cost matrix. The findings revealed that some parts of the district had very low accessibility to hospitals. Some colorectal cancer patients have to travel more than 3 hours to reach the cancer treatment and oncology specialist clinics located in the district. The findings could be used for planning better health care deliveries especially in sparsely populated areas.
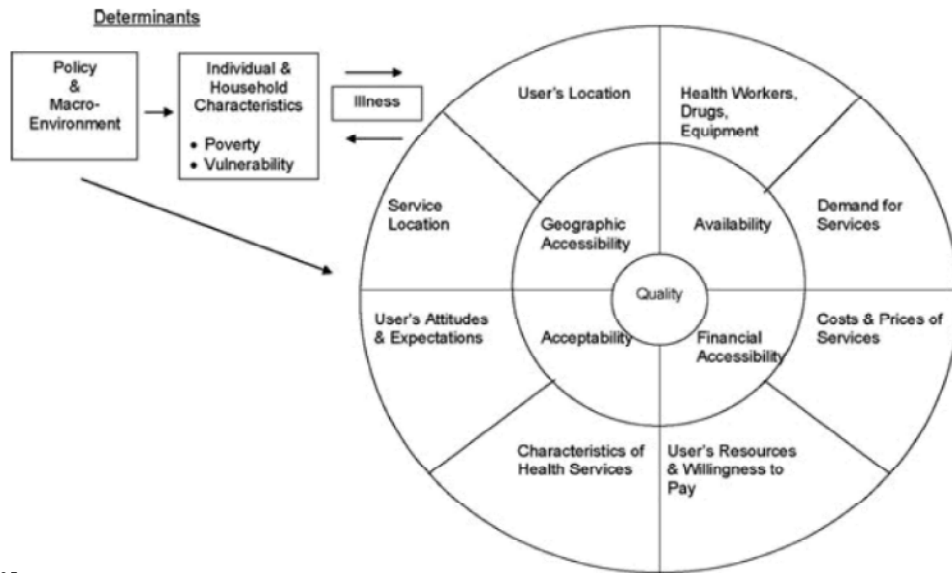
Key words: Geographical accessibility · Health care · Network analysis · Kota Bharu · Malaysia

INTRODUCTION

Cancer is a major health problem in many countries. It is a leading cause of death worldwide, estimated at 7.4 million deaths (around 13% of all deaths) in 2004 and predicted to reach 12 million deaths by 2030. Lung, stomach, liver, colorectal, esophagus and prostate are common types of cancer among men, while breast, lung, stomach, colorectal and cervical cancers frequently occur among women [1, 2]. In Malaysia, colorectal cancer, colon cancer or large bowel cancer which includes cancerous growths in the colon, rectum and appendix accounted for 14.2% of male cancers making it the commonest cancer among men; at 10.1% of female cancers it is the third most common cancer among women [3; 4] The statistics published by the National Cancer Registry (NCR) has shown an alarming rate of increase in the number of

cancer cases, hence health care facilities should be properly planned to cater to the needs of these patients.

In Malaysia, population based cancer registries in many states have been established to provide an epidemiological profile of cancers so that the cancer burden can be assessed as well as to identify trends and high risk groups for specific cancers to plan appropriate cancer control programs and sufficient patient care facilities [5]. The cancer registry in the state records all diagnosed cancer patients in the state, these records are regularly updated and reported to the Ministry of Health. Reports from all the state cancer registries are collated at national level to produce the NCR report for the country. At present, the reports from state cancer registries do not include the geographical variation of the case distribution; it is also not possible to identify possible cluster of cases as well as assess the accessibility of the

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Source: [10]
Fig. 1: Multi-dimensional Concept of Accessibility

cases to health care facilities [6, 7]. This study, therefore, aims to investigate geographic accessibility of colorectal cancer patients to health care facilities in Kelantan State, Malaysia using network analysis of ArcGIS 10.0 software.

Background of the Study: Health Geography or Medical Geography has been described as the application of geographical information and methods to the study of disease, ill health or other aspects of health care such as facility location, accessibility and utilization [8, 9]. In the study of geography of health care, accessibility and utilization of health care facilities among patients has become the primary concern. Accessibility means the ease with which one place can be reached from another [6; 8] or as the degree to which something is 'get-at-able' [10]. According [11] and [12] accessibility is a multi-dimensional concept which can be described based on four dimensions, namely geographic accessibility, availability, financial accessibility and acceptability (Figure 1). Geographic accessibility is measured based on physical distance or travel time from service delivery point to user. Availability is defined as having the right type of care available to those who need it, such as hours of operation and waiting times that meet demands of those who would use care, as well as having the appropriate type of service providers and materials. The third dimension of financial accessibility focuses on the relationship between the prices of services (in part affected by their costs) and the willingness and ability of users to pay for those services, as well as be protected

from the economic consequences of health costs. Finally, acceptability means the match between how responsive health service providers are to the social and cultural expectations of individual users and communities [6; 11]. In relation to health facilities, quality of service has been the main concern in order to ensure its benefit to the public. From the four dimensions of accessibility, geographical accessibility is much easier to measure and determine [12].

Geographic accessibility refers to the ability to command transportation network facilities needed for reaching supply locations at suitable times. Thus, a good mode of transport and its network will improve individual accessibility [13]. Additionally, [14] regard access and mobility as important dimensions of quality of life. Thus, accessibility to health care is a measure of mobility of certain groups of people to move from one specific place to health care facilities or to get access to facilities via the transport networks most commonly available to them. In essence, accessibility measures should reflect three common elements of people, transport and facilities.

As noted by [6, 15], accessibility measures can be defined in several ways and they must take into account at least three elements, which are the location and characteristics of the individual or type of person, the location and characteristics of opportunities for relevant activities and the connecting transport system. As for health care accessibility, [16] divided it into two categories namely revealed and potential accessibilities. The first category deals with the actual use of health care

services while the second category concerns the geographical patterns and aggregate supply of medical care resources [17]. These can be further divided into spatial and non-spatial accessibilities [18]. Spatial or geographic accessibility is referring to the geographic elements of distance and time between the location of the patient and the health facility. While the non-spatial accessibility reflects the non-geographic elements such as social class, income, race, age, sex, etc [19].

Geographic Information System (GIS) has widely been used in measuring geographic accessibility. GIS with Network Analysis function could be used to perform buffer analysis, service area analysis and origin-destination cost matrix analysis [20, 21]. The study by [12] used GIS to measure accessibility of health care facilities to the senior and non-senior perspectives in Montreal Island. The study found that travel behavior varies widely across space and older residents outside downtown areas were less mobile and have difficulties in accessing health care facilities. A study by [22] in Klang Valley, Malaysia found that ease of access was an important factor in determining compliance to treatment among breast cancer patients. Health care facilities are considered easily accessible when the distance between health facilities and residences of cancer patients are less than 12 kilometers or approximately 20 minutes driving time at a medium speed. This will reduce the burden of patients enduring pain during the travelling time as well as limit the cost of the journeys [23]. Another suggestion is that hospitals should be accessible within a 2km buffer of the surrounding population [6]. The study by [24] found that there was a relationship between number of treatments received and distance from healthcare facilities among stage IV colorectal cancer patients in Hamilton, Ontario. Thus, accessibility measures could guide decision makers and planners when planning new health care facilities or upgrading of existing facilities.

MATERIALS AND METHODS

Three measures of accessibilities were calculated using Network Analyst Function of ArcGIS 10.0 software. First, the study measured multiple rings buffer of 2 km [6], where radial Euclidean distance from hospital was calculated and mapped. Then, service area analysis was calculated based on distance and time travelled at the average transport speed of 60 km/hour from patient location to the nearest health facilities. Service area maps were produced which depicted travel time in minutes and km. From these maps, a suitability map, showing the

coverage of service for hospital was derived. Finally, origin-destination (O-D) cost matrix was used to measure travel time from districts centers to Oncology Specialty Clinics, which is located in Kota Bharu district.

Data Collection: As information from patients' notes were required, ethical approval was obtained from the Research Ethics Committee (Human) of Universiti Sains Malaysia which is in compliance with ICH GCP guidelines (USMKK/PPP/JEPM[204.3 (8)]). This study was also registered with the National Medical Research Register (NMRR-08-1336-2734). The locations of colorectal cancer patients were identified based on addresses gathered from patients' records at Universiti Sains Malaysia Hospital (HUSM) and geographic coordinates were captured using Global Positioning System (GPS). The original data was obtained in EXCEL format. In order to correctly locate the recorded addresses, Google Earth software, postmen and help from the local people were used. No contact was made with the patients and addresses were not verified with the owner of the houses. The data were entered into ArcView 3.2 and converted into ArcGIS 10.0 format. The entered data were verified with the patients' file records at HUSM. There were 96 confirmed and verified colorectal cancer cases in Kelantan State.

The data needed to conduct the analysis included location of cancer incidents, location of health centres, road network and population. The location of health centres were gathered from various sources and mapped by using ArcGIS 10.0 software. Road network was obtained from Department of Town and Country Planning, Kelantan State and population data was obtained from [25].

The Study Area: The population of Kelantan state is 1,539,601 and 95.7% are Malays, 3.4% Chinese, 0.3% Indians and 0.6% others [25]. The ethnic distribution in Kelantan is different from the Malaysian population (28.334 million) which has an ethnic distribution of 67.4% Malays and other Bumiputera, 24.6% Chinese, 7.3% Indian and 0.7% others. Kelantan state has 10 administrative districts namely Bachok, Kota Bharu, Machang, Pasir Mas, Pasir Puteh, Kuala Krai, Jeli, Tumpat and Gua Musang. Kota Bharu is a highly populated district accommodating 30% of the total population in Kelantan. Kelantan is located on the north-eastern part of Peninsular Malaysia (Figure 2). The reason for choosing Kelantan state is that the state has the highest incidence of poverty in Peninsular Malaysia which is at 2.7 % in

Fig. 2: The study area

2012 as compared to the national poverty rate of 1.7 % [26]. Mapping colorectal cancer cases in Kelantan using GIS allows the analysis of the pattern of the disease and could potentially be used for better health care delivery in the state.

RESULTS AND DISCUSSION

The study mapped the distribution of colorectal cancer cases in Kelantan State. Figure 3 shows the distribution of colorectal cancer cases in Kelantan. The cases were clustered in highly populated districts such as Kota Bharu, Tumpat, Bachok and Pasir Mas. In Kota Bharu district, there are three main hospitals namely HUSM, Hospital Raja Perempuan Zainab II and Kota Bharu Medical Centre that provide treatment for cancer cases. The only oncology specialist clinic is at HUSM [27]. Other health facilities in Kelantan state include smaller district hospitals that do not provide treatment for cancer cases. Three measures of accessibilities were calculated.

Multiple ring buffers at interval of 2 km were used to measure service area coverage for hospitals as suggested by [5]. Based on the analysis, it was found that most of
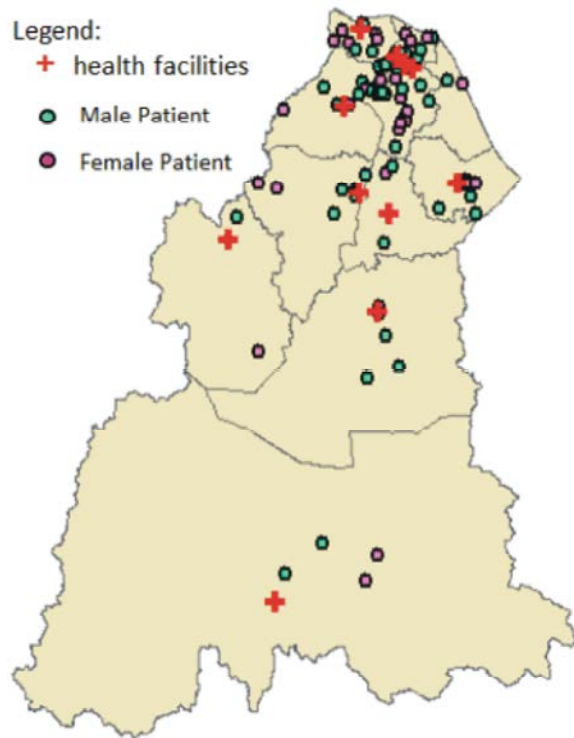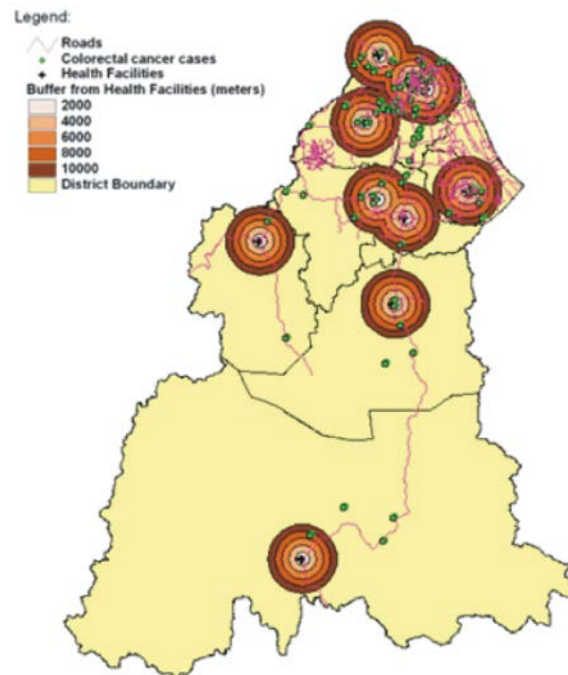
Source: Authors

Fig. 3: The distribution of colorectal cancer cases and hospitals in Kelantan State

Table 1: Distribution of Colorectal Cases by districts

Districts	No of Cases
Bachok	2
Gua Musang	4
Machang	3
Jeli	2
Kota Baharu	37
Kuala Krai	6
Pasir Mas	10
Pasir Puteh	11
Tanah Merah	8
Tumpat	13
Total	96 cases

Source: Authors

the cases were located within the 10 km rings from hospitals. Patients from highly populated districts like Kota Bharu could easily assess hospitals since three main hospitals in the state are located in this district. However, about 18 cases were located more than 10 km buffer from existing hospitals. This can be seen in Figure 4, where sparsely populated districts such as Jeli and Gua Musang had small number of cases but the size of districts is big and some of the cases were located outside the 10km buffer.

Source: Authors

Fig. 4: Multiple ring buffers from existing hospitals in Kelantan

The study then used service area analysis to investigate service area of hospitals based on absolute distance in km and relative distance in duration travel to reach the hospitals. To calculate duration travel, the speed of 60km/hour was used as this is the standard speed for state roads in Malaysia. Figure 5(a) illustrates service area of hospitals based on travel time in minutes and Figure 5(b) shows service area of hospitals in km. The map was overlaid with the distribution of cases (refer to Table 2). Table 2 indicates that 48 cases, 84 cases and 90 cases could reached the hospitals within 10 minutes, 20 minutes and 30 minutes travel duration respectively, while 48 cases, 12 cases and 6 cases were more than 10, 20 and 30 minutes away from the hospitals respectively. The table also indicates the stage of the cases, which shows that many of the cases were at the late stage of the disease. This study, however, could not establish any association between late diagnosis and low accessibility to hospitals.

Table 3 shows distance in km for colorectal cancer patients to reach the nearest hospitals. It illustrates that 40 cases, 59 cases and 84 cases were located within 6 km, 12 km, 20 km and 30 km from the nearest hospital respectively. It should be noted that [27] suggested that the ideal distance for cancer patients to the hospital shall be less than 20 km away to avoid pain and discomfort

Table 2: Travel distance (in minutes) from colorectal cancer patients to hospital the nearest hospitals

Duration	Total Cases Included	Total Cases Excluded	Stage 1	Stage 2	Stage 3	Stage 4
10 mins	48	48	1	7	14	26
20 mins	84	12	3	13	24	44
30 mins	90	6	3	14	26	47

Source: Authors

Table 3: Travel distance (in km) from colorectal cancer patients to hospital the nearest hospitals

Distance	Total Cases Included	Total Cases Excluded	Stage 1	Stage 2	Stage 3	Stage 4
6 km	40	56	1	4	13	22
12 km	59	37	1	9	16	33
20 km	84	12	3	13	24	44
30 km	90	6	3	14	26	47

Source: Authors

Table 4: Time travelled from Origin (Bachok and Gua Musang) to Destination (Hospitals) in Kelantan

| No.	Origin	Destination	Time Travel (Minutes)	Time Travel (Hours)
1	Bachok	Hospital USM	19.01	0.32
2	Bachok	Kota Bharu Medical Center	20.83	0.35
3	Bachok	Pusat Perubatan An-Nisa'	23.45	0.39
4	Bachok	Perdana Specialist Hospital	23.46	0.39
5	Bachok	Hospital Raja Perempuan Zainab II	23.57	0.39
6	Bachok	Hospital Tengku Anis	30.82	0.51
7	Bachok	Hospital Machang	47.68	0.79
8	Bachok	Hospital Tumpat	50.16	0.84
9	Bachok	Hospital Pasir Mas	61.45	1.02
10	Bachok	Hospital Tanah Merah	69.76	1.16
11	Bachok	Hospital Kuala Krai	73.66	1.23
12	Bachok	Hospital Jeli	102.31	1.71
13	Bachok	Hospital Gua Musang	190.59	3.18
14	Gua Musang	Hospital Gua Musang	10.38	0.17
15	Gua Musang	Hospital Kuala Krai	113.61	1.89
16	Gua Musang	Hospital Machang	138.99	2.32
17	Gua Musang	Hospital Tanah Merah	161.35	2.69
18	Gua Musang	Hospital Tengku Anis	166.84	2.78
19	Gua Musang	Pusat Perubatan An-Nisa'	179.53	2.99
20	Gua Musang	Perdana Specialist Hospital	179.54	2.99
21	Gua Musang	Hospital Raja Perempuan Zainab II	180.11	3.00
22	Gua Musang	Hospital USM	180.46	3.01
23	Gua Musang	Kota Bharu Medical Center	180.46	3.01
24	Gua Musang	Hospital Pasir Mas	187.57	3.13
25	Gua Musang	Hospital Jeli	193.90	3.23
26	Gua Musang	Hospital Tumpat	198.97	3.32

Source: Authors

during the travel. As stated previously, this study focused on geographic accessibility and it was not possible to investigate the reasons for late diagnosis for many of the cases of colorectal cancer due to the limitations imposed by the ethical approval. A study by [28] in the northern region of Peninsular Malaysia reported that late diagnosis among cancer patients was not due to distance to hospital as the investigators found that patients would only seek treatment from hospital when the disease was at a late stage. Furthermore, apart from socio-cultural factors, the embarrassment of having tests performed, the perceived pain associated with screening and cost of testing may also contribute towards late diagnosis among colorectal cancer patients [29].

Based on service area analysis undertaken, Figure 6 illustrates the suitability of health care facilities to existing colorectal cancer patients. This figure shows that, hospitals that could be reached by patients within 10 minutes shall be considered as the most suitable location. Hospitals reached within 20 minutes shall be considered as suitable. The hospitals that are reached within 30 minutes travel was considered less suitable locations [23].
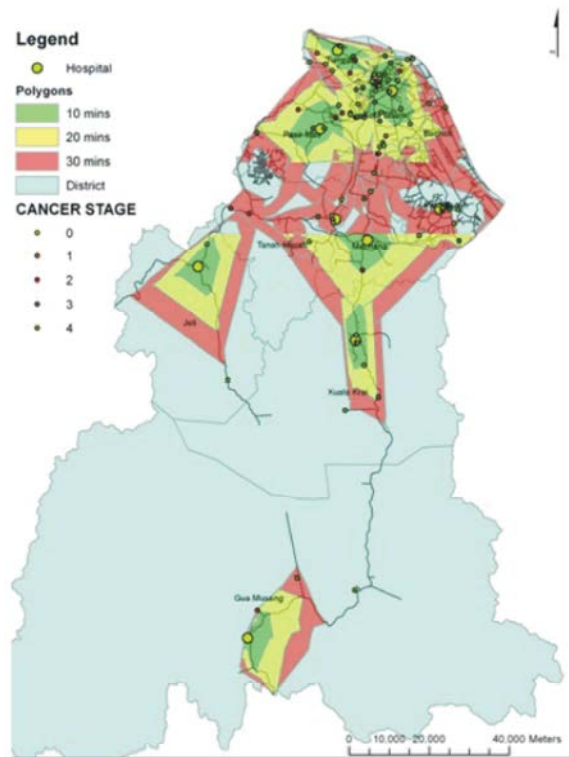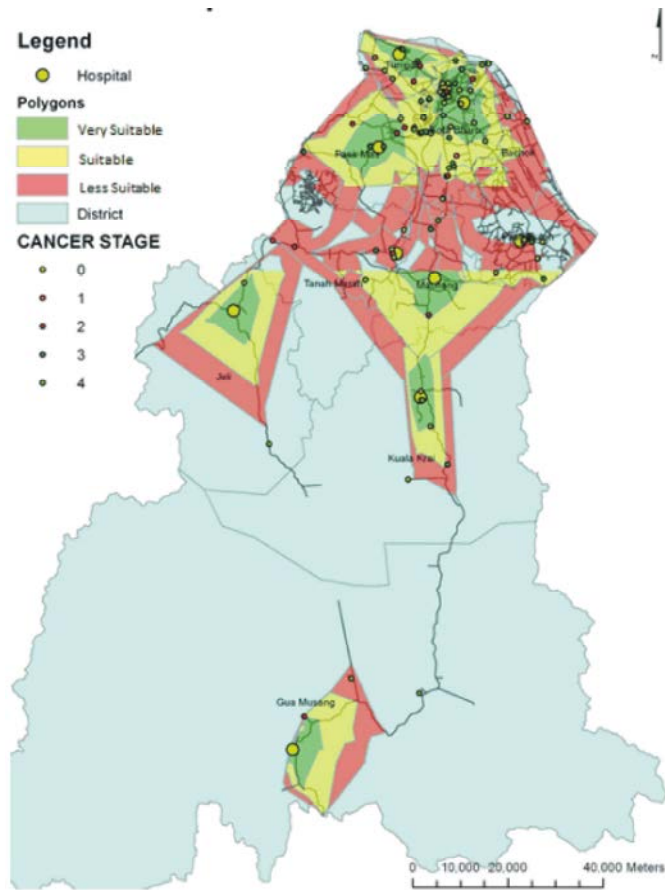
(a) Distance as shown based on travel time in minutes
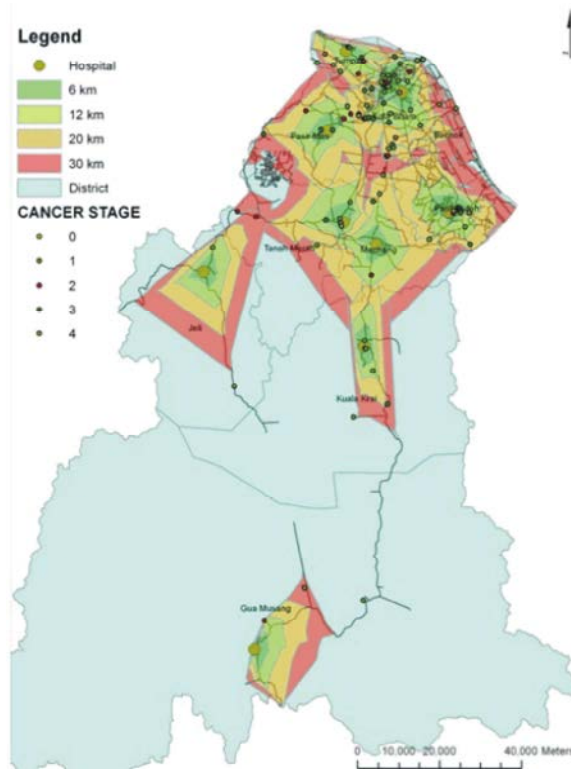
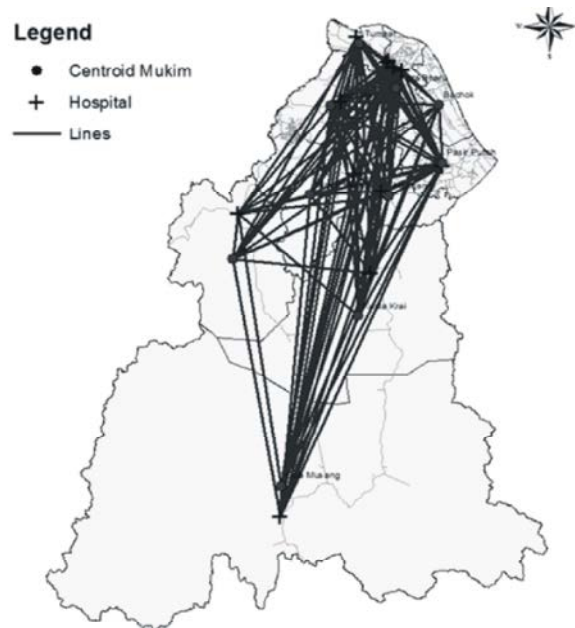(b) Distance as shown based on absolute distance in km

Source: Authors

Fig. 5: Service area analysis produced map of travel distance as measured based on time or physical distance

Source: Authors
Fig. 6: Suitable Locations for Heath Care Facilities

Source: Authors
Fig. 7: Connection between Origin (districts) and Destination (hospitals)

Based on the map produced, new facilities could probably be planned and developed in Tanah Merah and Pasir Puteh Districts, where patients had to travel more than 30 minutes to reach the hospitals.

Finally, this study measured accessibility using O-D cost matrix, which assessed the accessibility based on the origin (population centres) and destination (hospital in Kelantan) (refer to Figure 7). As stated earlier, an Oncology Specialist Clinic is only available in HUSM. Table 4 below illustrates distance from two districts (Bachok and Gua Musang) to HUSM to all districts in the study area. As stated in the table, it would take 19.01 minutes from Bachok to reach HUSM, while people from Gua Musang, which is located in the southern part of the state; it would take 180.46 minutes (3.01hours) to reach the HUSM. It should be noted that distance calculated is based on straight line distance and no barriers such as uneven terrain and heavy traffic have been taken into consideration. Figure 7 illustrates the connection between districts (origin) and hospitals (destination) in Kelantan State.

IMPLICATIONS AND CONCLUSION

This study suggests that assessing geographic accessibility is feasible and can play an important role in planning and allocating health care delivery especially to cancer patients since these patients need repeated treatments and may endure pain and discomfort during the travelling to seek treatment [23]. GIS-based approach used in this study could potentially be used in assessing the accessibility of cancer patients to hospitals and it was found that patients from some areas may have taken more than 3 hours to reach the oncology specialist clinic. It would be useful to include geographic components into the state cancer registry databases in order to map and visualize geographic variation of the cases, identify cluster of cases and investigate the accessibility of patients to health facilities. Although efforts by the various population-based cancer registries of the different states in Malaysia to gather information on cancer patients has been undertaken, analyzing the data spatially would potentially provide added value as finding associations between geographical and regional determinants may affect overall screening and early detection strategies and impact survival rate [30].

Based on the analyses conducted in this study, the geographic distribution of colorectal cancer cases provided useful information that can be used by planners and decision makers in identifying existing health care facilities that could be upgraded to improve health care delivery [6, 7, 30]. The existing state cancer registries in Malaysia have to provide a report to the Health Ministry regularly and it would be useful if geographic components were included in the database such that annual incidences could be marked geographically and variation due to factors such as new specialist in hospital or a new screening program initiation can be visualized [6]. Such information can contribute to an understanding of cancer trends.

Finally, this study has also shown that it is unnecessary to exactly identify the location of the cases to successfully carry out useful analyses on accessibility. The geocoding operation or the process of transforming a description of a location such as a pair of coordinates, an address, or a name of a place to the earth's surface, can use previously captured data (example same road and postcode) for mapping and spatial analysis [20, 21]. Such an approach will reduce the cost of capturing data on the ground and also safeguard the confidentiality of cancer cases [6]. Google Earth and field surveys could be undertaken at prescribed or random intervals to check the accuracy of the location obtained from the geocoding operation. If geographical components are added to databases of cancer registries, reliable cancer data with both geographic and tabular information would be available to assist planners and policy makers to optimize health care delivery.

ACKNOWLEDGEMENT

REFERENCES

1. Jemal, A., F. Bray, M.M. Center, J. Ferlay, E. Ward, D. Dan Forman, 2011. Global cancer statistics, CA Cancer J Clin, 61: 69-90. DOI:10.3322/caac.20107.

2. Amuamuta, A. and D. Seif, 2013. Anti-Epidermal Growth Factor Receptor Monoclonal Antibodies in Metastatic Colorectal Cancer Biotherapy: A Systematic Review, Academic Journal of Cancer Research, 6(1): 21-28, 2013, DOI: 10.5829/idosi.ajcr.2013.6.1.72115.

3. Zainal Ariffin Omar and Nor Saleha Ibrahim Tamin, 2007. Malaysian Cancer Statistics - Data and Figure Peninsular Malaysia 2007. Malaysia: Ministry of Health, Malaysia.

4. Zainal Ariffin Omar, Zainudin Mohd Ali & Nor Saleha Ibrahim Tamin, 2006. Malaysian Cancer Statistics - Data and Figure Peninsular Malaysia 2006. [Accessed on 29 April 2009]. Available from World Wide Web. http://www.makna.org.my/MalaysiaCancerStatistics.pdf.

5. Fauziah, M.N., M.S. Hamizah, A. Norazmi and P.M.M. Lila, 2006. Kelantan Cancer Registry Report 1999-2003, Kelantan: Kelantan State Health Department.

6. Murad, A., 2007. A GIS Application for Modelling Accessibility to Health Care Centers in Jeddah, Saudi Arabia, In: P.C. Lai and S.H. Ann, (Eds), Public Health and the Environment: Development in the Asia Pacific Region. Springer.

7. Samat, N., Aishah Knight Abd Shatar, Dina Jambi, Norulshahira Musa Azizah Ab Manan and Yasmin Sulaiman, 2010. Using Geographic Information System in Evaluating Accessibility of Breast Cancer Cases to Health Facilities in Penang State, Malaysia, Kajian Malaysia (Journal of Malaysian Studies), 28(1): 103-122.

8. Johnston, R.J., D. Gregory, G. Pratt and M. Watts, 2000. The dictionary of human geography, 4th edition, Blackwell Publishers Ltd. Massachusetts.

9. Esmaeili, P. and R. Moshiri, 2011. Geographical Factors in Medicine and Human Settlements. Journal of Applied Sciences, 11: 212-218, DOI: 10.3923/jas.2011.212.218

10. Moseley, M., 1979. Accessibility: The Rural Challenges, London: Metheun & Co Ltd.

11. Peters, D.H., A. Garg, G. Bloom, D.G. Walker, W.R. Brieger and M.H. Rahman, 2008. Poverty and Access to Health Care in Developing Countries, Ann. N.Y. Acad. Sci., 1136: 161-171,. DOI:10.1196/annals.1425.001

12. Paez, A., R.G. Mercado, S. Farber, C. Morency and M. Roorda, 2010. Accessibility to Health Care Facilities in Montreal Island: An Application of Relative Accessibility Indicators from the Perspective of Senior and Non-senior Residents, International Journal of Health Geographies, 9: 52.

13. Miller, H.J. and Y.H. Wu, 2000. GIS Software for Measuring Space-Time Accessibility in Transportation Planning and Analysis. GeoInformatica, 4: 141-59.

14. Matthews, H., L. Beale, P. Picton and D Briggs, 2003. Modelling access with GIS in Urban Systems (MAGUS): Capturing the experience of wheelchair users, Area, 35: 34-45.

15. Simmonds, D., 1998. Accessibility as a criterion in policy and project appraisal. Unpublished Report for the Department of the Environment, Transport and the Regions, David Simmonds Consultancy, University of Leeds, MVA, Oxford Brooks University.

16. Philips, D., 1990. Health and Health care in the Third World, New York: John Wiley & Sons.

17. Thouez, J.M., P. Bodson and A.E. Joseph, 1988. Some methods for measuring the geographic accessibility of medical service in rural regions, Medical Care, 26(1): 34-44.

18. Luo, W., 2004. Using a GIS-based Floating Catchment Method to Assess Areas with Shortage of Physicians. Health and Place, 10: 1-11.

19. Wang, F. and W. Luo, 2005. Assessing Spatial and Non-spatial Factors for Healthcare Access: Towards an Integrated Approach to Defining Health Professional Shortage Areas. Health and Place, 11: 131-146.

20 ESRI, 2013a. OD Cost Matrix Analysis, ArcGIS Resources [online]. [Accessed on 17 September 2013]. Available from World Wide Web. http://resource.arcgis.com/en/help/main/10.1.

21. ESRI, 2013b. What is geocoding?, ArcGIS Resources [online]. [Accessed on 17 September 2013]. Available from World Wide Web. http://resource.arcgis.com/en/help/main/10.1

22. Rabeta Mohd Salleh, Suzana Shahar, Ahmad Rohi Ghazali, Normah Haron and Poh Been Koon, 2011. Risk factor for breast cancer among women in Klang Valley, Malaysia. Health and the Environment Journal, 2(2): 29-33.

23. Jordon, H., P. Roderick, D. Martin and S. Barnett, 2004. Distance, rurality and the need for health care: Access to health services in South West England. International Journal of Health Geographics, 3(21). [Online] [Accessed on 8 August 2006]. Available from World Wide Web. http://www.ijhealthgeographicls.com/content/3/1/21.

24. Seal, M., G.R. Pond, T.J. Wilkieson and S.J. Hotte, 2011. Effect of geographic distance from a cancer centre on choice of systemic therapy in metastatic colorectal cancer, Oncology Exchange, 10(3): e-8-e-12.

25. Department of Statistics, Malaysia 2010. Population Distribution and Basic Demographic Characteristics, Putrajaya: Department of Statistics, Malaysia.

26. Economic Planning Unit - EPU 2011. Millennium Development Goals at 2010, Malaysia: Economic Planning Unit. http://www.epu.gov/MGD28042011 accessed date 20 Mac 2012.

27. Malaysian Oncology Society, 2012. Radiotherapy and Oncology Center. [Online]. [Accessed on 18 September 2013]. Available from World Wide Web. http://www.malaysiaoncology.org/specialist.php.

28. Ghazali, S., C. Atang, N. Samat, N. Md Nor, A. Azman, I.H. Hashim and K.S. Mokhtar, 2009. Kesengsaraan Berganda-Kemiskinan dan Kanser: Satu Tinjauan Ke Arah Tindakan, Final Report Cooperative Grant MAKNA-USM.

29. Dillard, A.J., A. Fagerlin, S.D. Cin, B.J. Zikmund-Fisher and P.A. Ubel, 2010. Narratives that address affective forecasting errors reduce perceived barriers to colorectal screening, Social Science & Medicine, 71(1): 45-52.

30. Movahedi, M., S. Haghighat, M. Khayamzadeh, A. Moradi, A. Ghanbari-Motlagh, H. Mirzaei and M. Esmail-Akbari, 2012. Survival Rate of Breast Cancer Based on Geographic Variation in Iran, a National Study, Iran Red Crescent Med Journal, 14(12): 798-804.