The COVID-19 Response in North America

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Abstract

In our Information Technology (IT) based societies, social media plays an important role in communications and social networks for COVID-19. This study explores social responses for COVID-19 in North America, which is the most severe continent affected by the COVID-19 pandemic. This study employs social network analysis for Twitter among the US, Canada, and Mexico. This study finds that the 3 countries show different characteristics of social networks for COVID-19. For example, the Prime Minister plays the second most important role in the Canadian networks, whereas the Presidents play the most significant role in them, in the US, and Mexico. WHO shows a pivotal effect on social networks of COVID-19 in Canada and the US, whereas it does not affect them in Mexico. Canadians are interested in COVID-19 apps, the American people criticize the president and administration as incompetent in terms of COVID-19, and the Mexican people search for COVID-19 cases and the pandemic in Mexico. This study shows that governments and disease experts should understand social networks and communications of social network services, to develop effective COVID-19 policies according to the characteristics of their country.

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Introduction

COVID-19 is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS). COVID-19 was first discovered in Wuhan, China and has become an ongoing pandemic. The World Health Organization declared the outbreak a Public Health Emergency of International Concern on January 30, 2020, and a pandemic on March 11, 2020.

Coronavirus (COVID-19) has been 1 of the most serious issues across the world since 2019. As at August 13, 2020, COVID-19 affects more than 188 countries and territories, resulting in more than 20.4 million cases of COVID-19 and 744000 deaths. Controlling COVID-19 has become 1 of the most important tasks for governments to protect their citizens and economies.[1–6]

Countries and governments have developed many policies to reduce the damage of COVID-19 and understand the effects of COVID-19 on human life.[7–9] For example, the Canadian government released the COVID-19 Economic Response Plan to help ensure that Canadians can pay for essentials like mortgages, rent, and groceries, and to help businesses continue to pay their employees and their bills during this time of uncertainty.[10]

Many scholars have explored how COVID-19 plays a severe role in people's health across the world.[11–13] For instance, a comprehensive report published by the Chinese Center for Disease Control and Prevention highlights that elderly people, particularly those older than 80 years, and people with comorbidities, such as cardiac disease, respiratory disease, and diabetes, are at greatest risk of serious disease and death based on epidemiological characteristics of 72314 patients with COVID-19.[14,15] People over 60 years old are at higher risk than children who might be less likely to become infected or, if so, may show milder symptoms or even asymptomatic infection.[13,16]

However, prior studies have heavily explored the number, symptoms, and differences of COVID-19 patients.[17–22] This is because COVID-19 is a new virus that was first identified in December 2019 and has become an ongoing pandemic.

Some studies have highlighted how COVID-19 plays an important role in people and economies by employing network analyses.[6,23,24] For example, Tiwari et al.[24] reported pandemic risk of COVID-19 outbreak in the US based on network connectedness with air travel data. So et al.[23] highlighted financial network connectedness and systemic risk during the COVID-19 pandemic. Xiang et al.[6,25] reported on the dynamic spread of global COVID-19 infections in 18 countries with the connectedness approach based on the TVP-VAR model. However, they have all barely highlighted how COVID-19 information is spread by Social Network Services (SNS) to cope with the new virus pandemic.

Understanding SNS for COVID-19 is highly important because most people get relevant information on COVID-19 from SNS in our IT- based societies. Governments and countries could provide important news and information on COVID-19 via SNS in a timely manner when

Table 1. COVID-19 in North America

COVID-19 in North America (by August 9, 2020)				
Ranking	Country	Confirmed	Deaths	Recovered
24	Canada	119451	8981	103728
1	United States	5199444	165617	2664701
7	Mexico	480278	52298	322465

they understand how people communicate with each other to spread pivotal information on COVID-19.

In this vein, this study explores Twitter, which is 1 of the most popular SNS, by employing social network analysis (SNA). This study highlights the communication networks for COVID-19 in Canada, the US, and Mexico since North America is the most severe continent affected by the COVID-19 pandemic.[26–28] For example, The US has become the country with the largest number of COVID-19 reported cases and deaths[24] (see Table 1). It is believed that this study is the first article exploring social networks of COVID-19 by employing SNA for Twitter across North America.[29–31]

Research methodology

This study employed Social Network Analysis (SNA) to explore the social networks of COVID-19 in North America. SNA is the process of investigating social structures using networks and graph theory.[32] It is a methodology for exploring the relationship among individuals, groups, and organizations in explaining variations in behaviors, and beliefs, as well as outcomes.[33] While SNA has been present in some form for decades, it entered popular culture in the beginning of the twenty-first century.[34] SNA allowed this study to characterize networked structures in terms of COVID-19 key players and Twitter users.

This study utilized Twitter data to highlight the online communications of people for COVID-19 across public key players. Twitter has been widely used for big data analyses.[35–39]

This study employed NodeXL (Social Media Research Foundation, California, USA) between August 1 and August 2, 2020, based on the keywords 'COVID-19,' and the countries used to highlight the social networks of North America for COVID-19. NodeXL (Social Media Research Foundation, California, USA) is a visualization software program, which supports social networks and content analysis. NodeXL (Social Media Research Foundation, California, USA) has been extensively used to analyze social network responses in academic fields[40] and it enabled this study to undertake social network analysis and capture key players in terms of COVID-19. It allowed the analysis of relational data and helped describe the overall relational COVID-19 network structure for Twitter. This study employed the between centrality to capture public key players for Twitter users. This is because the score of the between centrality could show people's dependence on the key player for the COVID-19 networks. The top 20 key players among all Twitter users were chosen based on the magnitude of the between centrality (see Table 2 for descriptive statistics).

This study first showed betweenness centrality, in-degree centrality, and eigenvector centrality to highlight social networks for COVID 19 in North America. The betweenness centrality calculates how much a node is in-between others. The betweenness centrality is measured by the number of shortest paths that passes through the node.[41] Each key player receives a score based on

Table 2. Descriptive statistics

Graph Metric	Canada	The US	Mexico
Graph Type	Directed	Directed	Directed
Vertices	15639	20014	14926
Unique Edges	21408	24263	19796
Edges with Duplicates	4,284	2945	4570
Total Edges	2692	27208	24366
Self-Loops	4346	3738	3188
Reciprocated Vertex Pair Ratio	0.006	0.007	0.005
Reciprocated Edge Ratio	0.013	0.013	0.010
Connected Components	2451	3620	1764
Single-Vertex Connected Components	1606	1820	1121
Maximum Vertices in a Connected Component	10663	10718	11450
Maximum Edges in a Connected Component	19165	16205	20117
Maximum Geodesic Distance (Diameter)	21	22	24
Average Geodesic Distance	5.674	6.368	6.215
Graph Density	0.000	0.000	0.000
Modularity	0.747	0.837	0.750
Minimum In-Degree	0	0	0
Maximum In-Degree	1227	1035	824
Average In-Degree	1.462	1.269	1.443
Median In-Degree	0.000	0	0
Minimum Betweenness Centrality	0	0	0
Maximum Betweenness Centrality	35577332	40811174	28700369
Average Betweenness Centrality	34014	30840	45814
Median Betweenness Centrality	0.000	0.000	0.000
Minimum Eigenvector Centrality	0.000	0.000	0.000
Maximum Eigenvector Centrality	0.025	0.024	0.032
Average Eigenvector Centrality	0.000	0.000	0.000
Median Eigenvector Centrality	0.000	0.000	0.000

the number of shortest paths that pass through the key player. Key players that more frequently lie on shortest paths between other users have higher betweenness centrality scores. In-degree is the number of connections that point inward at a vertex. For example, if a key player is mentioned 10 times by other users in a Twitter topic-network, the score of the key player is 10.[42] Eigenvector centrality calculates a node's centrality while considering the importance of its neighbors. For instance, a key player with 10 very popular twitter users has a higher score of eigenvector centrality than another key player with 10 relatively unpopular twitter users.[43]

Results

Figures 1 to 3 highlight that key players are highly concentrated in the central part of social networks for COVID-19, whereas they show different characteristics according to centrality types, key player types, and countries. For example, key players in Canadian networks are heavily clustered in the center of the main circle, whereas those in Mexico networks are relatively dispersed across the social networks. Another example is that all national key players are in the main circle of the social networks, while some international key players are placed in the outside of the main circle in the Mexican networks.
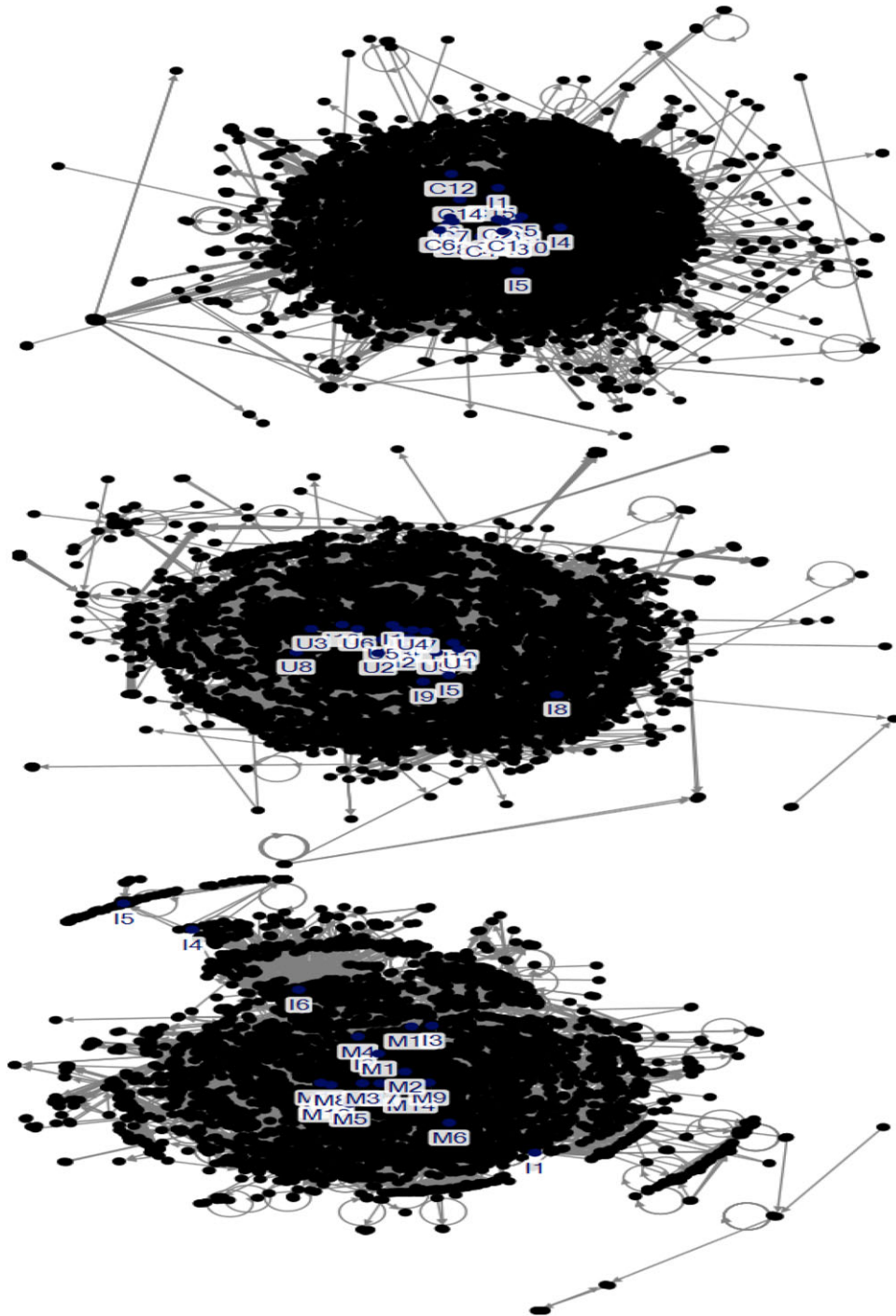
Figure 1. Between centrality (top: Canada, center: the US, and bottom: Mexico).

Tables 3 to 5 show the top 20 key players in Canada, the US, and Mexico. In Canadian networks, Health Canada and PHAC, which is the agency of the government of Canada, ranked first with the between centrality (BC)'s value of 35577332. Health Canada and PHAC showed the biggest gap from the second-ranked key player among Canada, the US, and Mexico. For example, the value of Health Canada and PHAC was 2.5 times higher than that of the second-ranked key player (35577332 and 14256089), while the other countries showed little difference between the top ranked

key player and the second-ranked player (the US: 40811174 and 40418529 and Mexico: 26593479 and 20525750).

This is also 1 of the significant differences from the US and Mexico since they have their president as the number 1 player. In contrast, Justin Trudeau, who is the Prime Minister of Canada, placed second (14256089). For the sake of readers, the Prime Minister of Canada is the head of the government in Canada, inconsistent with other countries, such as the US and Mexico. Also, 'CanadianPM,' which is the official account of the
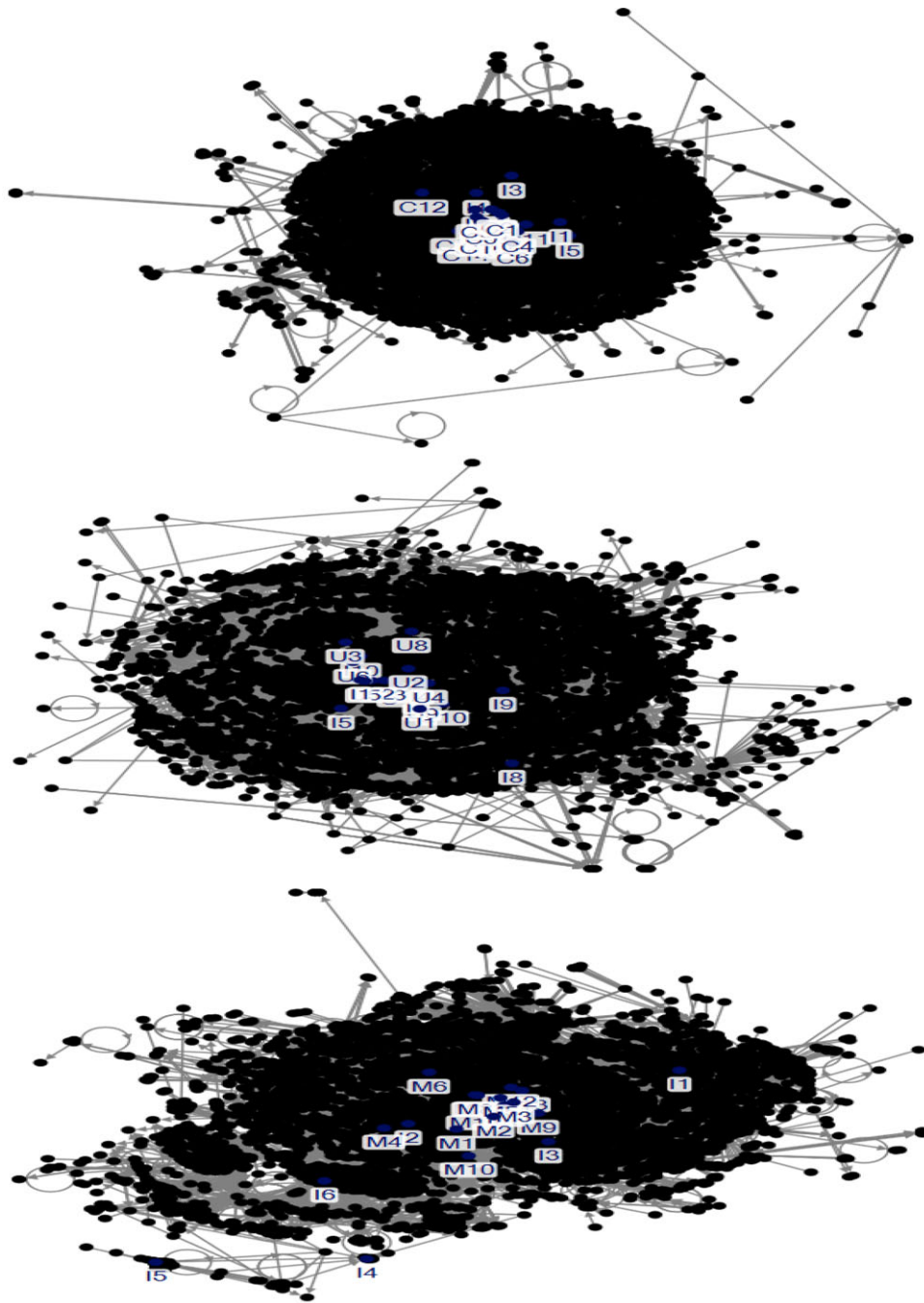
Figure 2. In-degree centrality (top: Canada, center: the US, and bottom: Mexico).

Prime Minister of Canada, and Chrystia Freeland who is the Deputy Prime Minister of Canada ranked fifteenth and sixteenth (4130006 and 3977503), respectively. The most remarkable finding was that CBC (Canadian Broadcasting Corporation) played an important role in social networks for COVID-19. For instance, CBC News and CBC News Alerts ranked third and fourth (10920955 and 10105638), respectively, while CBC British Columbia ranked eighth (7020672). CBC Calgary and CBC Toronto ranked nineteenth and twentieth (3265643 and 2853843), respectively. There were also some noticeable characteristics of Canada for social networks for COVID-19. Corona Update Bot, which is the Twitter account that runs automated tasks for

gathering COVID-19 information over the Internet, ranked tenth (5135869). Donald Trump (the US president at the time) placed fourteenth (4195138). World Health Organization (WHO) placed seventeenth (3898973).

In the US networks, President Donald Trump played the most important role in social networks of COVID-19. His account (Donald Trump) and the US government account (President Trump) placed first and eighteenth (40811174 and 2346261), respectively. President Donald Trump had the least gap from the second-ranked top player (CNN: 40418529) among the 3 countries. Another remarkable characteristic is that international key players exert a significant impact on social networks of COVID-
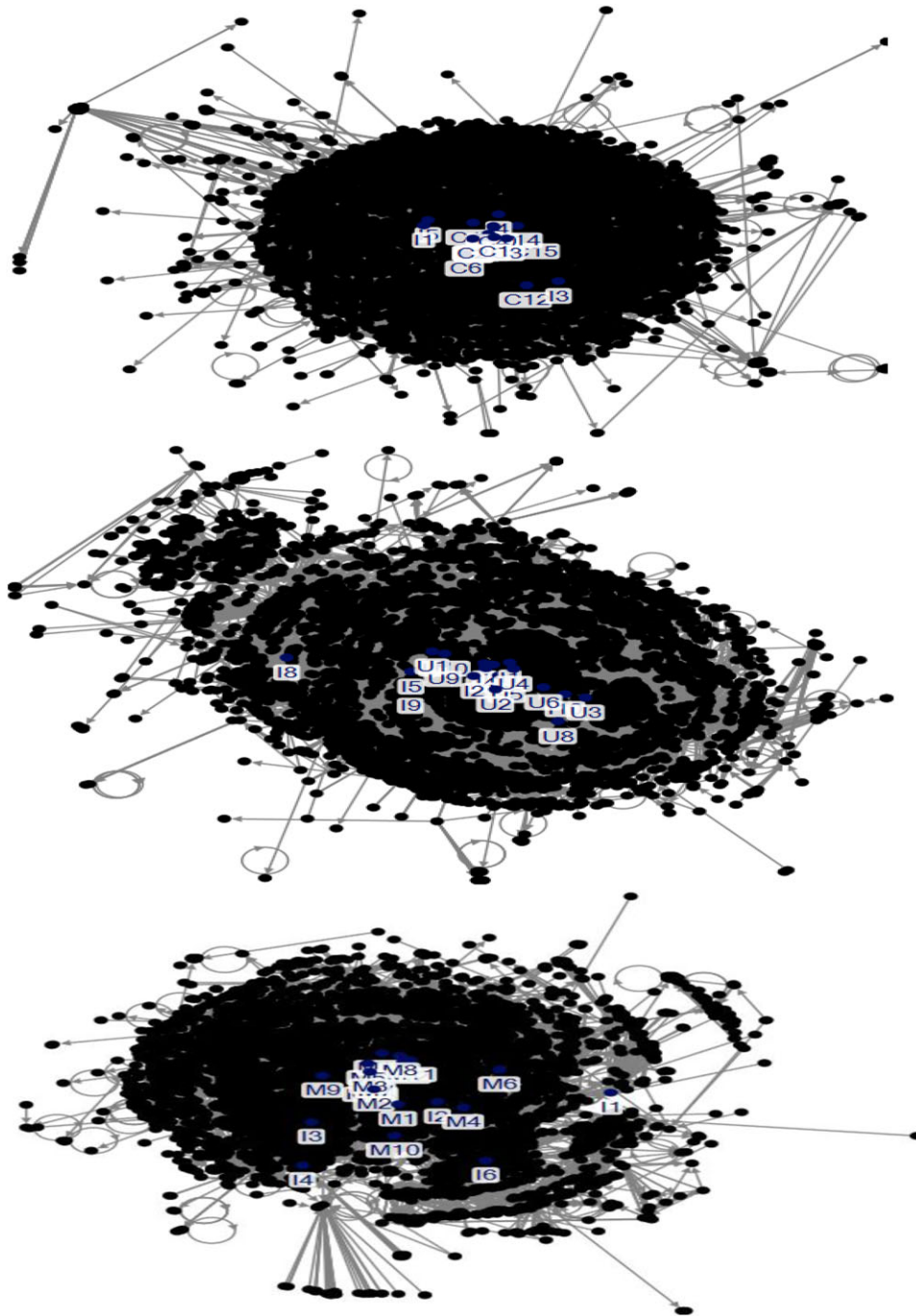
Figure 3. Eigenvector centrality (top: Canada, center: the US, and bottom: Mexico).

19 since the US has the highest number of international key players (10) among the 3 countries. For example, Reuters, which is an international news organization, ranked fifth (17980783), and World News, which is the news for all English users, placed seventh (6556337). The Guardian, which is the British daily newspaper, ranked eighth (6293035), and NDTV, which is the Indian television media company, placed eleventh (4781407). Nzherald, which is the New Zealand Herald newspaper, ranked fifteenth (3027882), and The Sydney Morning Herald, which is the Australia daily compact newspaper, placed nineteenth (1869109). Guardian news, which is the British daily newspaper, ranked twentieth (1613139). Another important characteristic is that Corona bots

play an essential role in social networks of COVID-19 in the US. For example, Corona Update Bot and Corona Virus Updates ranked ninth and thirteenth (6186204 and 3357575), respectively. On the other hand, WHO placed twelfth (4228332, 5 ranks higher than that of Canada).

In the Mexican networks, Andrés Manuel who is the President of Mexico had the most crucial impact on social networks of COVID-19 (26593479). Hugo López-Gatell Ramírez who is the head of the Undersecretariat of Prevention and Health Promotion at the Mexican Secretariat of Health ranked second (20525750). SALUD México, which is the Ministry of Health of Mexico, ranked third (19856765), and DW Español, which is

Table 3. The top 20 key players in Canada

	L	BC	Name	Description
1	C1	35577332	Health Canada and PHAC	Agency of the Government of Canada
2	C2	14256089	Justin Trudeau	Prime Minister of Canada
3	C3	10920955	CBC News	Canadian Broadcasting Corporation
4	C4	10105638	CBC News Alerts	Canadian Broadcasting Corporation Alerts
5	C5	8064724	The Globe and Mail	Canadian newspaper in Western and Central Canada
6	C6	7398429	Rachel Notley	The 17th Premier of Alberta
7	C7	7027855	Theresa Tam	The 3rd Chief Public Health Officer of Canada
8	C8	7020672	CBC British Columbia	Canadian Broadcasting Corporation British Columbia
9	I1	6595130	REFORMA	Mexican newspaper
10	I2	5135869	Corona Update Bot	Twitter account that runs automated tasks for gathering COVID-19 information over the Internet
11	C9	5054117	Toronto Star	Canadian broadsheet daily newspaper
12	I3	4946213	The Economist	International weekly newspaper
13	C10	4252638	Radio-Canada Info	The National Public Broadcaster for both radio and television
14	I4	4195138	Donald Trump	The US President
15	C11	4130006	CanadianPM	Official account of the Prime Minister of Canada
16	C12	3977503	Chrystia Freeland	Deputy Prime Minister of Canada
17	I5	3898973	WHO	World Health Organization
18	C13	3827592	Patty Hajdu	Canadian Liberal politician
19	C14	3265643	CBC Calgary	The division of the Canadian Broadcasting Corporation
20	C15	2853843	CBC Toronto	Canadian Broadcasting Corporation Toronto

Note: L, Label; BC, Between Centrality; C, Canada key player; U, US key player; M, Mexico key player; I, International key player

Table 4. The top 20 key players in the US

	L	BC	Name	Description
1	U1	40811174	Donald Trump	The US President
2	U2	40418529	CNN	American news-based television channel
3	U3	27796119	Elizabeth Warren	United States Senator
4	U4	19576088	NBC News	American broadcast television network NBC
5	I1	17980783	Reuters	International news organization
6	U5	9292760	Seth Abramson	Professor at University of New Hampshire
7	I2	6556337	World News	World news for all English Users
8	I3	6293035	The Guardian	British daily newspaper
9	I4	6186204	Corona Update Bot	Twitter account that runs automated tasks for gathering COVID-19 information over the Internet
10	U6	5004303	CNN International	American news-based pay television channel owned by CNN Worldwide International
11	I5	4781407	NDTV	Indian television media company
12	I6	4228332	WHO	World Health Organization
13	I7	3357575	Corona Virus Updates	Twitter account that runs automated tasks for gathering COVID-19 information over the Internet
14	U7	3100556	U.S. FDA	Federal Agency of the United States Department of Health and Human Services
15	I8	3027882	nzherald	The New Zealand Herald newspaper
16	U8	2709190	ProPublica	Nonprofit organization based in New York City. It is a newsroom that aims to produce investigative journalism pieces in the public's interest
17	U9	2681733	ABC News	American Broadcasting Company broadcast network
18	U10	2346261	President Trump	The US President
19	I9	1869109	The Sydney Morning Herald	Daily compact newspaper
20	I10	1613139	Guardian news	British daily newspaper

the regional version of official German TV Deutsche Welle for the Americas, placed fourth (12817876). An important finding is that key players in the Americas play a crucial role in social networks of COVID-19 for Mexico. For instance, Michelle Lujan Grisham who is the Governor of New Mexico ranked fifth (6852442), and CNN en Español, which is the Spanish version of the American news channel, placed sixth (6396820). Donald Trump ranked eighth (4415974), and Ecuavisa Noticias, which is the best television channel of Ecuador, placed eleventh (4083047). El Universo, which is 1 of the largest daily newspapers in Ecuador, placed fourteenth (2973207), and Presidencia Cuba, which is the official account of the Presidency of the Republic of Cuba, ranked fifteenth (2906046). Another remarkable characteristic is that Mexico does not have corona bots or WHO in its top key players, inconsistent with Canada and the US.

Next, this study employed cluster analysis by utilizing the Clauset–Newman–Moore cluster algorithm (see Figure 4 and 5).

Cluster analysis is a methodology for the task of assigning a set of objects into groups so that the objects in the same cluster are like each other than those in other clusters. The Clauset-Newman-Moore algorithm has been widely used to analyze social media metrics and represent the sociograms.[44]

Figure 4 shows the social networks of COVID-19 for the typical case. In the Canadian networks, nodes are highly concentrated as a circle, and some nodes are dispersed around the circle. All key players are also highly centralized in the main part of the circle. In the US networks, nodes and key players show more dispersed

Table 5. The top 20 key players in Mexico

	L	BC	Name	Description
1	M1	26593479	Andrés Manuel	President of Mexico
2	M2	20525750	Hugo López-Gatell Ramírez	Mexican epidemiologist
3	M3	19856765	SALUD México	Ministry of Health of Mexico
4	M4	12817876	DW Español	TV network
5	I1	6852442	Michelle Lujan Grisham	Governor of New Mexico
6	I2	6396820	CNN en Español	American news-based pay television channel owned by CNN en Español
7	M5	5328467	El Universal	Mexican newspaper based in Mexico City
8	I3	4415974	Donald Trump	The US President
9	M6	4350723	MVS Noticias	MVS News station about the events in Mexico and the world.
10	M7	4086844	REFORMA	Mexican newspaper
11	I4	4083047	Ecuavisa Noticias	The best television channel of Ecuador.
12	M8	3333236	La Razón de México	Mexican news
13	M9	3294387	Forbes México	American business magazine México
14	I5	2973207	El Universo	1 of the largest daily newspapers in Ecuador
15	I6	2906046	Presidencia Cuba	Official Account of the President of the Republic of Cuba
16	M10	2397243	Marcelo Ebrard C.	Former Head of Government of the Federal District
17	M11	2362085	MetroCDMX	The Mexico City Metro
18	M12	2300488	Milenio	Major national newspaper in Mexico
19	M13	2128614	El Financiero	Main newspaper in Mexico
20	M14	1742339	Animal Político	Breaking news, reports, research, videos and useful information about Mexico and the world

patterns. Nzherald (I8) is far apart from other key players. In the Mexican networks, nodes show a large circle, and there are many nodes under the circle. Key players show the most disperse pattern, and El Universo (I5) has some independent channels.

Figure 5 shows the social networks of COVID-19 according to groups. In the Canadian networks, many players are in the largest group (group 1). For example, Health Canada and PHAC (C1), Justin Trudeau (C2), and Theresa Tam (C7), as well as CanadianPM (C11), and Patty Hajdu (C13) are in the group 1. They are all governmental key players. Key players in Canada are in large groups. For instance, all key players are located within group 15. Also, people have the most open communication networks across groups among the 3 countries.

In the US networks, key players are relatively distributed in many groups. For instance, CNN (U2) and CNN International

(U6) play a significant role in group 1. Elizabeth Warren (U3) exerts a crucial impact on group 2. Donald Trump (U1), President Trump (U10), and Corona Update Bot (I4) are in the central part of group 3. Also, people show the most closed communication networks across groups among the countries.

In the Mexican networks, there is no key player in group 1, and this is the most distinguishable characteristic from Canada and the US. Instead, many key players are concentrated in group 2, and they are all Mexican key players. For example, Andrés Manuel (M1), Hugo López-Gatell Ramírez (M2), and SALUD México (M3), as well as REFORMA (M7), Marcelo Ebrard (M10), and Animal Político (M14) are in group 2. Also, they show the most active communication networks with people across groups.

Next, this study highlighted the top word pairs in tweets according to countries (see Table 6). In the Canadian networks, the top word pairs were 'covid,19,' followed by 'covid, alert,' 'alert, app,' '19, cases,' and 'download, here.' Canadians are highly interested in COVID-19 apps since the government provided digital tools to help them access services and get information on COVID-19. For instance, Health Canada released COVID-19 apps, such as COVID Alert and Canada COVID-19. COVID Alert notifies people if someone they met in the past 14 days, tells the app they tested positive. Canada COVID-19 is designed for people to stay informed about COVID-19 in Canada and determine what actions and next steps they should take.

In the US networks, people were searched about 'covid,19' ahead of 'Donald, trump,' 'united, states,' 'trump, incompetent,' and 'incompetent, administration.' The US people are highly interested in their president's pandemic policy and highly criticized the president and administration as incompetent for COVID-19. For instance, Pittsburgh Tribune-Review, which is the second largest daily newspaper serving metropolitan Pittsburgh, Pennsylvania, in the US, criticized President Trump and his administration as follows 'After a single case of coronavirus in China became a pandemic and reached our shores in January, we had a federal response we believe was incompetent. Trump and his administration not only failed to control the virus, but let it become the most dangerous outbreak on the planet.'[45]

In the Mexican networks, people focused on 'covid,19,' followed by 'en, méxico (in Mexico),' as well as 'de, covid (of covid),' 'la, pandemia (the pandemic),' and 'casos, y (cases and).' Mexican people searched for COVID-19 cases and the pandemic in Mexico. This is because on July 31, 2020, Mexico moved into third place in the number of fatalities, behind the United States and Brazil, with 46688 deaths, and occupied sixth place globally in the total number of confirmed cases, with 424637 cases.

Discussion

COVID-19 has become 1 of the worst disasters in human history. It totally damages people's daily life, and people are waiting for new COVID-19 vaccines. By August 2020, there was no choice but to keep social distancing and COVID-19 information updated. In this sense, understanding COVID-19 networks would be an essential task for governments to provide relevant information on COVID-19 to the public. Therefore, this study highlights how people communicate with each other on COVID-19 information by employing SNA for Twitter in North America.

This study unearthed some important findings, consistent with prior studies. First, this study shows that countries have different key players in social networks for COVID-19, consistent with prior studies.[46] For example, Yum[46] highlights that the UK has only
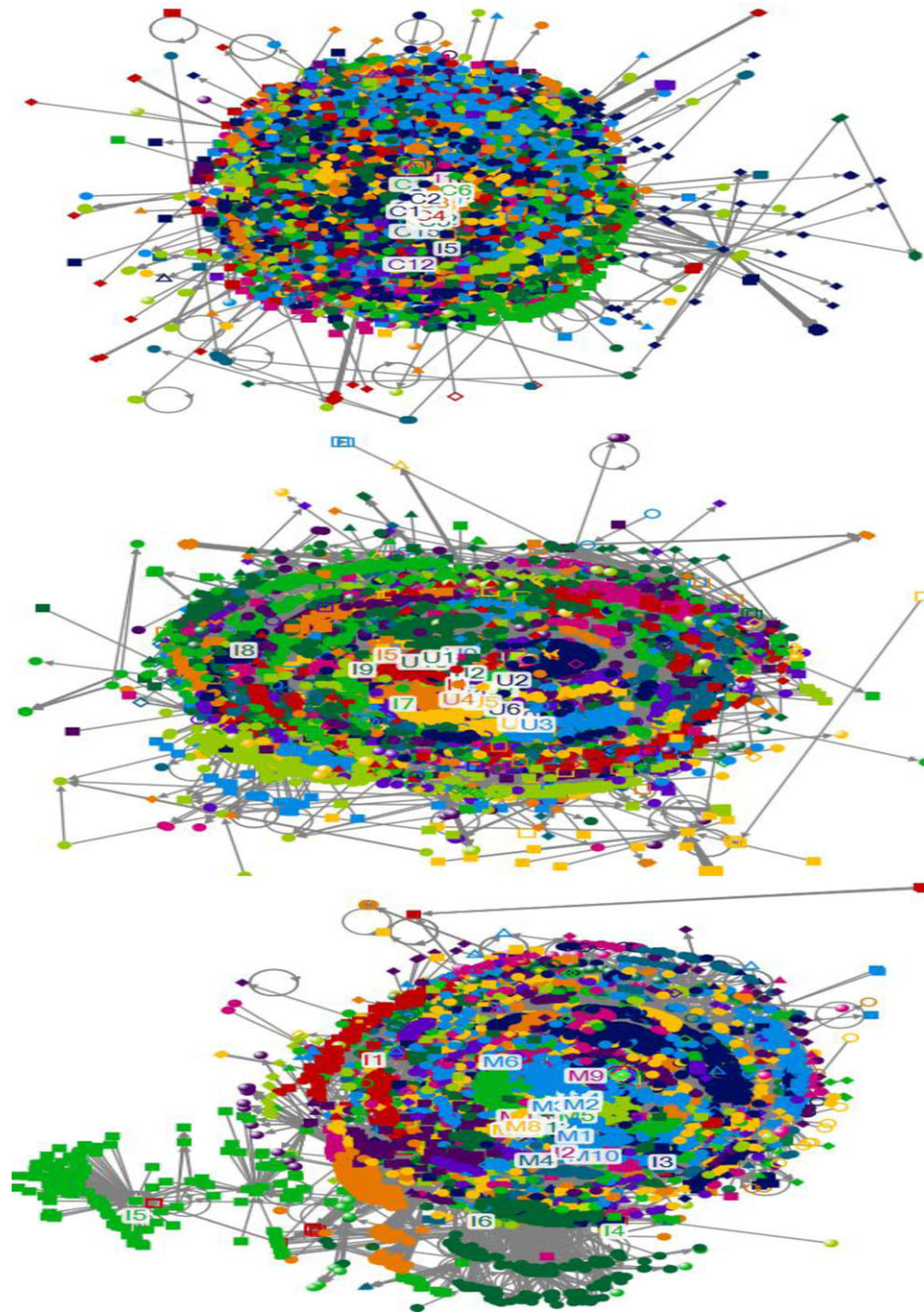
Figure 4. Social networks for the typical case (top: Canada, center: the US, and bottom: Mexico).

national key players, France has many national key players, and other countries have all global key players.

Second, the head of countries also plays an important role in social networks for COVID-19 in social network services as well as in the real world, which is a similar finding of previous articles.[47–49] For instance, Rufai and Bunce[48] found out that Twitter can represent a significant tool for world leaders to immediately communicate public health information with their citizens.

Third, people actively utilize their social network services for COVID-19 to share their opinions with each other and get valuable information across, and Twitter can be utilized to understand the

public's sentiments and opinions, which concurs with prior literature.[50–52] For example, Xue et al.[52] showed that Twitter can play a significant role in infodemiology studies, enabling scholars and governments to understand public opinions and sentiments during the COVID-19 pandemic.

Lastly, this study has some limitations which are follows: (1) this study focuses on key players in social networks for COVID-19. Future studies can be extended to other players to understand the social networks with more comprehensive understanding; (2) this study employs social network analysis only for Twitter. Other SNS, such as Facebook, YouTube, or Instagram, might show different findings and results. Future studies should explore social

Table 6. The top word pairs

	Canada		The US		Mexico	
	Word Pairs	Count	Word Pairs	Count	Word Pairs	Count
1	covid,19	11719	covid,19	13418	covid,19	12476
2	covid, alert	2316	Donald, trump	1514	en, méxico	4606
3	alert, app	1542	united, states	1331	de, covid	4124
4	19, cases	837	trump, incompetent	1035	la, pandemia	1701
5	download, here	784	incompetent, administration	1035	casos, y	1646
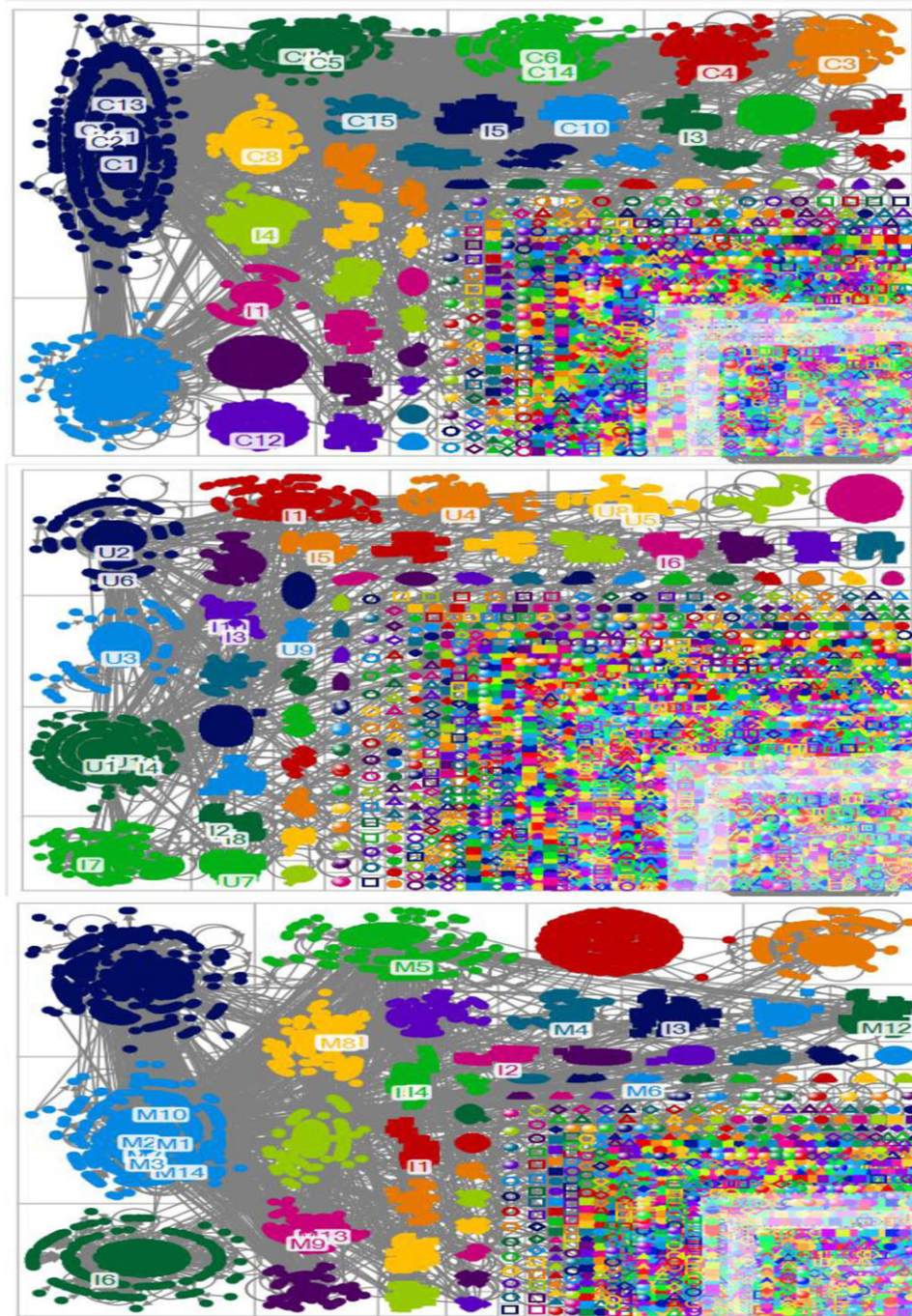
Figure 5. Social networks according to groups (top: Canada, center: the US, and bottom: Mexico).

networks for other SNS as well as Twitter; (3) this study analyzes social networks only for COVID-19. Future research could compare social networks between COVID-19 and other types of coronaviruses, such as Severe Acute Respiratory Syndrome or Middle East respiratory syndrome coronavirus, to effectively establish health policies for governments and health planners.

Conclusion

This study aimed to highlight COVID-19 response in North America since North America is the most severe continent affected by the COVID-19 pandemic. Hence, social network analysis was used to highlight social networks for COVID-19 on Twitter to provide useful implications and findings for scholars, governments, and centers for disease control and prevention.

The results from this study can be summarized as follows: (1) the Prime Minister plays the second important role in social networks for COVID-19 in the Canadian networks, whereas the Presidents play the most significant role in them in the US and Mexican networks; (2) Corona Update Bots exert a crucial impact on social networks of COVID-19 in Canada and the US, while they are not in the top 20 key players in Mexico; (3) Donald Trump played a significant role in all 3 countries; (4) WHO shows a pivotal effect on social networks of COVID-19 in Canada and the US, whereas it does not affect them in Mexico; (5) Canada shows the most open communication systems across groups, whereas the US reveals the most closed communication systems among groups; and (6) Canadians are highly interested in COVID-19 apps, the US people highly criticize the president and administration as incompetent for COVID-19, and Mexicans tend to search for COVID-19 cases and the pandemic in Mexico.

This study suggests important implications which are as follows: (1) countries should investigate their key players since they have different characteristics for social networks of COVID-19; (2) the Canadian government should utilize CBC news channels for COVID-19 since they are number 5 out of the top 20 key players. The US government should employ the accounts of Donald Trump because he placed first and eighteenth, respectively. The Mexican government should use the accounts of the President of Mexico and the Ministry of Health of Mexico since they ranked first and third, respectively; (3) governments should explore their communication networks systems both for individuals and groups since they have different characteristics according to countries; (4) countries and policy makers should investigate social keywords of people through social network services since they reveal their concerns and interests in the internet space; and (5) people should get COVID-19 information and recommendations from a multitude of key players as well as 1 or 2 key players since a key player might not align with current pandemic recommendations or have some political movements. For example, Donald Trump who ranked first in the US networks did not recommend wearing a mask in public, while many studies show that the use of face mask prevents the spread of COVID-19.[53–55] In this case, people might get the wrong information and be affected by others' political movements. Therefore, people should try to get objective COVID-19 news and policies by exploring a multitude of key players who are suggested in this study.

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Abbreviations list:. IT, Information Technology

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