National Cancer Center
Graduate School
of Cancer Science and Policy

Spatial Data Analysis (PE5019)
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Final report

Title: Geographic distribution and access to cancer care in Vietnam

Background and scope

In Vietnam, the National Cancer Control Plan was started in 2008 with aims to provide effective diagnosis and treatment. Even though the Cancer Control Network over 2011-2020 had been approved by the Ministry of Health, the cancer control infrastructure in Vietnam is still inadequate.[1] Given the limited resources, reallocation of available facilities and infrastructure to low-accessibility areas is thus of great importance.

Therefore, this research was conducted with following objectives:

- To describe the geographic distribution of cancer care facilities in Vietnam.
- To estimate the disparity in travel distance to the nearest cancer care facility by provincial level in Vietnam
- To describe the geographic distribution of radiotherapy facilities in Vietnam and disparity in travel distance to the nearest radiotherapy facility by provincial level

Identifying disparities in geographic access to cancer care will help to locate the shortage areas and inform the cancer control planning and policy to improve the overall accessibility.

Method

Data sources

All data management and analysis was performed as provincial level. The sources of data was described in Table 1. Administrative information for provinces was obtained from the website of Humanitarian Data Exchange. Population data was obtained from the Spatial Data Repository, the Demographic and Health Surveys (DHS) program website. This data source provides the geographically-linked health and demographic data for mapping in a geographic information system. Population data was provided in the Population Estimates section, by country and Vietnam is one of the countries included in the project. In this project, data of total population estimate for the year 2015 was used.

Data for the population centroid was not available for Vietnam as provincial level. Therefore, in this study, the location of People's Committee of each province was selected as the centroids with the assumption that significant proportion of population are living near this location. Cancer care facility data was obtained from Cancer Research Institute in Vietnam in May 2018. Cancer care facilities include either specialized oncology hospitals or hospitals with oncology department.

Table 1. Data sources

Data need	Data source	Brief description
Administrative Boundaries	The Humanitarian Data Exchange online database [2]	Administrative level: province
Population	Spatial Data Repository - DHS Program [3]	Total population in 2015
Population Centroid	Ministry of Planning Investment of Vietnam	Point locations of People's Committee
Cancer care facility	National Cancer Institute, Vietnam	Point locations of hospitals
Radiotherapy facility	DIRAC (Directory of Radiotherapy Centers), International Atomic Energy Agency (IAEA) [4]	Point locations of radiotherapy facilities

Data acquisition and manipulation

Geocode data

Point locations for population centroids (n=63), cancer care facility (n=68) and radiotherapy facility (n=18) as of May 2018 were geocoded using online website (https://www.latlong.net) by automatically converted street addresses to latitude and longitude.

Data manipulation

Join table function in ArcGIS was used in management and merging data tables, by using the key variable: FIPS_CODE (code of each province).

Data analysis procedures and ArcGIS functionalities

- Coordinate projection was conducted at beginning of analysis
- Buffer was performed to locate and count the number of facility within 30 km distance from population centroid.
- 'Find Nearest' tool in ArcGIS Online was used to evaluate disparity in the travel distance to the nearest facility.
- Maps were created and formatted using various functions in ArcMap.

Measures of geographic accessibility

The 'Find Nearest' tool is available at ArcGIS Online and is used to measure distance between input features and near features. There are several different travel modes using time or distance as the measure for nearest features. In this study, 'Driving time' and 'Driving Distance' modes were used in the analysis.[5]

Geographic accessibility was measured by the minimum travel distance and travel time provided from 'Find Nearest' function. Minimum travel distance was calculated based on the driving distance from the population centroids to the nearest cancer care facility/radiotherapy facility and measure unit was kilometer. Travel time was based on the route selected from travel distance analysis and measure unit was minutes. The travel distance categories included: <50Km, 50 to <100Km, 100 to <150Km, 100 to <200Km, 200 to <300Km, and >300Km. The travel time was converted to hour unit and categorized into: <1 Hour, 1 to <2 Hours, 2 to <3 Hours, 3 to <4 Hours, and >5 Hours.

Results and discussion

Geographic distribution of cancer care facilities in Vietnam

Distribution of Vietnam population and cancer care facilities were illustrated in Map 1. In general, there are 68 cancer care facilities which were distributed across the country. Majority of facilities locate in higher population provinces. Ha Noi and Ho Chi Minh City were two provinces that had the highest number of population (ranking 2nd and 1st respectively) and also the highest number of cancer care facility (n=12 and n=9 respectively). Twenty third over 63 provinces in Vietnam do not have cancer care facility within province area (Map 2).

Disparity in travel distance to the nearest cancer care facility

Results from buffer procedures showed that in Vietnam, 18 provinces do not have any facility within 30 Km from the population centroids. Therefore, the next analysis was to identify the travel distance and travel time from the population centroid to the nearest facility for these 18 provinces. Results were described in Map 3 and 4 respectively. Both two maps show the low accessibility in some provinces locating in Central Highlands and South Central Coast regions in Vietnam. Kon Tum and Gia Lai are two provinces that had the worse values with travel distance more than 150 Km and travel time more than 3 hours. The mean travel distance for these 18 provinces was 91.9 Km and mean travel time was 123.9 minutes (Table 2).

Geographic distribution and travel distance of radiotherapy facilities in Vietnam

Until 2018, there are 18 radiotherapy facilities in Vietnam (Map 5). Similar circumstance was observed: majority of facilities locate in high population provinces including Ha Noi and Ho Chi Minh City. Travel distance and travel time to the nearest radiotherapy facility were calculated for all 63 provinces (Map 6 and 7). The overall mean travel distance was 105.2 Km and mean travel time was 135.9 minutes. Central Highlands and South Central Coast regions were again low accessibility areas with travel distance > 200 Km and travel time more than 3 hours. Further, results also indicate that some provinces in north area also had low accessibility, including Dien Bien, Son La, Lai Chau, etc.

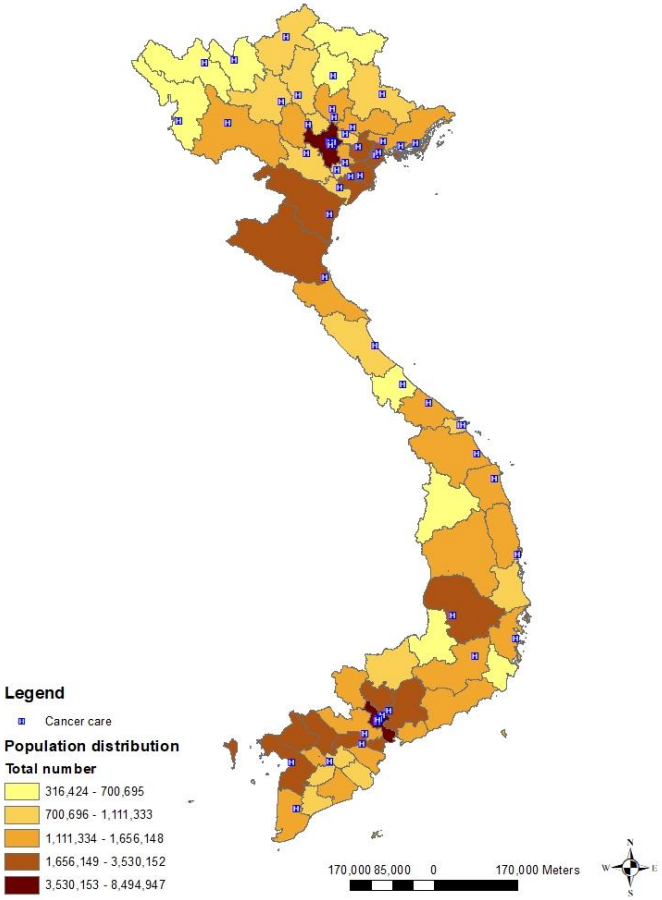
Conclusion and Future direction

There are several limitations that should be considered in this study. First, the use of People Committee location as the population centroid was less accurate to represent for the highest population density point. Second, findings from this study should be cooperated and interpreted together with cancer statistics (e.g. incidence rate, prevalent rate) of each province. However, at current time, cancer statistics by province are not available in Vietnam.

There are two strengths of this study. First, the data was obtained directly from Vietnam NCI which was more trustable than online source. Second, the travel distance and travel time were calculated based on network analysis, which considered other factors (travel mode, traffic light, speed limit, etc.) and is more accurate than simple line distance. Findings from this study suggest that the Central Highlands and South Central Coast regions had low geographic accessibility and should be prioritized in future development of cancer care network in Vietnam.

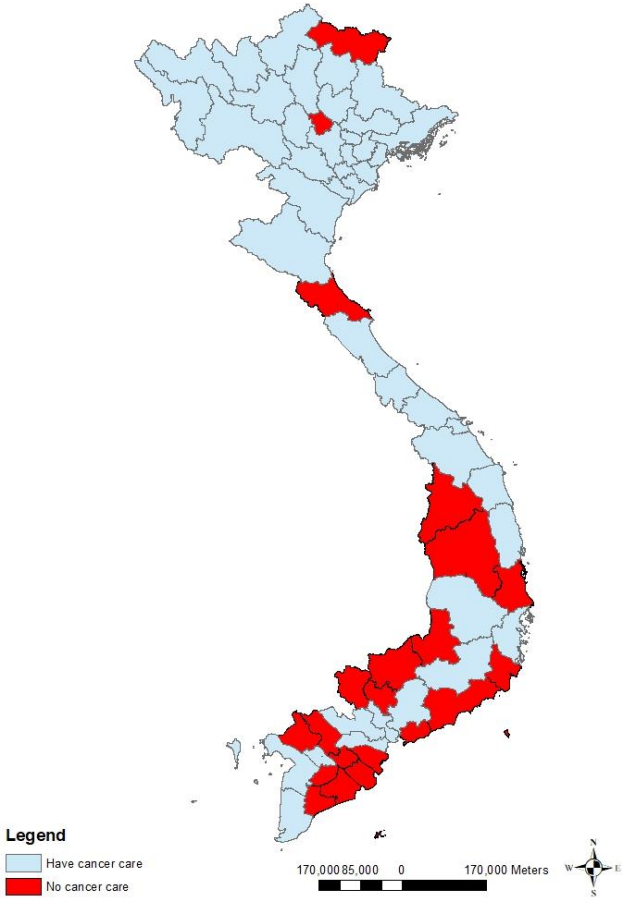
The approach and method in this study can be applied in future research to measure the travel distance for each cancer case to the cancer care facility. The individual-level analysis will be more useful in describing the disparity in accessibility.

Distribution of Population and
Cancer Care Facilities in Vietnam



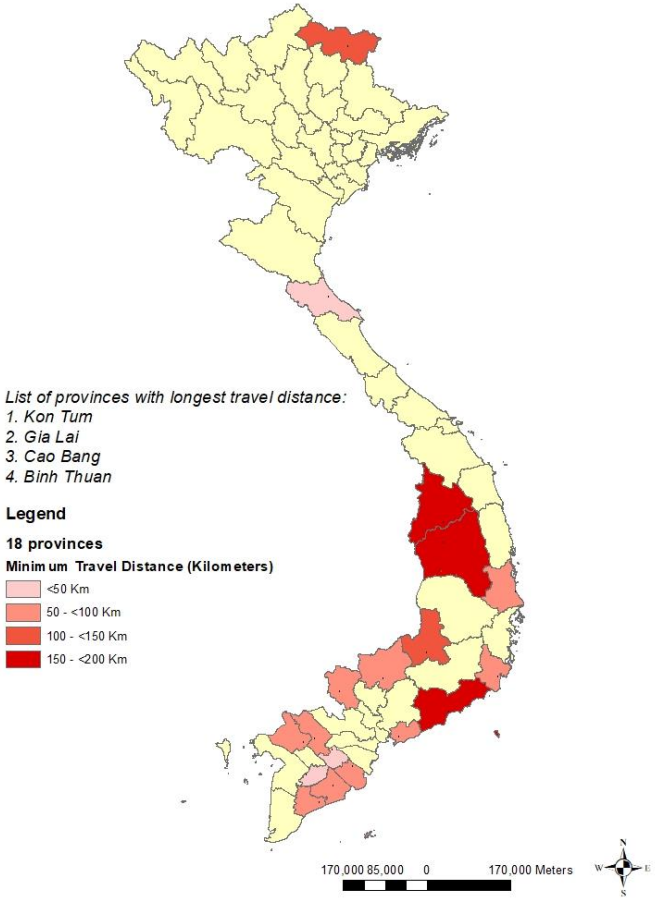
Map 1

Province With and Without
Cancer Care Facility



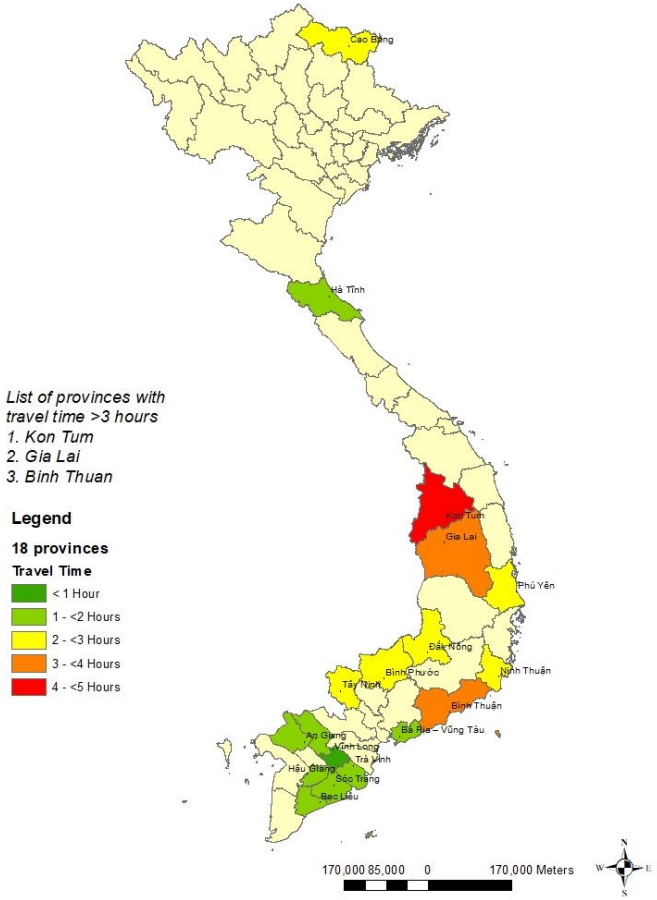
Map 2

Minimum Travel Distance to
The Nearest Cancer Care Facility

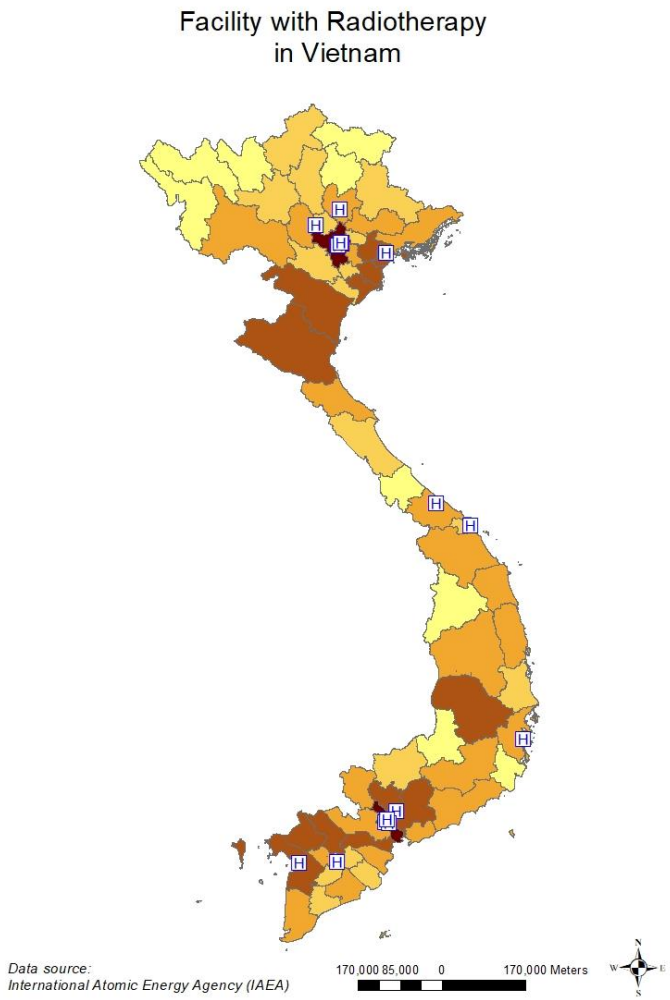


Map 3

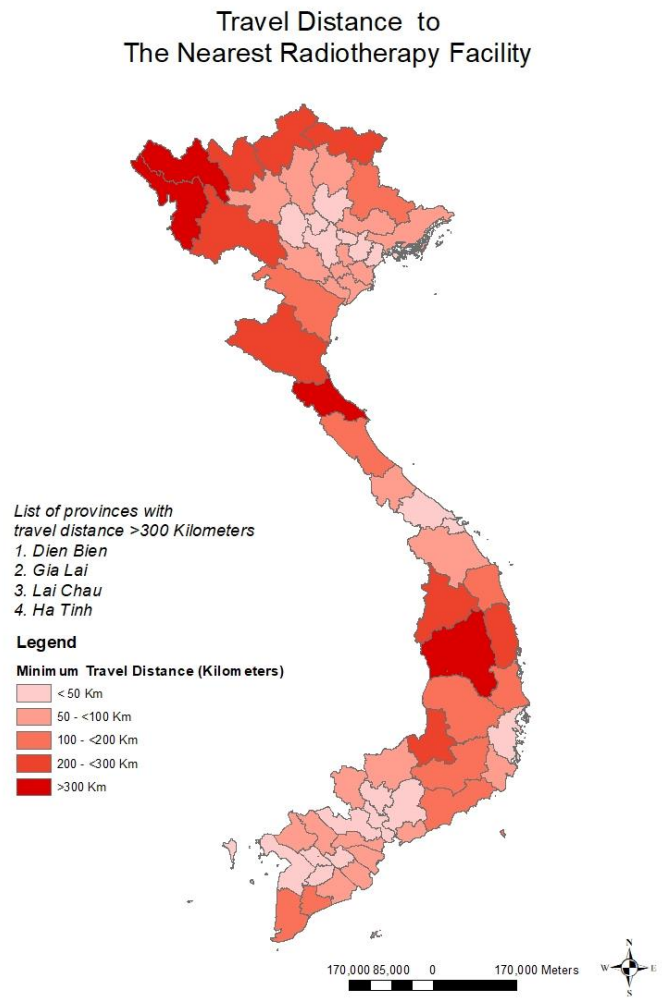
Travel Time to
The Nearest Cancer Care Facility



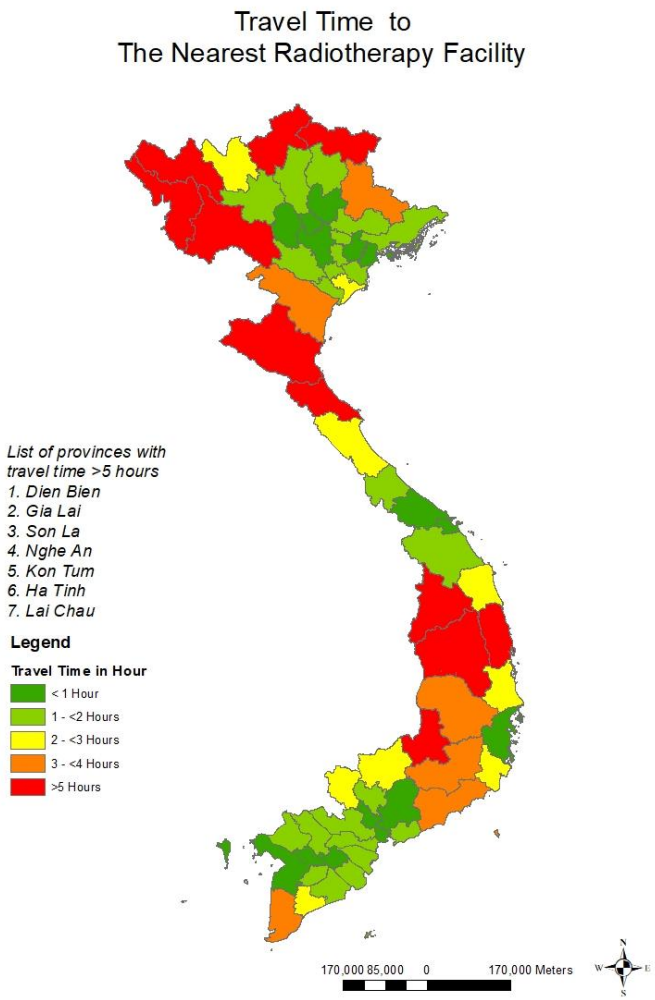
Map 4


Facility with Radiotherapy
in Vietnam
Data source:
International Atomic Energy Agency (IAEA)
170,000 85,000 0 170,000 Meters

Map 5


Travel Distance to
The Nearest Radiotherapy Facility
List of provinces with
travel distance >300 Kilometers
1. Dien Bien
2. Gia Lai
3. Lai Chau
4. Ha Tinh
Legend
Minimum Travel Distance (Kilometers)
< 50 Km
50 - <100 Km
100 - <200 Km
200 - <300 Km
>300 Km
170,000 85,000 0 170,000 Meters

Map 6



Map 7

Content	Value
No. of cancer care facilities	68
No. of radiotherapy facilities	18
No. of provinces without cancer care facility	21
No. of provinces without cancer care facility within 30 Km from population centroid point	18
Travel distance for 18 provinces to nearest cancer care (in kilometers)	Mean: 91.9 Min: 39.1 Max: 185.1
Travel time for 18 provinces to nearest cancer care (in minutes)	Mean: 123.9 Min: 47.1 Max: 263.6
Travel distance to the nearest radiotherapy facility (in kilometers)	Mean: 105.2 Min: 0.05 Max: 382.7
Travel time to the nearest radiotherapy facility (in minutes)	Mean: 135.9 Min: 0.2 Max: 536.2

Table 2. Summary of findings

Reference

1. Tran Van Thuan, et al. *Cancer Control in Vietnam: Where Are We?* [cited 2018 June 08]; Available from: http://www.cancercontrol.info/cc2016/cancer-control-in-vietnam-where-we-are/.
2. Exchange, H.D. *Viet Nam - Administrative Boundaries (Polygon & Polyline)*. [cited 2018; Available from: https://data.humdata.org/dataset/viet-nam-administrative-boundaries-polygon-polyline.
3. USAID. *Spatial Data Repository - Demographic and Health Surveys (DHS) Program*. [cited 2018; Available from: http://spatialdata.dhsprogram.com/home/
4. *DIRAC Data*. 2018 [cited June 2018; Available from: https://dirac.iaea.org/Data/Country.
5. ArcGIS. *Find Nearest*. 2018 [cited 2018; Available from: https://doc.arcgis.com/en/arcgis-online/analyze/find-nearest.htm.

End.