Using School Immunization Rates and Venue Location Data to Choose Medical Clinic Locations

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Introduction/Business Problem

- Understanding how to choose the ideal location for opening a medical clinic
- Of interest to medical professionals and stakeholders
- Interests due to public health concerns and investor's return on investments
- Important to look at current patient supply and demand for medical clinics

Data

- Patient ‘demand’ data comes from the Toronto Open Data Portal: “Immunization Coverage for Students Data”
- It has immunization rates for each individual school as well as geographic coordinates
- Medical clinic ‘supply’ data comes from the Foursquare API
- We will look at how many medical clinics are within 3 km of each school

Methodology

- After the data was cleaned a value was established on the population of nonvaccinated students per clinic
- This value was used as a basis to gauge the supply and demand of medical clinics around schools with low vaccination rates

Dataframe before cleaning

	_id	School Name	Enrolled population	DTP coverage rate (%)	DTP Religious exemption rate (%)	MMR coverage rate (%)	MMR Religious exemption rate (%)	Lat	Lng
0	1	A Y Jackson S.S.	1027	89.0	1.1	96.5	1.1	43.805261	-79.366555
1	2	Academie Alexandre-Dumas	129	86.8	1.6	89.1	1.6	43.762419	-79.179765
2	3	Adam Beck Jr P.S.	309	96.1	3.6	95.8	3.6	43.683152	-79.288488
3	4	Africentric Alternative School	77	71.4	20.8	72.7	20.8	43.745424	-79.488261
4	5	Agincourt C.I.	1241	87.3	1.0	98.1	1.0	43.788874	-79.278910
...	...	...	...	...	...	...	...	...	...
801	802	York Memorial C.I.	876	86.8	2.5	96.3	2.5	43.690279	-79.476240
802	803	York Mills C.I.	1200	86.3	1.3	97.2	1.3	43.751529	-79.373524
803	804	Yorkview P.S.	256	93.8	2.3	93.0	2.3	43.772574	-79.435566
804	805	Yorkwoods P.S.	224	88.4	0.9	91.5	0.9	43.750660	-79.513885
805	806	Zion Heights Jr H.S.	592	94.4	1.0	96.5	1.0	43.797915	-79.371097

806 rows × 9 columns

Dataframe after cleaning

	School Name	Enrolled population	DTP coverage rate (%)	MMR coverage rate (%)	Lat	Lng	freq	Average vaccine coverage rate (%)	Average vaccine noncoverage rate (%)	Average vaccine noncoverage ratio	Nonvaccinated students	Nonvaccinated students/clinic
0	Monsignor Percy Johnson Catholic H.S.	936	84.9	94.7	43.720695	-79.572017	1	89.80	10.20	0.1020	95.47	95.47
1	Josyf Cardinal Slipyj C.S.	395	84.8	84.8	43.659475	-79.566025	1	84.80	15.20	0.1520	60.04	60.04
2	St. Basil The Great College	1258	86.2	95.1	43.727168	-79.533451	2	90.65	9.35	0.0935	117.62	58.81
3	St. Mother Teresa Catholic Academy	413	83.5	90.1	43.807243	-79.217789	1	86.80	13.20	0.1320	54.52	54.52
4	St Benedict C.S.	436	86.5	89.4	43.720695	-79.572017	1	87.95	12.05	0.1205	52.54	52.54
...	...	...	...	...	...	...	...	...	...	...	...	...
801	Monsignor Fraser College - St. Martin	16	62.5	100.0	43.667175	-79.364426	67	81.25	18.75	0.1875	3.00	0.04
802	Rosedale Jr P.S.	151	98.7	98.7	43.677656	-79.381686	53	98.70	1.30	0.0130	1.96	0.04
803	Montrose Jr P.S.	112	99.1	98.2	43.658682	-79.418844	53	98.65	1.35	0.0135	1.51	0.03
804	Kimberley Jr P.S.	160	100.0	100.0	43.682620	-79.299128	13	100.00	0.00	0.0000	0.00	0.00
805	Anson S Taylor Jr P.S.	122	100.0	100.0	43.804292	-79.261561	6	100.00	0.00	0.0000	0.00	0.00

806 rows × 12 columns

Map of schools

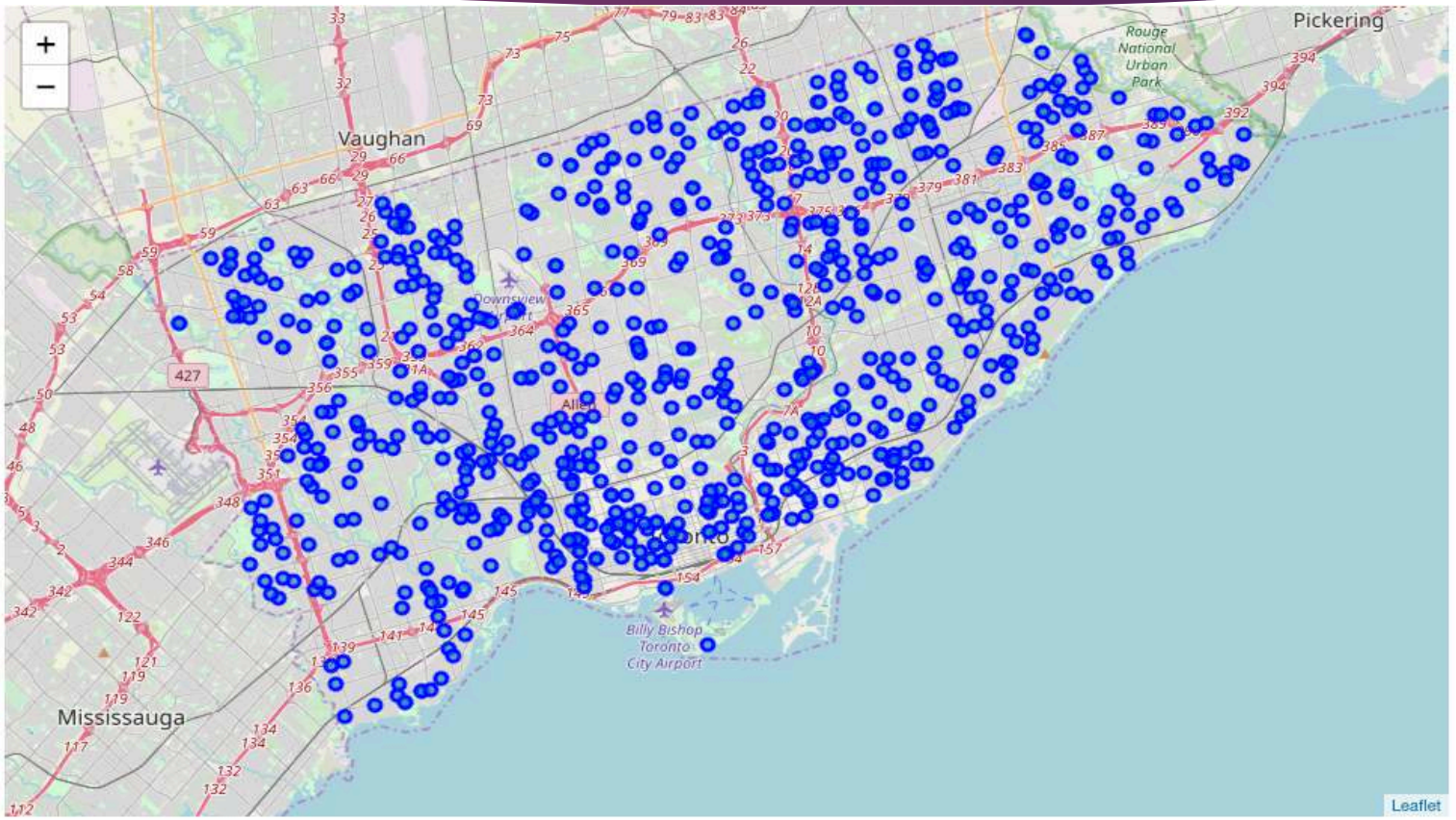

Figure 1. Map showing vaccination rate and population of every school in Toronto. The blue markers represent the schools.

Map of schools and clinics

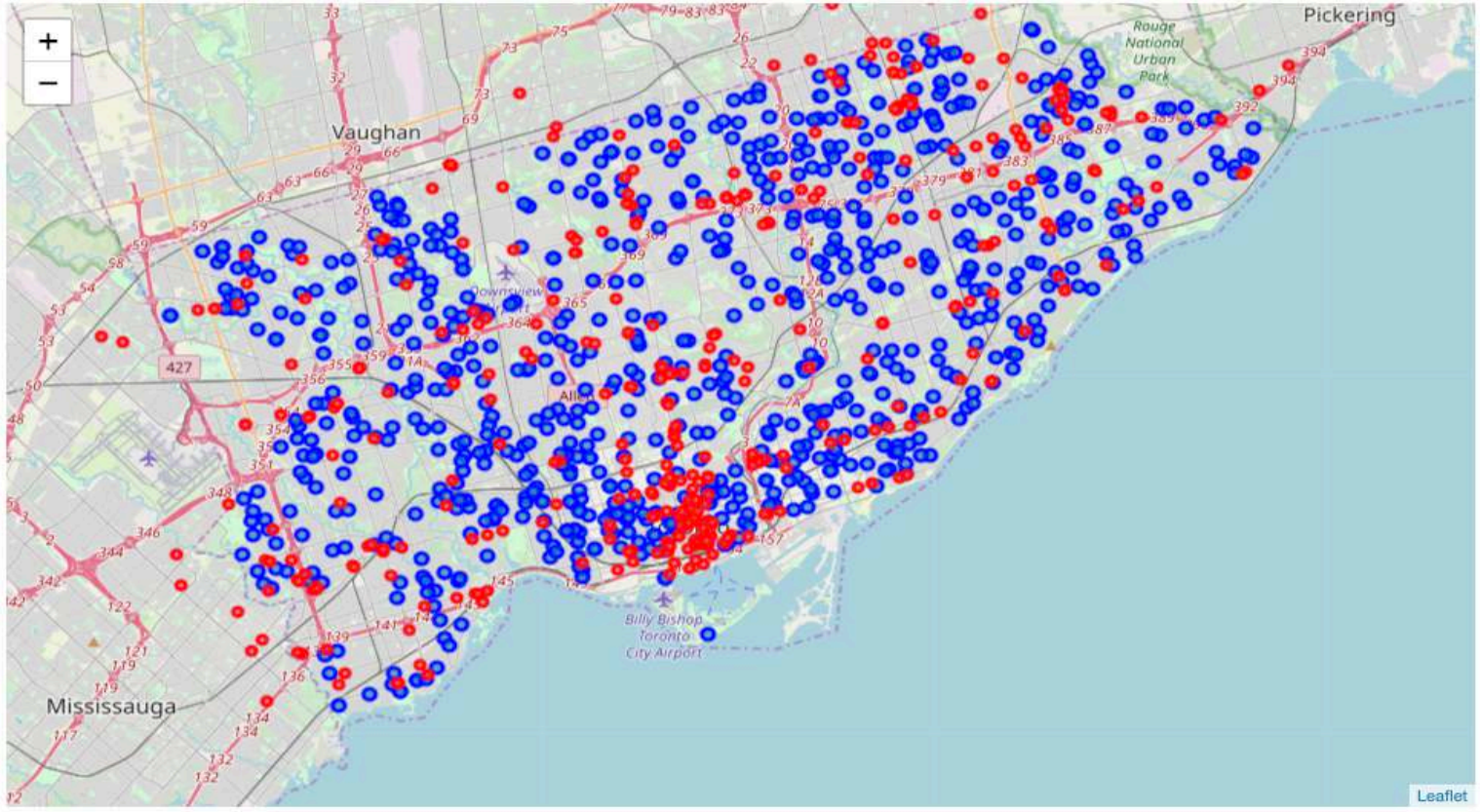

Figure 2. Map showing estimated nonvaccinated students/clinic for each school, and every medical clinic within 3 km of each school in Toronto. The blue markers represent the schools and the red markers represent the medical clinics.

Map of top and bottom 10% of schools

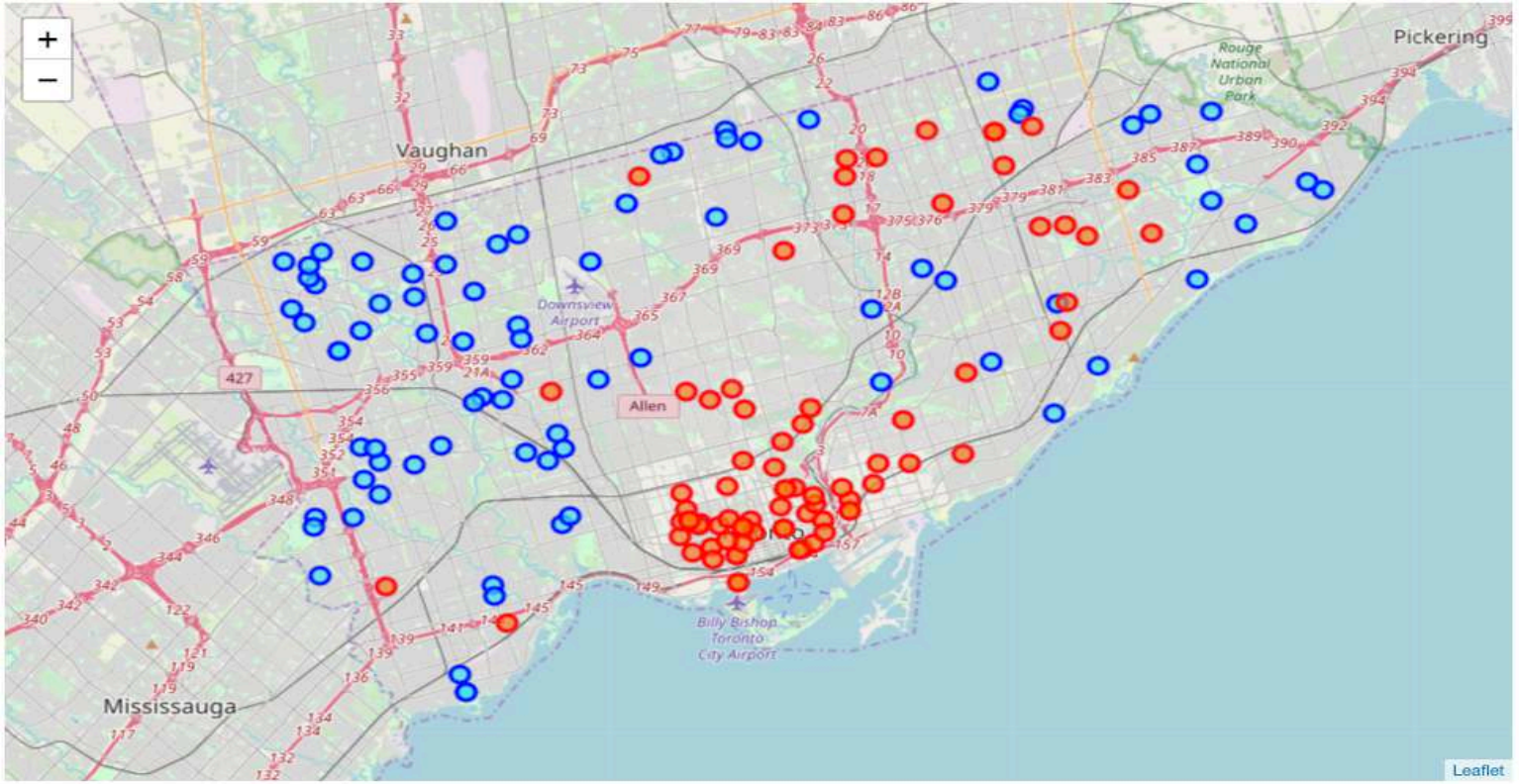

Figure 3. Map representing the population of nonvaccinated students and nonvaccinated students/clinic for each school in Toronto. The blue markers represent the top 10% of schools in Toronto in terms of highest nonvaccinated student/clinic rate, and the red markers represent the bottom 10% of schools. From an investor standpoint: the blue markers would be ideal locations to open a medical clinic, and the red markers would be non-ideal locations with heavy competition.

Results

In terms of population of nonvaccinated students/clinic:

- Top schools tend to be high population schools away from city center
- Bottom schools tend to be low population schools closer to city center

Discussion

- The top schools tend to be in the lower income areas of Toronto, mostly high schools
- Many of these schools are in high immigrant areas, which doesn't suggest immigrants are less likely to get vaccinated since the elementary schools in this area mostly have high vaccination rates, but it might be because the students are older and likely have more autonomy and may not be considering the vaccines as necessary
- 8/10 of the top schools are catholic schools which suggests these students may be more prone to opting out of vaccinations due to religious beliefs or maybe due to less stringent vaccination requirements

Discussion

- The schools at the bottom of the dataframe tend to be low population schools, alternative and public elementary schools
- These schools perhaps have more stringent vaccination requirements
- These schools likely also have greater parental oversight, which may explain the really high vaccination rates

Conclusion

- Investors looking to open a medical clinic should thus focus on areas outside the city center, with a lower income demographic
- The west end of Toronto should be an ideal location to open a medical clinic
- The data suggests that there is a possible correlation between vaccination rates and income