Short Communication

Tracking the origin of early COVID-19 cases in Canada

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A B S T R A C T

The original coronavirus disease 2019 (COVID-19) outbreak in Wuhan, China has become a global pandemic. By tracking the earliest 118 COVID-19 cases in Canada, we produced a Voronoi treemap to show the travel origins of the country's earliest COVID-19 cases. By March 11, 2020, even though the majority (64.1%) of the world's COVID-19 confirmed cases still had their origin in China, only 7.6% of Canada's first 118 COVID-19 cases were related to travelers from China. The most commonly reported travel history among the 118 cases related to the Middle East, the United States, and Europe. Thus, in retrospect, broadening of early screening tools and travel restrictions to countries and regions outside China may have helped control global COVID-19 spread.

Like many countries, Canada, whose 10 provinces and three territories cover almost 10 million square kilometers, is currently battling the coronavirus disease 2019 (COVID-19) pandemic. Tracking the travel history of early COVID-19 cases could help regulators evaluate whether or not the strategies employed to prevent the spread (e.g., screening for symptoms in targeted travel populations or employing travel bans) were optimal, in retrospect. To this end, we researched the travel history of the earliest 118 COVID-19 patients in Canada.

The 118 cases were confirmed between January 27, 2020 (the first COVID-19 case returning from Wuhan, China documented in Canada) and March 11, 2020, at which point widespread travel restrictions were in place and COVID-19 cases arising through community spread were becoming more commonly detected (CTV News, 2020). During that period, we followed the confirmed COVID-19 cases released by the government websites (e.g. alberta.ca, bccdc.ca, ontario.ca, and quebec.ca) every day and obtained the travel histories of these cases from national and local news websites (e.g., cbc.ca, globalnews.ca, and toronto.ctvnews.ca). Finally, we cross-validated all cases with those summarized by 1Point3Acres (available from https://coronavirus.1point3acres.com/en, last accessed 28 April 2020) and CTV News (available from, https://www.ctvnews.ca/health/coronavirus/tracking-every-case-of-covid-19-in-canada-1.4852102, last accessed 28 April 2020) to ensure correctness of the count of the confirmed cases and their origins.

A Voronoi treemap (Figure 1A), an excellent way of visualizing hierarchical data by recursively partitioning convex polygons, was used to show countries/regions from which the first 118 identified Canadian COVID-19 patients had returned. The areas of the convex polygons in the Voronoi treemap are proportional to the weights of their corresponding nodes in the 'tree' (Nocaj and Brandes, 2012). In our analyses, terminal nodes represented countries/regions and internal nodes represented continents (or sub-continents), which, combined with the root node (i.e., the globe), constituted a hierarchical structure. The weight of a terminal node was equal to the number of confirmed patients who had returned from the country/region corresponding to the node. If a case was linked to a person who had 'recently' travelled to two countries/regions, 0.5 was added to the weight of one of the two countries/regions. A convex polygon labeled 'MEC' was particularly assigned to the patients who had recently travelled to more than two European countries (see Figure 1A). The community cases, i.e., without recent travel records, were counted for the weight of the Canadian node. Another Voronoi treemap (Figure 1B) was produced to show the distribution of confirmed COVID-19 cases over the globe by March 11, 2020. In Figure 1B, a terminal node was assigned only to

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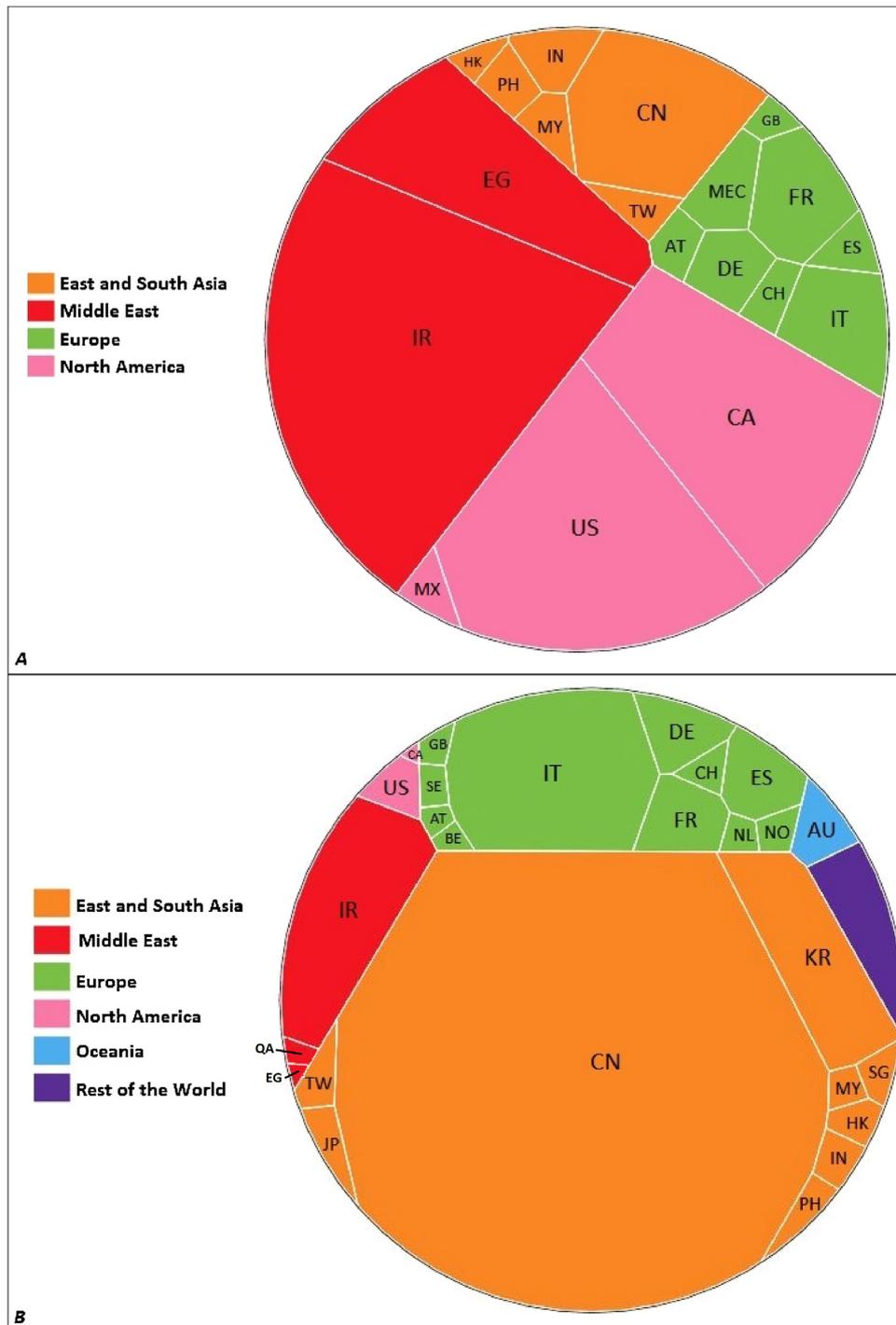*E-mail address:* sasha.bernatsky@mcgill.ca (S. Bernatsky).

Figure 1. Voronoi Treemaps showing A. Countries/regions from which Canada's earliest 118 documented COVID-19 patients returned versus B. Global analysis of countries from which COVID-19 cases arose; both represent cases arising prior to March 11, 2020.

the country/region that had at least 100 confirmed cases by March 11, 2020, or more than 50 confirmed cases by March 11, 2020 and had appeared in Figure 1A.

China (preceded only by the United States) is the second largest trading partner of Canada, and there were 649 260 Chinese immigrants in Canada as of 2016. This population is 4.2 times the immigrant population from Iran, based on Canada's latest census (Statistics Canada, 2017). By March 11, 2020, the majority (64.1%) of the world's 126 117 confirmed COVID-19 cases had come from China, while only 7.1% were reported by Iran (Worldometer, 2020).

Given the close connection between Canada and China and the much larger number of confirmed cases reported by China than by any other country, it might be expected that Canada's earliest coronavirus cases would have been mainly related to travel from China. However, as shown in the Figures, in actuality only nine (7.6%) of the 118 cases were related to travel from China, while an impressive number of cases (35/118, 29.7%) were linked to travel from Iran. Other travel destinations that were highly implicated included the United States (18.2%, by air or surface travel), Europe (13.1%), and Egypt (10.1%) (see Table 1).

Table 1
The travel origins of Canada's earliest 118 COVID-19 confirmed cases.

Continent/sub-continent	Country/region	The number of cases
East Asia	China	9
	Hong Kong	0.5
	India	1.5
	Malaysia	1
	Philippines	1
	Taiwan	1
The Middle East	Egypt	12
	Iran	35
Europe	Austria	1
	France	4
	Germany	2
	Italy	4
	Spain	1
	Switzerland	1
	The United Kingdom	0.5
	Multiple countries[a]	2
North America	Canada	19
	Mexico	1
	The United States	21.5

[a] 'Multiple countries' corresponds to the 'MEC' in Figure 1A.

Potential limitations of the analyses include the fact that as of March 11, 2020, there was likely severe under-reporting of COVID-19 cases in certain countries, including Iran, although given the population base of Iran, it would still be likely that the absolute number of COVID-19 cases by this time remained heavily weighted towards those from China (Desjardins et al., 2020). Additionally, the Canadian government did not enforce a COVID-19 test on each person landing from abroad, and a certain number of Canadian citizens may have been infected by March 11, 2020 but did not have COVID-19 tests due to mild symptoms or being asymptomatic. The stringent travel bans by the Chinese government and the timely decision to stop all direct flights between Canada and China by Air Canada on January 30, 2020 appear to have been effective in curtailing coronavirus imported from China. However, our study suggests that in the era of globalization, the risk of importing an epidemic from a given country is not necessarily proportional to the number of confirmed cases of disease in any one country. Broader initial responses with respect to travel bans (i.e., related to more countries where confirmed COVID-19 cases had emerged) on the part of governments could have been considered. This, coupled with screening (and possibly more COVID-10 testing) of travelers landing from abroad, may have more effectively blocked the spread of COVID-19.

Author contributions

All authors contributed to the study design; NZ and YL collected and analyzed the data; all authors contributed to the drafting of the manuscript.

Ethical approval

Not applicable.

Conflict of interest

None.

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