ER Accessibility per Neighborhood in Toronto

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Introduction

Physical healthcare accessibility is defined by World Health Organization as "the availability of good health services within reasonable reach of those who need them and of opening hours, appointment systems and other aspects of service organization and delivery that allow people to obtain the services when they need them"[1]. This is an important aspect for people wellbeing and city government must guarantee access to health services to all population. For this project I will focus on estimating the accessibility to Emergency Rooms available in Toronto, Canada.

The accurate measurement of spatial accessibility to health care is problematic chiefly because there is seldom any predetermined assignment or single pathway between individuals and specific health care services. For this project I will assume that metropolitan areas have services densely located and most individuals will access health services in close proximity. I will use the two-step floating catchment area (2SFCA) method as proposed by McGrail MR [2] and try to assess the accessibility for every neighborhood in Toronto based on the distance from neighborhoods to hospitals and emergency rooms and the population of the neighborhoods.

This information could be of importance for city planners to check if they should add more ER services according to growth of population or to people for whom might be interested in living in a neighbor with good access to these services. Also, this approach can be used to measure supply-to-demand ratio of other kind of venues.

Data

For this project I used foursquare API to obtain the location for the Hospitals and Emergency Rooms in Toronto, Canada. From https://open.toronto.ca/ I obtained the Neighbourhood Profiles dataset which cointains demographics data, from the 2016 Census for 140 neighbourhoods. I will also use the geojson file from open toronto data and will use Open Street Map data and Pandana library to estimate the distance from the centroid of the neighbourhoods to the venues from Foursquare.

Methodology

The method used for measuring the accessibility of the neighborhoods to Emergency Room is the 2SFCA. To calculate this measure first I search the venues corresponding to the Emergency Room category (4bf58dd8d48988d194941735). Then I calculated the distances from all Toronto neighborhoods to the venues retrieved previously. From the neighborhood profile file I extracted the population for all 140 neighborhoods Fig 1.
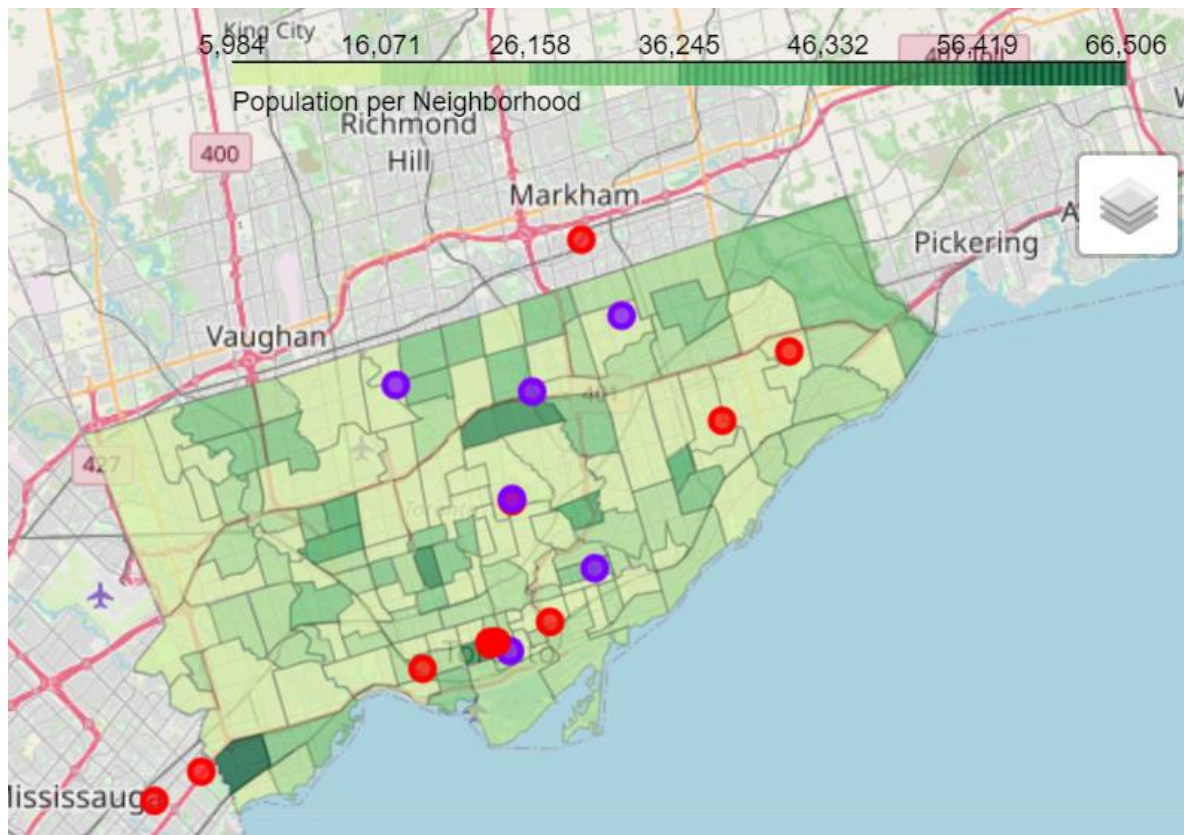
Fig 1. Population per neighborhood in Toronto

	_id	node_id	Toronto General Hospital Emergency Room	St. Michael's Hospital	Mount Sinai Emergency Department	Sick Kids Emergency	Emergency Department	Brynnikins
0	7001	6417768230	4632.001	5743.424	4519.456	4712.089	4624.518	4233.465
1	7002	1405176243	5826.818	6329.589	6041.763	5914.984	5893.336	9022.731
2	7003	1266058795	3800.323	4538.237	3971.762	3884.179	3858.659	6959.326
3	7004	48498586	17275.608	18219.813	17440.172	17359.464	17333.944	15378.339
4	7005	2622840340	9821.756	10933.179	9709.211	9901.844	9814.273	8136.364

Fig 2. Dataframe with distances from neighborhood to Emergency Rooms in Toronto

I defined an area catchment of 10km as an estimate of the maximum distance a person might travel in a metropolitan area and applied the following two steps of the method to obtain the table showed in Fig 3.

First Step

Calculate supply-to-demand ratio (R_j) that seraches all demand locations (k) within threshold (d_0) from supply location (j)

$$R_j = \frac{S_j}{\sum_{n\in(d_{kj})\leq d_0} D_k}$$

Second Step

For each demand location (i), sum up the supply-to-demand ratios (R_j) that supply location (j) are within threshold (d_0) from demand location (i)

$$A_i^F = \sum_{j\in(d_{ij}\leq d_0)} R_j$$

	_id	Access	AREA_NAME
0	7001	0.000976	Wychwood
1	7002	0.001256	Yonge-Eglinton
2	7003	0.000976	Yonge-St.Clair
3	7004	0.000141	York University Heights
4	7005	0.000837	Yorkdale-Glen Park

Fig 2. Dataframe with accessibility score to Emergency Rooms in Toronto

Discussion

From Fig 1 it can be stated that most of the population in Toronto is in downtown and the northwest part of the city is the less populated and this applies for the Emergency Rooms supply too. This information is congruent with the results obtained with the 2SFCA method and from the Fig 4 it can be showed that the city hoods with better accessibility to ER venues are in the center of the city and at the southwest.

In particular the southwest information might be misleading since the method is taking into account two venues outside of Toronto for which it does not take into account the residents in the location of these two venues.
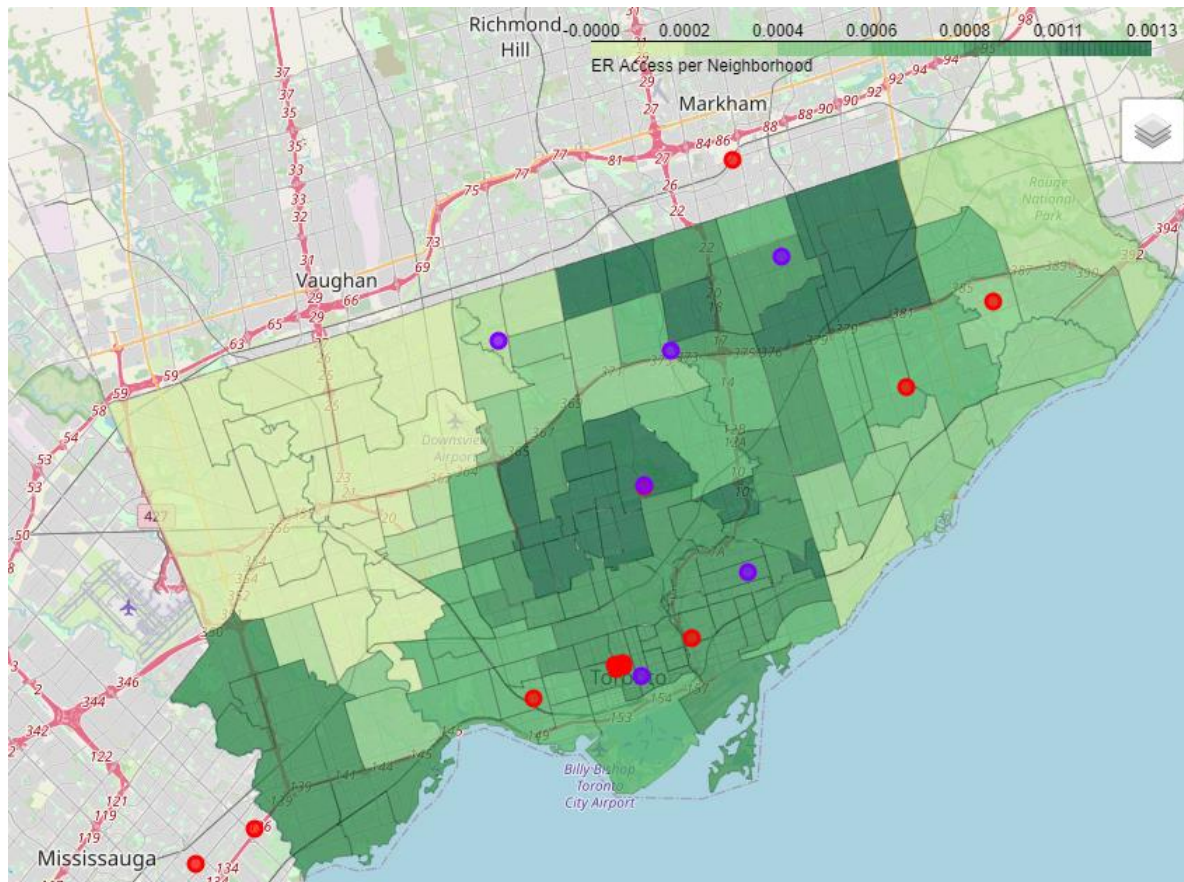
Conclusion

Based on the information described in the previous section the administration of Toronto might plan to grow bigger its health system to improve accessibility to healthcare services in the northwest part of the city.

The 2FSCA method seems to deliver information accordingly to the expected output but special care might have to be taken into account for the results obtained at the borders of the area of analysis or restrict the search for venues inside the selected area.