

Crisis Communications on Social Media: Insights from Canadian Officials Twitter Presence during COVID-19 Pandemic

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Abstract

COVID-19 pandemic is a unique case in crisis management given its length, scale, several different response systems, and public officials' extensive social media use for crisis communication. Leveraging text mining techniques, we examine Canadian officials' presence on Twitter during the pandemic by focusing on their COVID-19-related content. We identified eight themes of discussion that unveil 37 relevant subthemes. Concentrating on the COVID-19-addressing themes, we reveal that educating citizens on the safety information and keeping them informed with the latest crisis information was the Canadian officials' primary focus during the pandemic. To fight COVID-19, Canadian officials used four policies, and to implement those, they promoted eight measures and practices. According to the volume of generated content, the evolution of COVID-19-addressing themes over time, and their coexistence; Test and trace was the most advocated policy by emphasizing screening the symptoms. To stop the spread of COVID-19, Canadian officials promoted wearing Mask, Social distancing, Hand washing, and Stay home, where Mask and Social distancing were the most frequent practices. Our study contributes to crisis communication and management by depicting how Canadian officials leveraged social media during such a big-scale crisis.

1. Introduction

Since the advent of social media, it has had an ever-increasing role in times of crises [1, 2]. In 2012, during Hurricane Sandy, social media were extensively used to get the latest updates on the situation and receive safety information [2]. During the Zika outbreak, people used social media to understand the origin, nature, and the spread of the virus, and to seek safety information and effective preventive measures [3, 4, 5, 6]. These information seeking and production behaviors aimed at increasing situational awareness and adapting to and

recovering from the situation have become common in using social media during times of crises [1, 7, 8, 9]. The recent coronavirus disease (COVID-19) is the latest of such crises on an unprecedented and global scale. More than three billion people had gone to confinement during the pandemic. Online technologies have become the favored means for providing information to citizens and handling people's daily lives. As a result, online technologies have become the primary choice of having social interactions [10, 11]. In this context, people are increasingly using social media to seek and disseminate information on evolving topics about COVID-19 from its origin and the source to its impact on people and preventive measures to decrease its spread [12].

The presence and activities of public officials on social media in recent years have been increasing as well. The way they use social media has also been undergoing considerable changes since the early years of social media when they were used primarily for passively disseminating information about authorities' perspectives and missions [13]. Public officials utilize social media to actively monitor public concerns to enhance decision-making and create communication channels for facilitating citizens' engagement, improving government responsiveness, and promoting public policies [9, 14, 15]. Public authorities' roles have become more prominent in times of crises since the general public perceives them as credible information sources on social media [15]. For example, given their credibility, public health officials' correction of health-related misinformation is proven to be an effective way for rumor management [16]. Having earned the reputation of a credible source, public officials use social media in crises to provide and disseminate reliable information, educate the public with the safety and preventive measures and engage citizens in conversations and collective actions [7, 11].

Given the current COVID-19 scope and magnitude, it has been a great challenge for public officials in terms of crisis management and communication. Moreover, different political and healthcare systems of the affected

countries, for example, the center-oriented systems of China and Thailand with national homogeneous policy response systems in comparison to the federal systems of the U.S. and Canada, have resulted in large variations of COVID-19 pandemic responses [17]. However, the presence and activity of public officials on social media and their contribution to the COVID-19 discourses in a relatively long-term pandemic have been unprecedented. Therefore, analyzing this presence in terms of the produced content and their activities on social media networks yields valuable information about the nature, features, and evolution of COVID-19 response systems. Eventually, such analysis contributes to building more resilient crisis management systems.

This paper analyzes the COVID-19-related content generated by the Canadian officials on Twitter over 13 months, from the beginning of January 2020 to the end of January 2021. We determine the main contributors of COVID-19 discourse among different groups of Canadian officials. As our primary goal, we analyze the generated content to identify the themes and subthemes of discussions. Then, we focus only on the themes that address COVID-19, including policies, measures, and practices to reveal how they were used, their interrelations, and their evolution during the pandemic.

2. Related work

One of the earliest studies pointing to the emerging role of social media in changing the nature of crisis management and communication is Latonero and Shklovski [13]. In a longitudinal case study of social media use for crisis management, they highlight the opportunity provided by social media for public organizations to directly communicate with the public on an unparalleled scale and bypass the constraints imposed by traditional media. Wukich et al. [7] reviewed the literature on the public officials' social media use for emergency management and found three main strategies: monitoring social media to increase situational awareness, engaging the public in conversation, and disseminating emergency information, including warnings, resource provision, preparedness education, and administrative news. Panagiotopoulos et al. [2] bring attention to the challenges of communicating risks to the public in time of a crisis. They find the presence and activeness of public officials on Twitter a useful means to quickly disseminate vital information and mitigate the emergencies' impacts by managing the public reaction. Analyzing UK public officials' tweets after two crises, they found the officials used Twitter to communicate and manage risks by providing updates, encouraging protective behaviors, increasing awareness,

and directing public attention to mitigating actions.

In health crisis management, Guidry et al. [18] analyzed the presence of prominent healthcare organizations on social media and emphasized the role of creating meaningful and interactive communication with the public in times of global health crises. Its findings suggest public officials' presence on social media is most effective when their messaging behavior is based on risk communication principles like acknowledging the public fears and concerns and providing solution-based communication. On the specific case of the COVID-19 crisis, Chen et al. [19] examined the theoretical factors of public engagement with public officials' accounts on social media. While the media richness negatively affects citizens' engagement, stimulating public dialogue and providing responding channels for citizens enhance it. More importantly, keeping the citizens informed and updated and ensuring them of the government's effort to handle the crisis positively affect public engagement. Wang et al. [11] analyzed the risk communications of 67 U.S. federal health agencies during the early stages of the COVID-19 crisis. They revealed the agencies underestimated the pandemic's risks initially, but their attention increased over time. The agencies increased situational awareness and educated the public about preventive strategies in their communication. However, the communication had insufficiency, incongruency, and inconsistency across the message types.

3. Methods

3.1. Data collection and pre-processing

We started by collecting Canadian public officials' information. It includes eight types of public officials' accounts: *City*, *Mayor*, *Federal official*, *Federal department*, *Health service*, *Hospital*, *Provincial official* and *Provincial department*. A *Health service* is a regional healthcare system or a network of hospitals. *Federal official* and *Provincial official* refer to people, including cabinet members, also health officials who are actively involved in managing the pandemic, e.g., Dr. Theresa Tam, the chief public health officer of Canada. *Federal department* and *Provincial department* refer to ministries, also other departments that are actively involved with the COVID-19 pandemic, e.g., the Public Health Agency of Canada.

We extracted federal and provincial officials and their departments' information from official websites and manually searched for their accounts on Twitter. Using a city list [20] and a hospital list [21] of Canada, we searched for city accounts, mayors, hospitals, and health networks using Twitter Application Programming

Interface (API). The search strings were city\hospital names, and the result was lists of accounts that we manually chose the correct account for each search. This process resulted in a list with 919 entries (Figure 1). In a separate round of verification, we excluded 123 entries as we identified them as non-official. Of the remaining 796 official accounts, eight accounts were inactive, and two were private (protected accounts). The exclusion resulted in 786 accounts on Twitter. Finally, we verified the authenticity of all the public-official accounts either by using Twitter verified accounts (the blue verified badge) or by visiting their official websites.

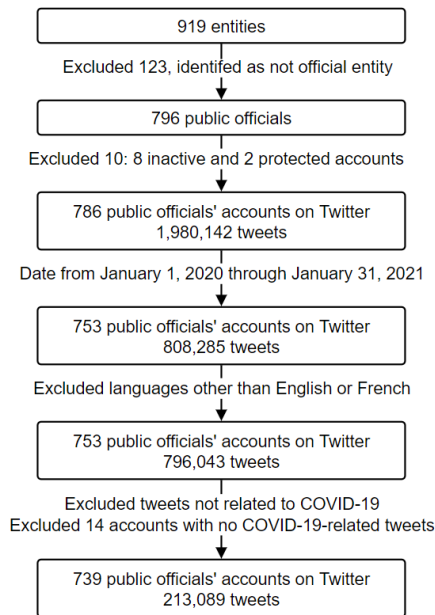


Figure 1. Data collection process.

Next, we collected the public officials' tweets using Twitter APIs that allow access to each account's most recent 3000 tweets. Our first round of data collection took place in December 2020, and we continued collecting the data until February 2021. At the end of the process, we collected 1,980,142 tweets from 786 accounts. As the first reported COVID-19 case in Canada was on January 25, 2020 [22], we set the start date on January 1, 2020, and we included 13 months of data until January 31, 2021. Excluding tweets out of this range resulted in 753 accounts with 808,285 tweets. For 94.28% (710 of 753 accounts) of the officials, we collected their tweets for the whole duration of the Canada COVID-19 pandemic. For 5.71% (43 of 753 accounts) officials, we could not collect their tweets for the whole duration as the number of tweets exceeded the Twitter API limitation. We also excluded languages other than English or French that decreased tweets to

796,043. Finally, we used a set of terms (including *covid*, *corona*, *korona*, *ncov*, *covd*, *sars*, *epidemic*, *outbreak*, *pandemic*, *épidémie*, and *pandémie*) based on the literature to identify COVID-19-related tweets. This resulted in 739 official accounts with 213,089 tweets. Fourteen accounts were excluded as they did not have any tweets related to COVID-19. These accounts were weakly active, with 14 tweets on average and 194 tweets in total for the whole COVID-19 pandemic duration.

We removed symbols, emojis, numbers, and non-alphanumeric characters except for white space. In addition, we normalized URLs and user mentions using common placeholders. We translated French tweets to English using Google Translate. We also lemmatized words to their dictionary form using the WordNetLemmatizer module of the Python Natural Language Toolkit.

3.2. Data analysis

Data Analysis had two main phases: hashtag analysis and frequent term analysis. Since our goal was to find the main themes and subthemes in the social media presence of Canadian officials on Twitter, we decided to start with hashtag analysis. Hashtags are community-driven conventions to categorize posts and highlight their topics [23, 24] by adding a hashtag symbol (#) at the start of key terms. Wang et al. [23] categorize hashtags into three types. Most hashtags are *topic hashtags* that identify specific topics, for example, *#MentalHealth*. In other cases, hashtags can only have sentiment information (*sentiment hashtags*), like *#kind* or *#hope*; or they can include a topic and a sentiment about it (*sentiment-topic hashtags*), like *#NursesRock*. In a preliminary analysis on the most-frequent hashtags (≥ 10 for English hashtags and ≥ 5 for French hashtags) in our data, 92.93% (1800 hashtags) were *topic hashtags*, 6.97% (135 hashtags) were *sentiment-topic hashtags* and only 0.1% (2 hashtags) were *sentiment hashtags*. It confirmed our approach as public officials tend to use hashtags to highlight the topics of their messages.

We used the hashtag field in the tweets' metadata to extract the hashtags. Then, we used the most frequent hashtags to identify the most common themes and topics manually. After two rounds of labeling, the authors reached a consensus for 47 fine-grained topics, i.e., subthemes. Next, we extracted the top frequent terms, including unigrams, bigrams, and trigrams. To extract the top frequent terms, we used the count vectorizer module from the Python sklearn package. We analyzed the top 2388 frequent terms (occurrence $\geq 3\%$) and added five new subthemes to enrich the previously identified subthemes. For all the labeled terms, we

searched and labeled other similar terms. This phase resulted in 52 subthemes and a complete list of terms for each. We used these terms to classify tweets into predetermined subthemes. We decided to keep the subthemes with a density of more than 1% of the total tweets. As a result, we kept 37 subthemes and excluded others as their densities were less than 1%.

4. Results

4.1. Public officials' contribution

Out of 400 cities and towns in Canada, we could only find 216 accounts on Twitter. We speculate the missing cities' populations are small, and they have no account on Twitter. Yet, it is worse for the mayor accounts as we could only find 82 mayor accounts. In total, we identified 219 provincial officials, of which 30 had no Twitter account. Federal officials were the only group that all were active on Twitter.

Over the course of study (from January 1, 2020, to January 31, 2021), 796,043 tweets were collected of which 213,089 were about COVID-19 (Figure 1). Table 1 shows the eight official groups' contribution to the total and COVID-19-related tweets. Health services, hospitals, federal departments, and provincial departments are at the top as they have dedicated more than 35% of their tweets to COVID-19. In COVID-19-related tweets, provincial officials (23.98%), provincial departments (17.85%), and cities (17.34%) provide the highest number of tweets. The high percentage of tweets for provincial officials and cities are justified by their high volume of accounts. However, the provincial department has less than half of the accounts compared to the other two. It drove us toward using a more explanatory variable to identify the most active group of users. To do so, we calculated the average activeness of each group by dividing their number of tweets over the number of accounts. According to average activeness, federal departments and federal officials with 28.58% and 19.98% of the total average activeness were the most active users during the pandemic. Then come provincial departments

and provincial officials with 15.77% and 9.6% of the total average activeness. It shows that the main load of managing the COVID-19 crisis in Canada was on the shoulders of federal and provincial governments.

4.2. Emerged themes

On average, each tweet in our data had 3.31 keywords and 2.46 subthemes. For example, the tweet: “*Stay home and get tested if you are sick or experiencing any #COVID19AB symptoms. Have a cough, fever, runny nose, shortness of breath or sore throat? It's mandatory to isolate for at least 10 days. Find out more:@URL*” by the Alberta government has eight keywords (symptom, fever, runny nose, breath, sore, isolate, stay home, and tested) that classifies the tweet into four subthemes: *Stay home*, *Self-isolation*, *Symptoms*, and *Test and trace*. In this section, we introduce the 37 emerged subthemes in the context of eight themes (Figure 2).

4.2.1. Educating. *Educating* (%52.77) as the most prevalent theme includes *Stay informed*, *Safety*, *Cases*, *COVID wise*, and *Symptoms*. *Stay informed* (23.19%) as the most used subtheme encourages people to get the latest information and to stay informed about all the matters related to COVID-19, such as the provided help and support for citizens, statistics about the disease, and the new measures. *Safety* (22.38%), the second top-used subtheme, asks people to follow safety measures, stay safe, and protect themselves in a general context. It does not include specific practices or measures, for example, hand washing or wearing a mask. However, it emphasizes following the safety guidelines and measures. *COVID wise* (7.89%) is similar to *Safety* as it encourages people to follow safety measures. Still, its distinguishing difference is that it addresses people as intelligent and active agents in combating COVID-19 by emphasizing learning about COVID-19, acting wisely, and being vigilant. Educating people about *Cases*, i.e., the number of cases and deaths (12%), and the *Symptoms* (3.81%) they might experience covered specific aspects of COVID-19 disease. Updating about

Table 1. Public officials' contribution to the total and COVID-19-related tweets.

Public Official	Total tweets			COVID-19 tweets		
	Accounts	Tweets	COVID-19 tweets (%)	Accounts (% of total)	Tweets (% of total)	Average activeness (% of total)
City	218	203896	18.12%	213 (28.82%)	36949 (17.34%)	173.47 (5.9%)
Mayor	82	83288	21.35%	79 (10.69%)	17781 (8.34%)	225.08 (7.65%)
Federal official	49	93904	30.67%	49 (6.63%)	28802 (13.52%)	587.8 (19.98%)
Federal department	24	53398	37.79%	24 (3.25%)	20177 (9.47%)	840.71 (28.58%)
Health Service	51	25294	37.39%	48 (6.5%)	9457 (4.44%)	197.02 (6.7%)
Hospital	63	29984	35.97%	63 (8.53%)	10785 (5.06%)	171.19 (5.82%)
Provincial official	184	201241	25.39%	181 (24.49%)	51091 (23.98%)	282.27 (9.6%)
Provincial department	82	105038	36.22%	82 (11.1%)	38047 (17.85%)	463.99 (15.77%)
Total	753	796043	26.77%	739 (100%)	213089 (100%)	2941.53 (100%)

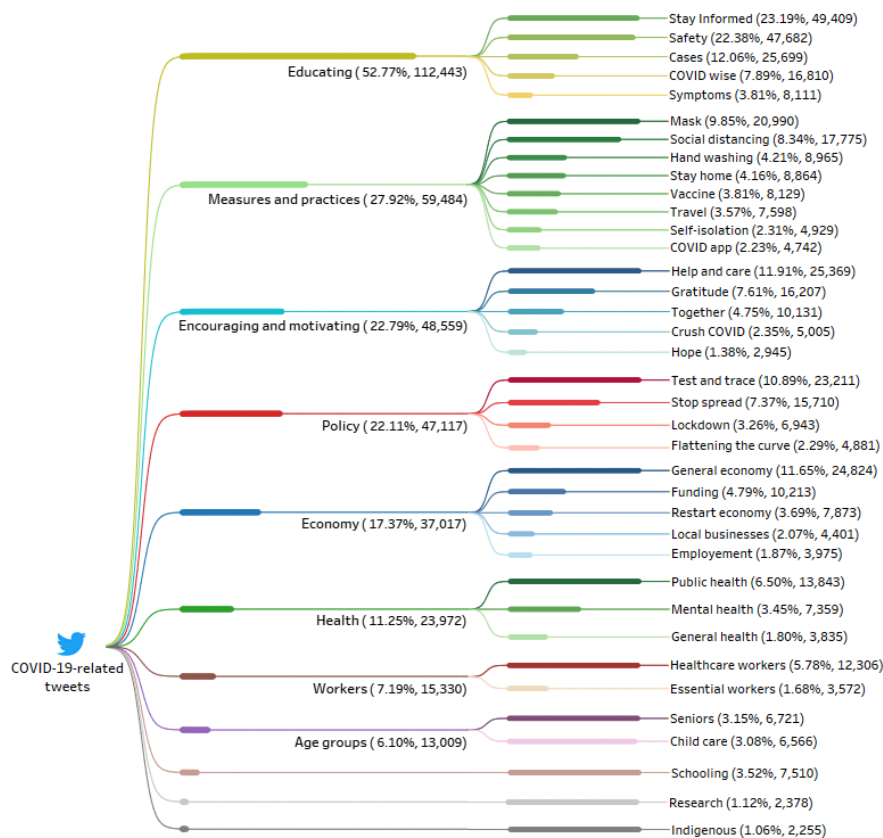


Figure 2. Emerged themes and subthemes.

cases was more like a daily task and was done mainly by the provincial government accounts.

4.2.2. Measures and practices. The second most-used theme in the Canadian officials' tweets was *Measures and practices* (27.92%). Its subthemes address the citizens at the individual level and ask them to follow specific measures and practices so that the community can manage and overcome the pandemic. The eight measures and practices are *Mask*, *Social distancing*, *Hand washing*, *Stay home*, *Vaccine*, *Travel*, *Self-isolation*, and *COVID app*. Based on their prevalence, wearing a mask (9.85%) and *Social distancing* (8.34%) are the two most highly advised practices by Canadian officials as they are twice-prevalent than the other practices. *Hand washing*, *Stay home*, following *Travel* measures, and getting vaccinated are in the middle as their prevalence is between 4.2% to 3.5% of the tweets. *Self-isolation* has a low presence percentage (2.3%) in comparison to the others. *COVID app*, i.e., the COVID Alert application, also has a low percentage (2.2%). *COVID app* is a mobile application developed by the federal government for notifying people of their potential

exposure to COVID-19 before they have any symptoms. Based on contact tracing strategy [25], the application works by receiving reports from diagnosed people with COVID-19 and exchanging this information with nearby people using Bluetooth technology. Identifying account types advocating COVID Alert shows that it is mainly promoted by the federal government accounts (3020 tweets) as its contribution is three times higher than the provincial government (897 tweets) and the city and mayor accounts (718 tweets).

4.2.3. Encouraging and motivating. *Encouraging and motivating* (22.79%), the third most prevalent theme, did not directly address COVID-19. However, its subthemes encouraged citizens to continue fighting COVID-19 and kept them motivated during the pandemic. *Help and care* (11.91%) encourages citizens to be kind, caring, and supportive; it also includes supportive messages from the governments to citizens. *Gratitude* (7.61%) was dedicated to thanking those who were mostly involved in dealing with the pandemic, i.e., healthcare professionals and essential workers. *Together* (4.75%) and *Crush COVID* (2.35%) emphasize dealing with COVID-19 as a collective effort. Being

together and strong during the pandemic and addressing the pandemic's problems as a community was the main context in *Together*. Officials also used *Crush COVID* for the same purpose. However, their language tends to be somewhat militant. They used terms like beating, combating, battling, fighting, and crushing COVID to emphasize this collective effort and inject encouragement to the community to address the COVID-19 pandemic. Posts in *Hope* (1.38%) emphasize promoting hope in the community by motivating people to keep up their hope and efforts.

4.2.4. Policy. We identified *Test and trace*, *Stop spread*, *Lockdown*, and *Flattening the curve* as Canadian officials' policies and strategies on Twitter to fight COVID-19. It is worth distinguishing *Policy* and *Measures and practices*. *Measures and practices* are at the individual level, asking people to follow specific tasks like keeping social distancing and washing their hands. Policies are the strategies taken by the officials at the community level to manage the pandemic. To implement policies, citizens should follow *Measures and practices*.

Test and trace (10.89%) was the top Canadian officials' policy. In *Test and trace*, they encourage citizens to screen COVID-19 symptoms, get tested, and trace their contacts if their test is positive. The second policy, *Stop spread* (7.37%), mainly focused on asking citizens to limit and reduce the spread and transmission of the virus. *Lockdown* (3.26%) is the third identified policy that has the same goal as *Stop spread*. However, the difference is that in *Stop spread*, citizens are addressed as active agents to prevent, stop, and limit the spread of the virus. In *Lockdown*, citizens have no active role. Officials only disseminate the information about the restrictions and closures that they have implemented to stop the spread of the virus. The last policy is *Flattening the curve* (2.29%) that its goal is keeping the number of cases at a manageable level by the health system.

4.2.5. Economy. Although *Economy* did not address COVID-19, it emerged in 17.37% of tweets in five subthemes: *General economy*, *Funding*, *Restart economy*, *Local business*, and *Employment*. It shows the importance of the economy to Canadian officials and how it was affected by the COVID-19 pandemic. *General economy* (11.65%) encompasses all talks about the economy at the general level with no specific context. *Funding* (4.79%) includes posts informing citizens about different funding sources provided by the federal and provincial governments. *Restart economy* (3.69%) includes the plans to relaunch the economy. *Local businesses* (2.07%) includes

information about how public officials supported local businesses. *Employment* (1.87%) contains concerns about citizens' employment during the pandemic, losing jobs, and informing them about creating new jobs.

4.2.6. Health. *Health* (11.25%) emerged in three subthemes: *Public health*, *Mental health*, and *General health*. *Public health* (6.5%) encompasses the talks and information about public health. *Mental health* (3.45%) has been so important during the pandemic that it emerged as an independent subtheme. It contains posts about the importance of mental health during the pandemic and how to prevent and deal with it. *General health* (1.8%) as a subtheme includes posts providing health services information to the citizen.

4.2.7. Workers. Two types of workers and services got the attention of the Canadian officials during the pandemic: *Healthcare workers* and *Essential workers*. *Healthcare workers* (5.75%) include the talks about all professionals in the healthcare system, including nurses, caregivers, physicians, paramedics, and other health staff. *Essential workers* (1.68%) includes talks about workers and services that should be active and open during the pandemic. The context of both subthemes was mainly showing gratitude toward the workers, helping them, and asking citizens to follow safety measures for them.

4.2.8. Age groups. *Age groups* (6.1%) includes *Seniors* and *Child care* as subthemes. *Seniors* (3.15%) contained the talks about long-term care facilities, seniors' safety, and providing help and care to them. *Childcare* (3.08%) includes talks about children and parenting during the pandemic. It emerged with safety concerns, schooling, and learning during the pandemic.

4.2.9. Other subthemes. *Schooling*, *Research*, and *Indigenous* emerged with no shared theme. *Schooling* (3.52%) covers the talks on education and learning during the pandemic. *Research* (1.12%) was about the information on the latest research and lab works about COVID-19. As the name suggests, the *Indigenous* (1.06%) covers all the talks related to the first nation people in Canada. The main topics discussed in *Indigenous* were help and care, economy, and following safety measures.

4.3. Themes coexistence

In this section and the next, we focus on *Educating*, *Measures and practices*, and *Policy* as the COVID-19-addressing themes. In this section, we analyze COVID-19-addressing themes coexistence by calculating the number and percentages of tweets at

Table 2. Coexistence of COVID-19-addressing subthemes.

		Stay informed	Safety	Cases	COVID wise	Symptoms	Mask	Social distancing	Hand washing	Stay home	Vaccine	Travel	Self-isolation	COVID app	Test and trace	Stop spread	Lockdown	Flattening the curve
Stay informed	(%)	100.00	21.89	30.41	26.02	19.73	15.05	15.90	14.92	15.85	16.15	26.77	20.45	16.72	20.02	21.53	21.63	26.53
	tweets	49,409	10,438	7,816	4,374	1,601	3,159	2,826	1,338	1,405	1,313	2,034	1,008	793	4,648	3,382	1,502	1,295
Safety	(%)	21.13	100.00	14.08	39.33	29.35	38.60	43.25	48.35	46.42	23.11	32.19	27.37	49.33	14.06	48.12	23.22	43.58
	tweets	10,438	47,682	3,618	6,612	2,381	8,103	7,688	4,335	4,115	1,879	2,446	1,349	2,339	3,263	7,560	1,612	2,127
Cases	(%)	15.82		100.00								10.23	14.77		27.15			12.17
	tweets	7,816		25,699								777	728		6,302			594
COVID wise	(%)		13.87		100.00	16.17	12.84	16.16	19.67	14.75		11.65		13.69		16.68		
	tweets		6,612		16,810	1,312	2,695	2,873	1,763	1,307		885		649		2,620		
Symptoms	(%)				100.00			10.33	17.86			12.28	25.62		18.09			
	tweets				8,111			926	1,583			933	1,263		4,200			
Mask	(%)		16.99		16.03	11.06	100.00	37.57	56.49	20.84				12.44		15.63		
	tweets		8,103		2,695	897	20,990	6,678	5,064	1,847				590		2,456		
	(%)		16.12		17.09	13.30	31.82	100.00	53.06	39.25						22.24		
	tweets		7,688		2,873	1,079	6,678	17,775	4,757	3,479		11.15	11.54			3,494	939	1,339
Social distancing	(%)				10.49	11.41	24.13	26.76	100.00	24.62				11.32		13.49		20.65
	tweets				1,763	926	5,064	4,757	8,965	2,182				558		2,120		1,008
Stay home	(%)				19.51		3.479	2.182	8.864									
	tweets				1,583		3,479	2,182	8,864									
Vaccine	(%)										100.00							
	tweets										8,129							
Travel	(%)				11.50							100.00	23.92				13.01	
	tweets				933							7,598	1,179				903	
	(%)				15.57							15.52	100.00					
	tweets				1,263							1,179	4,929					
Self-isolation	(%)													100.00				
	tweets													4,742				
COVID app	(%)				24.52							15.91	24.24	100.00				
	tweets				6,302							1,209	1,195	507				
Test and trace	(%)				51.77							15.14	25.77					
	tweets				4,200							998	1,222					
Stop spread	(%)		15.85		15.59		11.70	19.66	19.69	23.92						100.00	17.27	17.72
	tweets		7,560		2,620		2,456	3,494	1,765	2,120						15,710	1,199	865
Lockdown	(%)																100.00	
	tweets																6,943	
Flattening the curve	(%)									11.37								100.00
	tweets									1,008								4,881

their subthemes intersection (Table 2). In the context of this research, themes' coexistence becomes vital as it can reveal important information. For example, the coexistence of policies with *Measures and practices* can show what *Measures and practices* Canadian officials used to implement a *Policy*. Each cell in Table 2 has two values: the percentage of the tweets from the row in the tweets of the column and the number of common tweets between them. The percentage in cells should be read in the row-column order as the percentages are not symmetric. For example, the *COVID wise* (row)-*Mask* (column) cell shows 12.84% of *COVID wise* tweets coexist with *Mask*. However, the *Mask* (row)-*COVID wise* (column) cell shows 16% of *Mask* tweets coexist with *COVID wise*. We only filled the cells with percentages more than 10% to improve readability.

Stay informed and *Safety* were the most prevalent subthemes by being in 23.2% and 22,38% of the tweets. They were also the most prevalent in the other COVID-19-addressing subthemes. *Stay informed* coexistence with other COVID-19-addressing subthemes varies between 16% to 30%. *Safety* coexists with other COVID-19-addressing subthemes between 14% to 49%. Notably, *Safety* coexists with the *COVID app*, *Flattening the curve*, *Stay home*, *Hand washing*, *Stop spread*, *Social distancing*, and *Mask*

between 39% to 49%. *COVID wise* also coexists with several other COVID-19-addressing subthemes. *Stay informed*, *Safety*, and *COVID wise* emphasize staying informed, following safety measures, and acting wisely in a general theme. Their prevalence in the other COVID-19-addressing subthemes shows Canadian officials held a consistent educating theme in their COVID-19-addressing tweets, no matter the main topics of the tweet.

A rectangle is visible in the *Mask*, *Social distancing*, *Hand washing*, and *Stay home* columns and rows of Table 2. They have a common feature that is they should be followed all the time during the COVID-19 pandemic. They are not like *Vaccine*, *Travel*, or *Self-isolation* that are dependant on specific situations. Their coexistence together and the coexistence of *Stop spread* with them shows the Canadian officials' strategy that asks citizens to *Stop spread* by emphasizing these four together as the main practices during the COVID-19 pandemic. Among these four, *Social distancing* and *Mask* were more emphasized, shown by their frequency and percentage in the other practices.

Test and trace is the most-used policy by Canadian officials (10.89%). Its coexistence with other subthemes highlights two main messages of Canadian officials when using *Test and trace*. First, its coexistence with

Cases and Symptoms highlights Canadian officials' message of educating people about COVID-19 cases and symptoms; and asking citizens to screen symptoms and get tested if having symptoms. Second, *Travel and Self-isolation* coexistence and *Test and trace* coexistence with these two highlights the message of getting tested and self-isolating in case of traveling.

Although *Test and trace* is the most prevalent policy, *Stop spread* is the most coexisted policy. *Stop spread* coexists with *Safety* and *COVID-wise* (COVID-19 educating), with *Mask*, *Social distancing*, *Hand washing*, and *Stay home* (main practices for COVID-19), with *Travel* and *COVID app*, and with *Lockdown* and *Flattening the curve*. Essentially, *Stop spread* is the Canadian officials broad policy that realizes through implementing other policies and citizens following *Measures and practices*.

4.4. Themes over time

Although our data starts from January 2020, and the first case of COVID-19 in Canada was reported on January 25th, 2020, Canadian officials' serious effort about COVID-19 on Twitter starts from March 2020. Canadian officials tweeted 696 tweets in January and 990 tweets in February 2020. However, in March and April 2020 (the first COVID-19 wave in Canada), the COVID-19-related presence of the officials jumped to its peak by 32,711 tweets in March and 32,241 tweets in April. The number of tweets declined in May, and afterward, it went around 15,396 tweets on average per month. In reporting the result of time analysis, we skipped the first two months as the officials' were not actively tweeting about COVID-19.

Changes in COVID-19-addressing themes during

the pandemic are depicted in Figure 3. To improve readability, we used three separate diagrams for *Educating*, *Measures and practices*, and *Policy*. The diagrams are based on the percentage of tweets per month, and all three diagrams use the same axes. Keeping citizens informed and educating them with safety tips were always the top priority for the Canadian officials during the pandemic. They also consistently shared the number of cases on Twitter and asked citizens to act wisely during the COVID-19 pandemic, though the case information had more priority.

Figure 3 indicates *Test and trace* has always been the top priority policy, followed by *Stop spread*. *Lockdown* and *Flattening the curve* were the last choices of Canadian officials as they have always been used in less than 5% of the tweets per month. The top usage of *Flattening the curve* was on the first wave of COVID-19 in Canada (March and April 2020). On the contrary, *Lockdown* and implementing restrictions gained importance from October 2020 to January 2021.

Among the eight *Measures and practices*, *Mask* and *Social distancing* were the top priorities. Tweets about using masks were less than 5% in March 2020, 5.88% in April, and 7.74% in May. However, by mandating wearing masks in closed spaces in Canada, the emphasis on wearing masks started to rise to 21.37% of the tweets in July 2020. Canadian officials were more consistent about *Social distancing* as it was always around 9% of tweets per month. However, From November to December, the situation changed. There is a huge rise in *Vaccine* and massive declines in *Mask* and *Social Distancing* during this time. *Vaccine's* percentage that was less than 2% until November 2020 jumped to 17% in December 2020 and 21% in January 2021. The

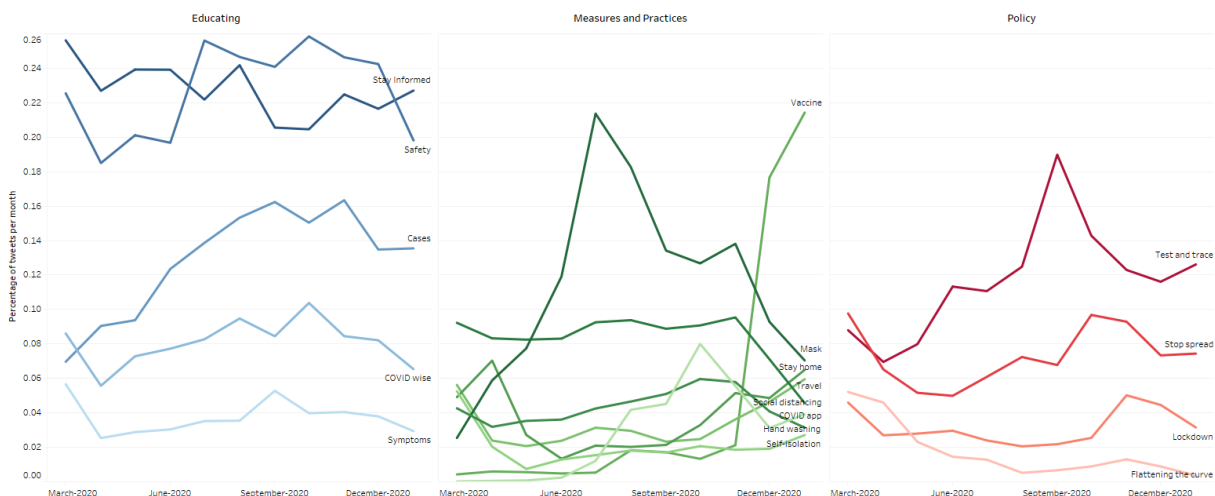


Figure 3. COVID-19-addressing subthemes over the pandemic time.

simultaneous rise of *Vaccine* and the decline of *Mask* and *Social distancing* show the change of Canadian officials' focus. As the first vaccine doses became available for the public in December 2020, Canadian Officials changed their focus from emphasizing *Mask* and *Social distancing* to getting vaccinated. Other measures and practices, including *Hand washing*, *Stay home*, *Travel*, and *Self-isolation*, were not the top picks of Canadian officials. Still, they consistently mentioned them in their tweets.

5. Discussions

Like the U.S. public health agencies and government stakeholders [11], Canadian officials' presence on Twitter was inefficient and confusing, with no stabilized theme at the early stages of the COVID-19. In January and February 2020, a limited number of positive cases started to appear in Canada, while other countries like China were dealing with COVID-19 as an outbreak. During this time, the Canadian officials did not act proactively on Twitter. Their presence was minimal, mostly like observers of a situation, filled with multitude instances of topics with no stabilized theme to deal with the disease. The active presence of Canadian officials began from the first week of March 2020 as the outbreak started in Canada. Since then, they used the common global strategies [17], though their focus was different at different points in time.

The results of this paper confirm literature findings on crisis communication and management [7, 13, 18]. The literature emphasizes the role of public officials in disseminating emergency information, educating people about protective behaviors, and increasing awareness to manage the crisis eventually. Canadian officials mainly tweeted to educate citizens about the situation. The top theme is *Stay informed* that provides the latest resources of information to Canadians and encourages them to seek the information from official sources. They advised Canadians on the safety measures and asked them to act wisely while educating them about COVID-19 symptoms. Simultaneously they updated Canadians about the number of cases. They also actively shared the *Policy* information to manage the crisis with the public and asked citizens to follow *Measures and practices* to implement them.

Stop spread of COVID-19 was Canadian officials' broad policy realizing through other policies, educating citizens, and particularly asking them to follow four main practices: *Mask*, *Social distancing*, *Hand washing*, and *Stay home* (Figure 3 and Table 2). Canadian officials' top policy was *Test and trace*, particularly by emphasizing screening COVID-19 *Symptoms*. The tracing part of the *Test and trace* follows the contact

tracing strategy that is found an effective method in containing outbreaks [25]. The federal government also developed the *COVID app* as a practice to implement the contact tracing strategy. However, *COVID app* is the least mentioned practice in Canadian officials' tweets, mostly advocated by the Federal government. It shows this practice failure, although it could have had a high impact on the success of *Test and trace* policy. One reason for this lack of interest in tracing as part of the *Test and trace* policy and *COVID app* could be the lack of discussion about privacy as a critical concern [25] in the Federal government's content.

Beyond the discussions that addressed COVID-19 directly, Canadian officials' used *Encouraging and motivating* as a strategy to emphasize managing the pandemic as a collective effort, encourage citizens to keep up their good deeds during the pandemic, and keep Canadians motivated about the final success over it. Although the crisis communication literature points to the use of social media by public officials to coordinate collective actions in the time of a crisis [7, 13], the Canadian officials put a step further by promoting *Encouraging and motivating*. Given the long duration of the pandemic, this theme and its subthemes work as a new strategy to keep citizens motivated during the pandemic and hopeful about the final overcome.

This study revealed eight themes of discussion in the Canadian officials' COVID-19-related content. However, we only focused on the COVID-19-addressing themes by analyzing their evolution over time and coexistence. Analyzing *Encouraging and motivating* content as the third most-used theme will help practitioners on how to use such cognitive incentives in the time of a pandemic. Analyzing *Funding* resources for citizens, *Restart Economy*, and *Local businesses* subthemes will reveal insights on how these topics were affected by the pandemic and how they contributed to it. *Mental health* emergence in the public officials' COVID-19-related talks shows its importance in the time of a pandemic. Future researches can analyze how public officials addressed this health problem that is a consequence of the pandemic situation. We only focused on the content analysis of the Canadian officials in the pandemic. Future researches can apply network analysis in the same context to investigate the information flow and communication patterns among public officials over time.

6. Conclusion

In this study, we analyzed the Canadian officials' content on Twitter during the COVID-19 pandemic. They did not have a notable activity in the early stages, a lost opportunity to manage the crisis proactively.

However, by the beginning of the outbreak and during it, they actively propagated educating safety information and tried to keep citizens informed. Based on the content volume and subthemes evolution and coexistence, the major policy in Canada was *Test and trace* by emphasizing screening the *Symptoms. To Stop spread*, Canadian officials asked citizens to follow four main *Measures and practices: Mask, Social distancing, Hand washing, and Stay home*. Among these, *Mask and Social Distancing* were the major practices.

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