COVID-19 ANALYSIS: A NEIGHBOURHOOD VIEW FOR THE CITY OF TORONTO

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Introduction

There have been some events of note in the Canadian data world over the past month. The City of Toronto began releasing daily COVID-19 case data for each of its 140 neighbourhoods. Environics Analytics (EA) released a once-in-five-years rebuild of its PRIZM segmentation system, creating an up-to-date portrait of Canadians. And most recently, Ontario appointed former federal health minister Jane Philpott to be a special adviser on the Ontario Health Data Platform, which is intended to improve the detection and response to COVID-19. Dr. Philpott says she is particularly interested in studying the socio-economic and racial impacts of the virus.

In light of these topical events, we wondered how combining the city's more detailed case data with EA's newly released population data could support the public health response to COVID-19. EA produces the kind of privacy-compliant, small-area estimates that have been used for more than 30 years to understand populations of interest in private industry, the public sector and non-profits alike. These pre-processed data are easily combined with patient data (or outside of healthcare, with customer, donor, prospect and facility location data) to do two main things:

1. To learn about the populations of interest at the neighbourhood level in order to tailor communications and services more effectively and efficiently.

2. To benchmark or calculate an "expected" rate of a health condition for a population segment or geographic area, driven by socio-demographic characteristics. This is achieved by looking at health conditions or behaviours in statistically similar populations.

Approach

The following steps were taken to analyze the data:

- **Access city-based COVID-19 data.** We used case counts from the City of Toronto website as of May 30 summarized by neighbourhood – a total of 9,155 cases.

- **Estimate cases by PRIZM segment for each City of Toronto neighbourhood.** PRIZM is a segmentation system based on the assignment of residential postal codes to one of 67 unique lifestyle segments, and is created using detailed census, urbanity and other data to reflect Canadian society. Each City of Toronto neighbourhood has its own distribution of population across the PRIZM segments. We assigned each neighbourhood's case count proportionately to each of the 67 segments according to their share of neighbourhood population. To improve the accuracy of the analysis, health researchers with access to patient-level data could assign patients to their PRIZM segment based on home postal code or dissemination area using de-identified data to protect privacy.

- **Create a citywide infection profile.** We aggregated the estimated case counts by PRIZM segment across the 140 neighbourhoods to calculate an estimated total case count for each PRIZM segment. We also estimated the COVID-19 infection rate by dividing cases by total estimated 2020 population for each PRIZM segment. This allows an understanding of how infection rates differ across the population segments.

- **Create socio-demographically driven "expected" case counts by city neighbourhood**. We applied the PRIZM-based infection rate to the corresponding PRIZM population for each neighbourhood and summed up the expected case count for each neighbourhood. The result is an expected case count based on the average citywide infection rate for each PRIZM segment applied to each neighbourhood's population.

- **Compare actual case count to expected rate.** The neighbourhoods that have fewer cases than expected based on socio-demographics could be prioritized for prevention efforts as these areas resemble others in the city that have higher infection rates and could have a higher propensity for community spread as we've seen elsewhere in the city.

To note

Toronto Public Health (TPH) completed an analysis that looked at the social determinants of health as they relate to COVID-19 in the city. They cautioned that the conclusions are not absolutely certain because the analysis was not based on attributes collected directly from patients, but were inferred by analyzing case rates by quintiles of census-tract-level demographics to understand whether areas with higher income, or higher shares of newcomers (and other variables) have higher or lower case rates. This an important caveat in the interpretation of any geodemographic analysis but the appropriate use of this technique can reliably and efficiently yield important insights, which is what we are exploring in this analysis.

Findings

Estimated COVID-19 Cases by PRIZM Segment - City of Toronto

PRIZM (SESI Indicator)	PRIZM Descriptor	2020 Population	Estimated Cases (As of May 30, 2020)	Case Rate Per 100,000	Index vs City Average	Cultural Diversity Index	Family Status	Education	Job Type	Dwelling Type
61	Multi-ethnic, middle-aged urban renters	482,576	2,093	434	142	High	Singles/Families	Mixed	Service Sector	Apartments
31	Diverse, middle-income city dwellers	516,148	2,216	429	141	High	Families	Univ/High School/Grade 9	Mixed	Mixed
15	Urban, upper-middle-income South Asian Families	72,843	309	424	139	High	Families	Univ/High School	Blue Collar/Service Sector	Single Detached/Semi/Duplex
18	Diverse, upper-middle-income city families	173,846	703	404	132	High	Families	Univ/College/High School	Service Sector/White Collar	Single Detached/Row
64	Urban lower-middle-income families and singles	16,062	64	400	131	High	Families/Singles	Grade 9/High School	Service Sector/Blue Collar	Single Detached/Row/Low Rise Apt
52	Young, diverse lower-middle-income city dwellers	30,388	117	387	127	High	Singles/Families	University/High School	Service Sector/White Collar	Low Rise Apt/Apt 5+/Single Detached
55	Diverse, downscale city singles and families	17,957	68	377	123	High	Singles/Families	Grade 9/Trade School	Service Sector	Low Rise Apt/Duplex
16	Upper-middle-income seniors in urban apartments	15,650	53	342	112	Low	Singles/Couples	Univ/College/High School	White Collar/Service Sector	Mixed
51	City seniors in apartment rentals	39,842	132	332	109	Medium	Singles	Mixed	Service Sector/White Collar	Apt 5+
47	Young diverse singles in city apartments	60,886	193	317	104	High	Singles	University/High School	Service Sector/White Collar	Apartments
08	Upscale, multi-ethnic suburban families	19,809	60	301	99	High	Families	University/College	White Collar/Service Sector	Single Detached
07	Older and mature upscale city dwellers	88,087	244	277	91	Medium	Families/Couples	University	White Collar	Single Detached
20	Younger, educated Asian singles and couples	162,244	402	247	81	High	Singles/Couples	University	White Collar/Service Sector	Apartments
28	Younger, single urban renters	16,661	39	237	78	Low	Singles	University	White Collar/Service Sector	Apartments
22	Younger and middle-aged urban singles and couples	258,930	516	199	65	Low	Singles/Couples	University	White Collar/Service Sector	Low Rise Apt/Semi/Duplex
12	Younger, well-educated urban singles	378,521	738	195	64	High	Singles	University	White Collar	Apt 5+
02	Wealthy, older and mature city sophisticates	65,083	121	186	61	Low	Families/Couples	University	White Collar	Single Detached
03	Upscale, middle-aged Asian families	29,711	53	180	59	High	Families	University	White Collar	Single Detached
10	Successful, middle-aged and older Asian families	134,445	199	148	49	High	Families	University/High School	Service Sector/White Collar	Single Detached/Duplex/Row
01	Very wealthy cosmopolitan families and couples	78,970	111	140	46	Low	Families/Couples	University	White Collar	Single Detached
06	Younger and middle-aged upscale city dwellers	232,119	315	136	44	Low	Mixed	University	White Collar	Single Detached/Low Rise Apt/Semi
	Other PRIZM Segments (27 segments)	106,898	409	383	125					
	Total City of Toronto	**2,997,676**	**9,155**	**305**	**100**					

Note: from City of Toronto statistcs published as of May 30, 2020. Basis of this analysis was City data table "Cases of COVID-19 by Neighbourhood".

Findings

Case rates are higher in population segments with high visible minority presence, but not all visible minority groups have high case rates.

When we look at the estimated case rates through PRIZM, we see the pattern that TPH and others have found. There are 21 significant PRIZM segments in the City of Toronto (segment contains >15,000 residents or at least 0.5% of EA's 2020 population estimate of 2.998 million). All of the PRIZM segments that have high case rates (segments with a rate more than 20% above the average of 305 per 100,000 population) are also "high" on EA's Cultural Diversity Index (a score using a number of variables relating to diversity to capture its many facets). They also have lower education, a lower proportion of residents with white-collar jobs and more multi-unit residential housing.

However, not all PRIZM segments with high cultural diversity have high case rates. Segments 03, 10, 12 and 20 all have relatively low case rates of 148 to 247 per 100,000, or 20% to 50% below the average. Below is a table showing each PRIZM segment's population and case rate, along with key demographic attributes.

To understand the cultural diversity picture, we grouped the top three PRIZM segments by case rate (representing half of the city's infections) and compared them to the four PRIZM segments that have low case rates, but still have high cultural diversity. We found big differences in key demographics and health propensities. The higher-case-rate group has lower educational attainment and income and is more likely to be in risky occupations. The visible minority make-up of the two groups is also very different. The data indicate South Asians, Black populations and Filipinos are far more likely to be in the high-case-rate segments. The low-case-rate group contains far more Torontonians who declare themselves as Chinese visible minority. Of further concern is the prevalence of health conditions known to put those infected with COVID-19 at risk of serious complications. We estimate at least double the expected prevalence of these conditions among the high-case-rate group, making COVID-19 prevention even more important.

Findings continued

The data indicate a need to understand cultural and population differences more deeply in this pandemic. Two specific PRIZM segments make for stark comparison: PRIZM 10 is 56% Chinese visible minority, while PRIZM 15 is 51% South Asian. Other demographic attributes are quite similar across both segments: income, education, age, job types, size of household and housing type have, at most, small differences between them. The COVID-19 case rates, however, are vastly different: PRIZM 10 is third lowest at 199 per 100,000, while PRIZM 15 is third highest with 309 per 100,000 or a 55% higher case rate for the segment containing many South Asians.

Overall, while it is true that COVID-19 disproportionately affects visible minorities, the ethno-cultural profile of COVID-19 cases has some important nuances that should inform the public health response to ensure it is as effective as possible.

Comparison of High Cultural Diversity PRIZM Groups by COVID-19 Case Rate

	High Case Rate (PRIZMs 31, 61, 15)	Low Case Rate (PRIZMs 10, 03, 12, 20)
Share of Toronto Population	36%	24%
Share of Toronto Infections	50%	15%
Case Rate (per 100,000)	427	197
% University Degree	26%	51%
Occupations: Sales & Service, Trades & Transport, Health	52%	21%
Average Household Income	$80,258	$112,246
% Visible Minority	72%	62%
% Chinese VM	5%	26%
% South Asian VM	23%	12%
% Black VM	17%	5%
% Filipino VM	8%	3%
No Knowledge of English or French	5%	7%
Fair or Poor Self-Perceived Health	18%	7%
Has Diabetes	9%	5%
Has COPD (among age 35+)	5%	2%
Has Asthma	10%	5%

Source: Environics Analytics DemoStats 2020, CommunityHealth and PRIZM

Findings continued

The eastern part of Toronto has lower-than-expected cases; the northwestern corner has higher-than-expected cases.

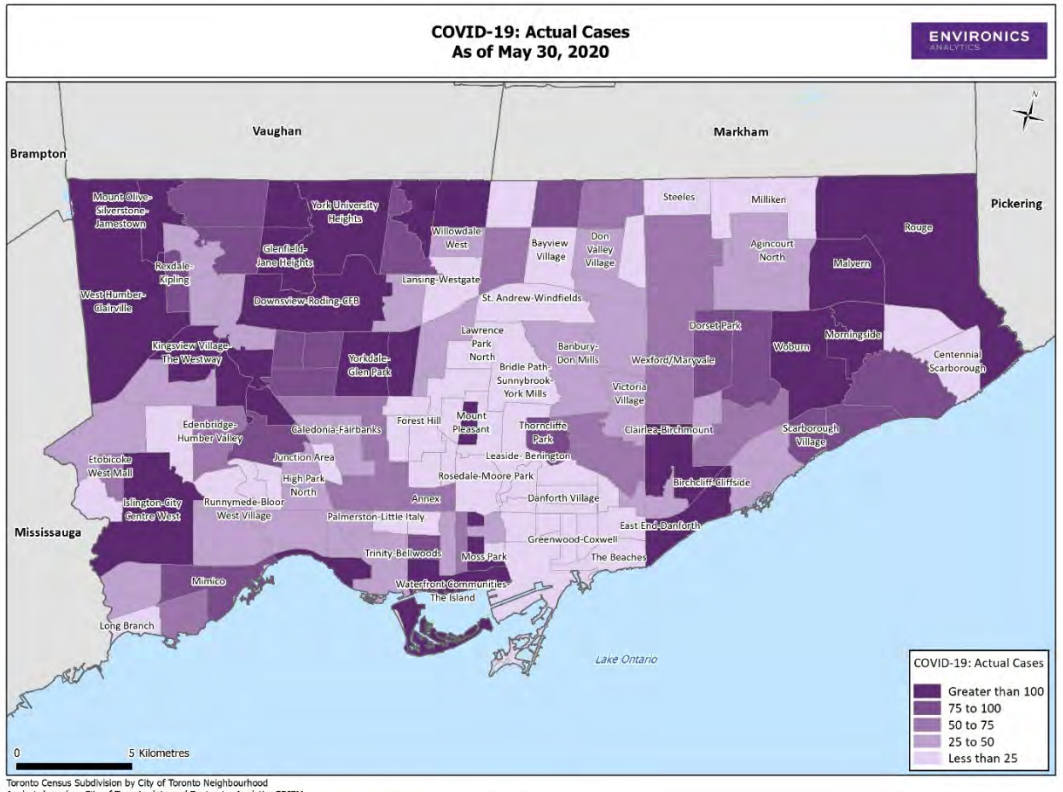
Geodemographic segments (as reflected in PRIZM) sort postal codes into similar types of populations. One application of them is to understand the typical, or "expected", characteristics (behaviours, prevalence of health conditions and more) of a population segment. This expected rate, when applied to the population in each postal code in a neighbourhood and then summed up, creates an expected number of cases in the neighbourhood. Looking at actual and expected COVID-19 cases has a few powerful applications because it creates a basis for comparison of different neighbourhoods:

- Identifying areas that are more successful in controlling the spread and those that are less successful (while controlling for socio-demographic characteristics);
- Identifying where resources could be prioritized to prevent outbreaks (i.e. the areas with significantly lower-than-expected cases that could become hotspots); and
- Identifying which areas to study more closely to understand what is different about those with lower-than-expected case rates. This could help identify what these neighbourhoods are doing right.

We can illustrate this with maps.

Mapping – Actual COVID-19 Cases by City of Toronto Neighbourhood

The first map shows the case count by City of Toronto neighbourhood. For those familiar with the city's socio-demographic "map", we see the typical pattern associated with education and affluence. The central spine running north from Lake Ontario has low case rates and contains large numbers of the low-case-rate PRIZM segments. In contrast, the east and west parts of the city, both have a much larger number of cases. Looking only at cases (or case rates) does not reveal the pattern that eastern Toronto has lower-than-expected cases. We see the general pattern that affluent, well-educated areas have lower rates, while the opposite is true where populations are less-affluent and less educated.



Toronto Census Subdivision by City of Toronto Neighbourhood
Analysis based on City of Toronto data and Environics Analytics PRIZM

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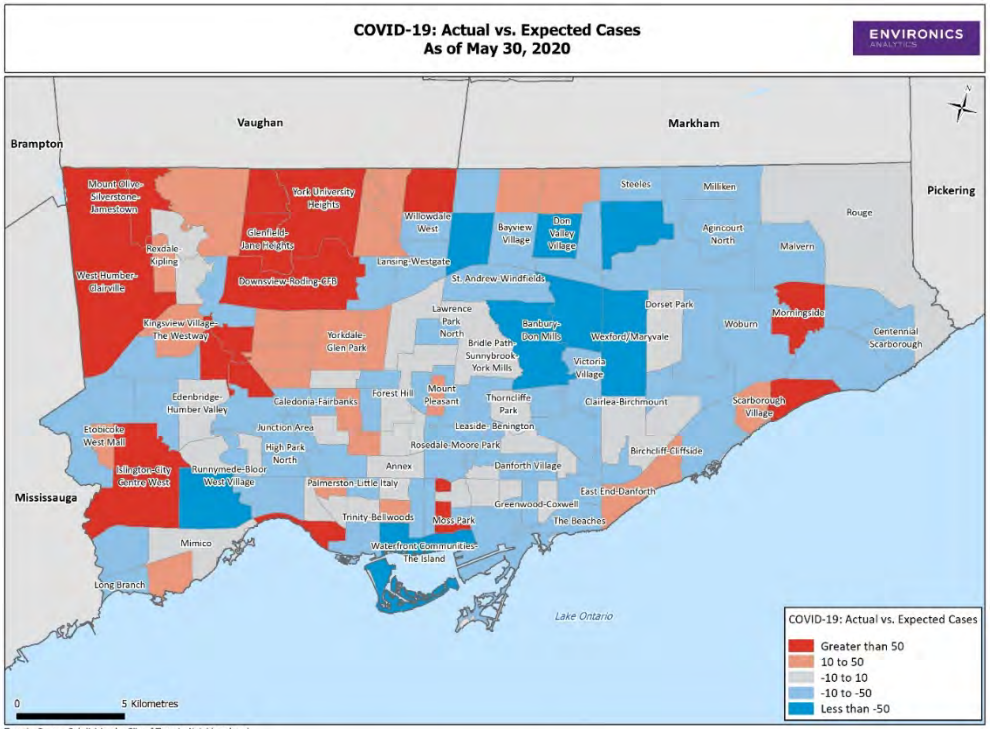
Mapping – Actual vs Expected COVID-19 Cases by Toronto Neighbourhood

When we look at the difference between actual and "expected" cases, we see a different pattern. The next map puts the neighbourhood case counts into perspective, and there appears to be an east-west divide in the city. The dark red neighbourhoods have 50+ cases *more* than expected, while the dark blue neighbourhoods have at least 50 *fewer* cases than expected. This analysis is based on applying the average infection rates associated with each PRIZM segment to the corresponding PRIZM population make-up in those areas. The northwest corner of the city almost consistently has higher-than-expected cases, while in the east, though there are large absolute numbers of cases in some neighbourhoods, most actually have fewer-than-expected. In these areas, vigilant infection prevention and public health communications could help contain the virus because, based on the experience elsewhere in the city with similar populations, the case rates could go higher. These areas could also be studied in comparison to the "red" areas to understand the differences in the "on-the-ground" context to help explain different outcomes among relatively similar populations.



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Prevention effort insights

What About Those "Dark Blue" Neighbourhoods?

We can look a little more deeply into the areas that have lower-than-expected cases to help tailor prevention efforts to these populations. We focused on three neighbourhoods to illustrate: Wexford/Maryvale, Parkwoods-Donalda (located in between Banbury-Don Mills and Wexford/Maryvale on the map), and L'Amoreaux (located due north of Wexford/Maryvale). All have large numbers of residents in the PRIZM segment with the highest case rates: 61 and 31 (see the first table in this analysis for more details). Yet these neighbourhoods have far fewer cases than would be expected given typical case rates. If prevention efforts were to be directed to residents in these areas, in a quick look at the data, a few things seem important in a health promotion response.

- Residents score low on a Social Value called *Effort Toward Health*, meaning that they are less likely to be proactive in engaging in healthy behaviours. But they do score high on *Confidence in Advertising* so messages delivered via ads are more likely to be received and believed.
- Traditional media are more popular, especially TV and radio. Digital and social are used less than average.
- Residents are more likely to have Android smartphones, but they download fewer apps than average and are less engaged in social media. One exception is WhatsApp.

This is only a sampling of a few items of relevance in considering health promotion efforts, contact tracing and the discussion over apps. There are many others that could be uncovered in more careful analysis. Also, other neighbourhoods of interest may have very different populations (e.g. Waterfront Communities – The Islands), so the data could be easily pulled specifically for them.

Conclusions

This analysis has identified important patterns in COVID-19 cases in the City of Toronto by using geodemographic methods. The approach allows the merging of many data sources to provide a richer, more nuanced view of the pandemic as it affects Toronto. The analysis, of course, could go deeper and requires careful interpretation of the results because we are inferring the characteristics of patients based on where they live. However, the approach has key benefits given the ability to merge many sources of data, to benchmark and compare results, and to understand case rates in context so that more appropriate, targeted public health responses and communications can be implemented.

Data used in the analysis

PRIZM segmentation system
Covid-19 and the Social Determinants of Health

About Environics Analytics

Canada's premier marketing and analytical services companies, Environics Analytics (EA) helps customers turn data and analytics into insight, strategy and results. Established in 2003, EA offers the full range of analytical services—from data supplier to strategic consultancy—and provides authoritative reports, software and modelling to solve business challenges. Its team of 200 marketers, modellers and geographers help organizations identify their business challenges, develop data-driven solutions and achieve success along every phase of their analytics journey. For the past three years, EA has been recognized as one of Canada's top growing companies by Canadian Business' Growth 500 listing.

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