Public Health Communication and Engagement on Social Media during the COVID-19 Pandemic

Lisa Teichmann[1], Sean Nossek[1], Aengus Bridgman[1], Peter John Loewen[2], Taylor Owen[1], Derek Ruths[1], and Oleg Zhilin[1]

[1]McGill University

[2]University of Toronto

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Abstract

Social media provides governments the opportunity to directly communicate with their constituents. During a pandemic, reaching as many citizens as possible with health messaging is critical to reducing the spread of the disease. This study evaluates efforts to spread healthcare information by Canadian local, provincial, and federal governments during the first five months of the COVID-19 pandemic. We collect all health-related communications coming from government accounts on Facebook and Twitter and analyze the data using a nested mixed method approach. We first identify quantifiable features linked with citizen engagement, before subsequently performing content analysis on outlier posts. We make two critical contributions to existing knowledge about government communication, particularly during public health crises. We identify cross-platform variations in strategy effectiveness and draw attention to specific, evidence-based practices that can increase engagement with government health information.

Keywords: Government communication, Canada, COVID-19

Supplementary material for this article is available in the online edition.

The COVID-19 pandemic has been met with unparalleled government communication efforts and massive information seeking from the public. As health communications receive unprecedented attention, the methods and means through which governments transmit information become critical objects of study. While news media has played an important role, direct communications from political and health leaders through live press conferences and social media posts have become invaluable tools in the direct transmission of life-saving information to an attentive public. As stressed by the World Health Organization in several reports on strategic preparedness and response to health crises (2017, 2020), these platforms are now an integral mediator in the transfer of information about the pandemic from governments to citizens.

Here we focus on the Canadian case study, where national, sub-national, and municipal political and health leaders have been communicating directly with the public about SARS-CoV-2 coronavirus and the COVID-19 disease (hereafter collectively referred to as COVID-19) in an effort to ensure an effective response. These strong elite cues have been generally fruitful, with a highly attentive public appearing to receive and internalize important health information (Merkley et al. 2020). But what constitutes effective government information during a crisis? In this paper, we evaluate organic (non-advertised) government social media communication efforts during the first months of the COVID-19 pandemic. We identify practices that governments can adopt to effectively spread crucial public health information during the COVID-19 pandemic; lessons which may be useful during future crises where mass communication is essential to ensuring extensive public cooperation, understanding, and safety. We employ a nested mixed method approach to provide both high-level and rich context-based insights.

1 Government Communication During Crises

Dissemination of important government messages has historically been done through mass media coverage, including television and print media. However, these messages are often

lost in translation with substantial discrepancies being observed between government messages and how they are shared by traditional media (Ophir 2018). This can be particularly worrisome during a crisis situation where governments need to ensure fidelity of message transmission. This has led many governments and politicians to try to speak directly to their constituents. Crucially, there is mounting evidence that social media can be a key information pathway (Basch et al. 2020) and that these platforms are increasingly relied upon as primary sources of news and information more generally (Mitchell 2016). Governments thus have strong incentives to maximize their social media efforts and have employed significant use of social media during past crises (Graham et al. 2015; Chatfield and Reddick 2015; Tagliacozzo and Magni 2018). During the COVID-19 pandemic, social media played a particularly important role in many countries (Thelwall and Thelwall 2020; Cinelli et al. 2020; Sha et al. 2020) but has also been linked to the spread of misinformation (Bridgman et al. 2020).

Specific case studies have identified instances where social media was utilized by governments during crises. Three examples highlight mixed results in these initiatives. Gálvez-Rodríguez et al. (2019) examine the November 2015 Paris attacks and found that French local governments were highly active on social media and effectively responded to citizen concerns and questions in real time and with massive reach. Sharma et al. (2017) review posting activity following the 2016 Zika outbreak in the United States and found that useful information (often coming from government health organizations) was not as effectively shared as misleading or misguiding information shared by others on Facebook. Chatfield and Reddick (2018) highlights the role that citizens played during Hurricane Sandy in 2012 to share important information when government capacity was lacking. An important measure of success across all three cases was the extent to which citizens on social media increased (or did not increase) the spread of important information on these platforms. The main pathway to this amplification is engagement, which consists of three elements: satisfaction (i.e. likes), responses (i.e. comments), and further propogation (i.e. shares) (Cho et al. 2014). Each of these elements contributes to the spread of the message and increases the number

of "impressions" (views) a given piece of content will receive.

Government information must both reach the target audience and induce behavioural and attitudinal changes. Measuring these changes is extremely difficult, but there are strong indications from research in psychology and communications that repeat exposure, particularly from peers, can indeed change minds. Repeated exposure to any given statement has been shown to be strongly associated with increased belief in the veracity of that statement (Bacon 1979; Polage 2012; Pennycook et al. 2018). This has been demonstrated in a social media context where repeat exposure has been linked to attitude formation (Bail et al. 2018). These attitudinal and behavioural changes are found to be particularly strong following peer-to-peer prompts that normalise or sanction behaviours (Munger 2017). Expertise also has an important role to play, with exposure to social media interventions such as the correction of misinformation by experts leading to improved knowledge (Vraga and Bode 2017), although there is some evidence to suggest that when people are motivated by identities, notably partisanship, they may ignore information coming from political out-groups (Thorson 2016; Nyhan and Reifler 2010). Despite these findings, mass publics have been shown to be receptive to important information from governments (Goldberg et al. 2020). Thus, in line with the norms of extant research on government information campaigns, we proxy success of a given campaign with engagement. We discuss limits to this approach in the conclusion.

2 Maximizing engagement on social media

Research on maximizing impressions and engagements on social media has exploded in recent years (e.g Dumbrell and Steele 2012; Bonsón et al. 2017; Bonsón et al. 2019; Liang et al. 2019; Stone and Can 2020). There are two main sets of features that have been examined: 1) the content of the message itself, including embedded content and linguistic factors; and 2) account-specific features, including number of followers/subscribers, position, institutional context, and frequency of posting.

First, governments have been shown to be able to strategically increase engagement by

varying the content and subject of their message (Rahim et al. 2019). Thematic analyses have shown that certain types of content are far more likely to be engaged with (Bonsón et al. 2015). Tone and sentiment also impact engagement, with emotive language (both positive and negative) performing better (Stone and Can 2020). Another element of the message identified as important is the inclusion of embedded/attached content where a user is directed to a visual, an external link, a video, or another non-text piece of content. While plain-text messaging can communicate short ideas with clarity, the inclusion of additional non-text content in social media postings supports the spread of longer and more complex ideas. Visual content such as videos or images are generally found to be more effective at increasing engagement of messaging (Kim and Yang 2017), with evocative visualizations doing particularly well (Niederdeppe et al. 2008).

During crises, specific approaches are more effective than others. Generally, the literature has found that government communication during crisis is most effective when it translates scientific and technical information in simple terms, while acknowledging underlying uncertainty (Herovic et al. 2020). Health messages emphasizing personal responsibility and value judgements tend to receive higher engagement, as compared to complex argument-based messages (Gollust and Cappella 2014). Another effective message strategy is relying upon appealing narratives such as personal stories and examples of individual experiences. Finally, content that contains actionable advice also generally receives more engagement (Dumbrell and Steele 2012).

Second, account-specific features are highly important. These include account metadata such as biography, image, and number of followers, non-platform features such as the reputation and perceived trustworthiness of the account holder (Haro-de-Rosario et al. 2018), and prior behavior of the account. For example, posting more frequently on Twitter is associated with lower levels of engagement with each individual post (Bonsón et al. 2019; Stone and Can 2020). There are other account behavioral features that are likely influential but have not been examined. These might include the types of followers that an account attracts and

past engagement with influencers — or those with an outsized influence on a given platform.

There are thus a multitude of supply-side explanations for why a given piece of content is likely to receive a high level of engagement. In addition to these, engagement also depends on demand-side explanations, with the engagement obtained on a given platform some function of user and platform demand preferences. User preferences refers to the dispositions of the platform-specific user-base that 'reward' specific types of content and 'punish' others. These preferences are likely highly variable across platforms, in part because of the unique demographic and attitudinal profiles of each platform (Mislove and Lehmann 2011; Ruths and Pfeffer 2014; Hargittai 2020). Platform preferences, alternatively, are the specific algorithmic choices unique to a platform which promote some content at the expense of others. Given these two preference sets that vary across platforms, there are strong reasons to believe that there are platform-specific dynamics for many factors that drive engagement as described above. Unfortunately, the studies described above typically examine a single platform and thus cannot speak to whether a given strategy is similarly effective across social media platforms.

We focus here on a subset of supply-side features that can easily be manipulated by governing entities to attempt to reach a broader audience with their public health information. We significantly extend existing literature through a cross-platform comparison, as well as a combination of quantitative and qualitative methods that provides insight both into broad quantifiable features and content-specific strategies.

3 Methodology and Data

We collected Facebook and Twitter communications from a comprehensive list of Canadian official government accounts that provided COVID-19 related information from January to May 2020. This dataset includes the content of the posts, along with various meta-data fields as available from the APIs (Application Program Interfaces) of Twitter and the Facebook

CrowdTangle platform.[1] Using these data we employ a nested mixed method approach (Lieberman 2015) in order to establish what constitutes an effective strategy for public health communications on social media during the COVID-19 pandemic.

3.1 Government Communication on Social Media

The social media dataset collected consists of all Canadian Twitter and Facebook postings about COVID-19 from a set of government accounts. Specifically, we included accounts of the Prime Minister, leaders of provincial and territorial governments, and the mayors of large cities. We also collected accounts of the public health authorities of the federal government, provinces and territories, and large cities, in addition to general government accounts for provinces and cities. For inclusion, the entity must have been on both Twitter and Facebook during the time period examined. We utilize these matched samples to allow direct comparisons of engagement mechanisms across platforms. We thus collected all tweets and Facebook posts between January 1, 2020 and May 24, 2020 (n = 50961 tweets, 9500 posts). Post attributes like favorites and shares were captured May 25, 2020 and the performance of each post is anchored to the day it was posted. We removed all retweets, sponsored tweets, and advertised Facebook posts to focus exclusively on organic engagement coming directly from government accounts. We then restricted our sample to COVID-19 related content using a dictionary approach.[2] Our final dataset includes 14674 tweets and 4510 Facebook posts.

The left panel in Figure 1 plots the volume of COVID-19 related posts over time on Twitter and Facebook. This count of posts differs substantially across platforms, despite the fact that each Facebook account is matched to its Twitter counterpart from the same government entity. The volume of COVID-19 posts is not constant over time; after peaking

1. In addition to the main analyses using the social media dataset, we also conducted a nationally representative survey of Canadians in order to establish a general picture of the patterns of Canadian consumption of COVID-19 related public health information. We further describe this survey and our findings in the supplementary material.

2. Municipal officials and mayors were included for cities with populations larger than 200,000. For a complete list of handles and the full dictionary of terms used to identify COVID-19 related content, alongside a list of entities without accounts which met these criteria, see the supplementary materials.

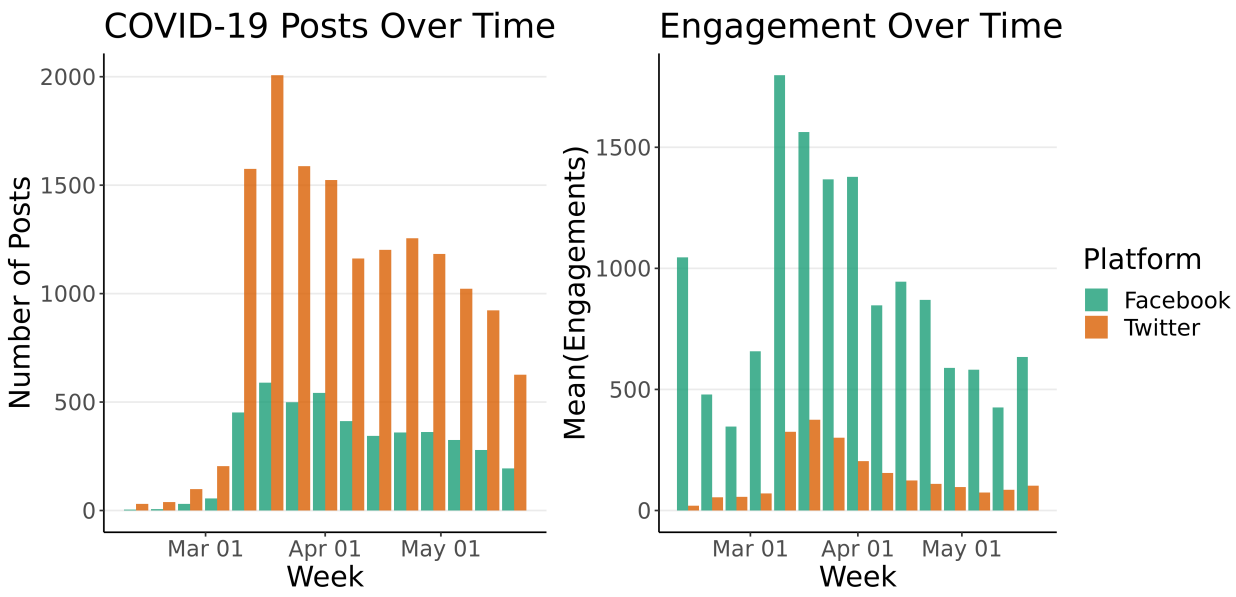

Figure 1: Engagement with COVID-19 Related Posts from Government Accounts Over Time

in mid-March, there has been a steep decline in posts per week on both platforms (a trend more pronounced on Facebook). This suggests a declining intensity in government's efforts to communicate with citizens about COVID-19 during the pandemic in Canada. In the right panel we plot the mean count of engagements per post as it changes over time. Engagements per post are calculated by combining likes and shares (on Facebook) and favorites and retweets (on Twitter), based on metrics widely used in the literature (e.g. Bonsón and Ratkai 2013; Stone and Can 2020). Posts about COVID-19 received the highest engagement between the second and fourth weeks of March, but steadily declined throughout April and May.

Notably, we find that while the volume of COVID-19 related posts from government accounts is higher on Twitter, each Facebook post receives much more engagement on average. Facebook posts in our dataset received a total count of approximately 4.9 million likes and shares, compared to approximately 2.9 million favorites and retweets on Twitter. We thus find that, despite posting much less on Facebook, government accounts engage more citizens overall on that platform.

The vast majority of social media posts in our dataset (85.3 percent) contained some type of attached non-text media (links, images, or videos). Figure 2 plots the proportion of

posts on Twitter and Facebook by embedded media type, with images as the most frequently included in both the Twitter and Facebook datasets. Non-text media are an integral part of government public communication efforts during the COVID-19 crisis. Notably, there are very few posts on Facebook that include no additional media.[3]

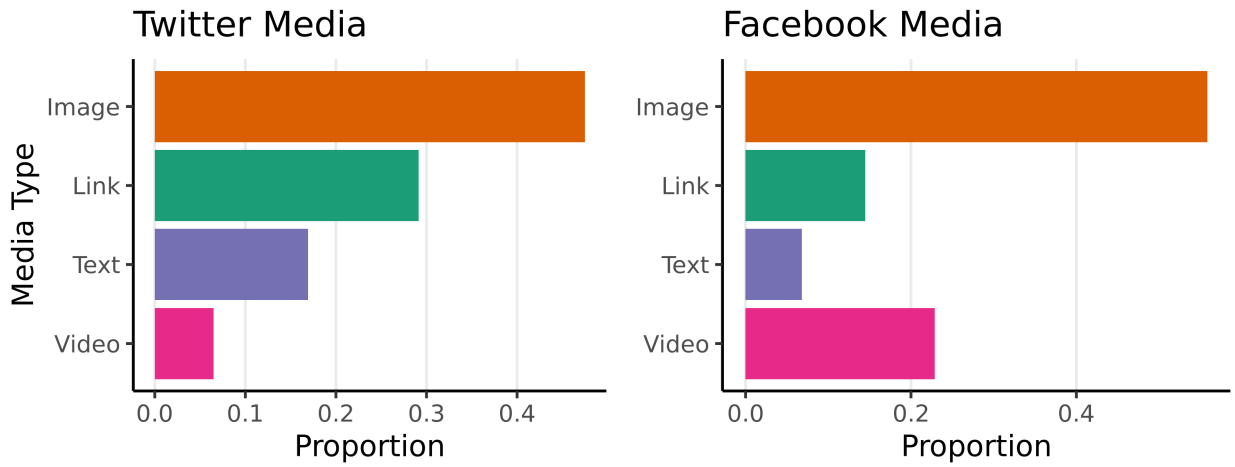

Figure 2: Percentage of embedded media types of government COVID-19 posts on Twitter versus Facebook

3.2 Nested Mixed Method

Using these data, we employ a mixed-method nested analysis approach (Lieberman 2015) to better identify what types of content are generating the most engagement on social media. We first draw upon the literature described above to identify potential key explanatory variables and include these in a large-N regression analysis. We follow this by a qualitative content analysis that consists of a close reading of posts with the highest and lowest residuals (sometimes referred to as observations "off-the-line") from the large-N model, which allows a detailed investigation into what features may have contributed to over- and underperforming content. As the large-N analysis does not evaluate the substantive content of the text or media included in posts and tweets, our second step qualitative content analysis helps

3. For Facebook, we utilize the post typology from the CrowdTangle API. "Status" posts are recoded as "Text", though they may contain a link within their message. "Links" are posts which explicitly embed URLs, like other posts embed videos or photos. When displayed on the platform these posts appear differently than statuses (what we call text posts).

produce both a richer understanding of content-specific dynamics and a validation of the large-N model. The close reading approach in particular entails the detailed examination of over- and underperforming posts for peculiarities of thematic content, language, and attached media which would be missed by the large-N analysis alone.

Our main large-N model focuses on two key explanatory features: type of embedded media (or text-only) (*Media Type*) and the account type of the posting government entity (*Gov Type*). The dependent variable of interest is user engagement with COVID-19 related post p from government or public health authority account i at time t. We measure engagement by log transforming the sum of shares and likes for posts on the Facebook platform, and retweets and favorites on Twitter, and analyse each platform in turn.[4]

Our model includes a vector, $\mathbf{Z}$, of relevant controls at the post and account level, depending on the platform. For Facebook we control for $log(page\ subscribers)$ and account frequency of posting. On Twitter we control for $log(number\ of\ followers)$, if a tweet was a direct reply to another user[5], the number of hashtags included in the tweet, and account frequency of tweeting. Absent this control for subscribers/followers (the number of users who are potentially directly exposed to a post), our estimates would simply reflect variation in the size of the audience for each account. Instead, we seek to identify the differential effects of posts from different account types and of different media, net of differences in raw audience size between accounts. We control for frequency of posting as prior studies have shown that Twitter accounts which tweet more experience fewer engagements per tweet (Stone and Can 2020).[6] Analyses of both platforms contain daily time fixed effects (γ) and language fixed effects (δ) which we've coded for each post, while we omit account level fixed effects in the main model specification to allow the estimation of effects for each type of government

4. A similar engagement index focusing on popularity, commitment, and virality by using the sum of likes and shares has been developed to measure stakeholder engagement with social media content by, among others, Bonsón et al. (2014), Bonsón et al. (2015), and Jiang and Beaudoin (2016).

5. Direct replies receive considerably less engagement as they do not appear on the main profile pages and are far less visible on the platform. See `https://help.twitter.com/en/using-twitter/twitter-conversations` (accessed July 2, 2020).

6. The measure used here is a rolling 5 day average of posts per day for the posting account.

account. Daily fixed effects enable us to control precisely for differences in engagement with COVID-19 related content over time, as identified in Figure 1. Formally:

$$Engagement_{pit} = \beta_0 + \beta_1 Media\ Type_p + \beta_2 Gov\ Type_i + \alpha^\top \mathbf{Z}_{pit} + \gamma_t + \delta_p + \epsilon_{pit} \quad (1)$$

4 Results

We first report results from the large-N quantitative analysis based on Equation 1. This is followed by step 2 of the nested analysis, where we perform a small-N qualitative analysis on outlier posts where the level of engagement was not accurately predicted (based on high or highly negative residuals).

4.1 Quantitative analysis

We begin by reporting our results for the effect of embedding media on engagement, before moving to government account.

4.1.1 Embedded media type and engagement with public health information

We find significant within and cross-platform heterogeneity in the relationship between embedded media type and engagement with public health information on social media. Panel A of Table 1 shows coefficients for embedded media types from our estimations for Twitter (Columns 1 and 2) and Facebook (Columns 3 and 4). Columns 2 and 4 included account-level fixed effects. It is difficult to interpret coefficients which are relative to a base category and when the outcome is log-transformed, so we plot raw (untransformed) expected engagement by both of our explanatory variables of interest in Figure 3 for Twitter and Figure 4 for Facebook.[7]

Column 2 includes day, account, and language fixed effects, and shows that, relative to text tweets, those which contain videos or images receive more user engagement. These

7. Predicted engagement is calculated using audience size and post frequency held at their means, date is set to March 23, 2020, near the height of public engagement with COVID-19 related posts from government accounts, and language set to English. For Twitter, predicted engagements are computed when the tweet is not a direct reply and includes no hashtags.

Table 1: The Effect of Media and Account Type on Engagement

	Dependent Variable:			
	log(Engagements)			
	Twitter		Facebook	
Panel A:	(1)	(2)	(3)	(4)
Image	0.352***	0.302***	−0.407***	−0.070
	(0.030)	(0.029)	(0.066)	(0.053)
Video	0.960***	0.795***	−0.350***	−0.300***
	(0.045)	(0.042)	(0.071)	(0.058)
Link	−0.017	−0.033	−0.691***	−0.502***
	(0.030)	(0.028)	(0.075)	(0.060)
Panel B:				
Fed. Health	0.987***		1.086***	
	(0.050)		(0.091)	
Prov. Health	1.390***		1.108***	
	(0.039)		(0.063)	
Local Health	1.063***		0.430***	
	(0.036)		(0.061)	
Prime Minister	2.113***		4.050***	
	(0.070)		(0.122)	
Premier	2.082***		1.750***	
	(0.034)		(0.057)	
Mayor	1.086***		0.203***	
	(0.030)		(0.057)	
Provincial Gov.	0.861***		0.523***	
	(0.035)		(0.060)	
Panel C:				
Post Freq.	−0.069***	−0.046***	−0.011	0.029
	(0.003)	(0.004)	(0.020)	(0.020)
log(Audience Count)	0.563***	−0.202	0.140***	−0.017
	(0.008)	(0.317)	(0.005)	(0.011)
Reply Dummy	−2.485***	−2.584***		
	(0.041)	(0.040)		
Hashtag Count	0.042***	0.114***		
	(0.009)	(0.010)		
Language FEs	Yes	Yes	Yes	Yes
Day FEs	Yes	Yes	Yes	Yes
Account FEs	No	Yes	No	Yes
Observations	14,674	14,674	4,510	4,510
R^2	0.606	0.686	0.584	0.768
Residual Std. Error	1.114	0.996	1.060	0.798

Notes: The reference categories are large city government accounts and text posts. Media and account types represent coefficients for dummy variables, relative to these categories. The dependent variable is $log(favorites + retweets)$ for Twitter, and $log(likes + shares)$ for Facebook. Audience count is subscribers or followers for Facebook or Twitter, respectively. *p<0.05; **p<0.01; ***p<0.001

effects are the largest for video content, with the coefficient of 0.795 translating to an expected increase of 121 percent in engagements (again, the sum of retweets and favorites) relative to a text-only tweet.[8] A video post from the Prime Minister is expected to receive 816 engagements, compared to just 372 expected for a text tweet. By contrast, the increase in engagement associated with images is much smaller at about 35 percent (or 444 expected engagements for an image tweeted by the Prime Minister). We do not identify a significant difference for url links.

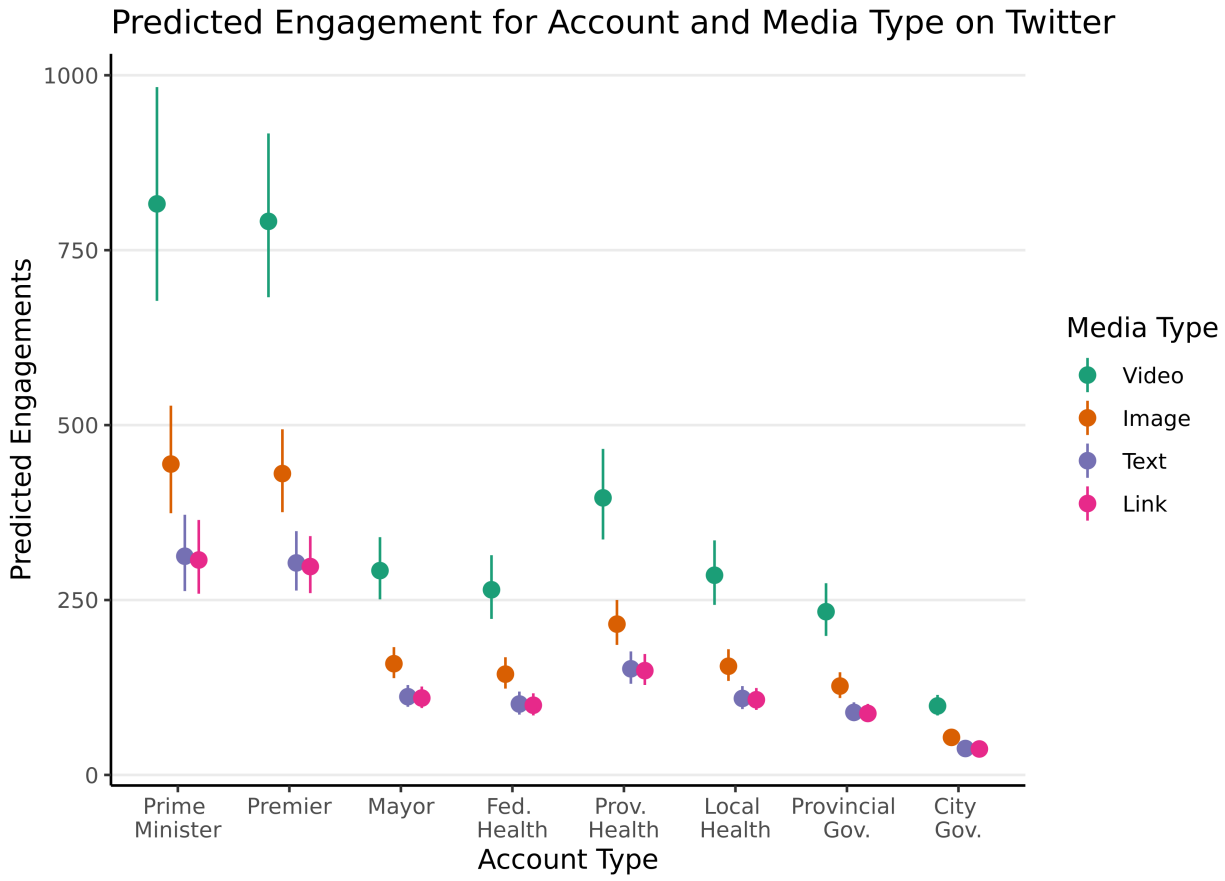

Figure 3: Predicted Engagement with Twitter Posts

These findings show that engagement with posts from government accounts is at least partially determined by the inclusion of specific media types on Twitter, with tweets of text or links expected to generate many fewer engagements than those which contain images or

8. The transformation of coefficients when there is a logged dependent variable to attain percentage change is as follows: $100 * (exp(\beta) - 1)$, such that $100 * (exp(.795) - 1) = 121.44$.

videos. We consider this finding especially robust given its similarity to effects identified in previous studies (Kim and Yang 2017; Rahim et al. 2019).

Expected engagement with Facebook content, as shown in Column 4, is subject to different dynamics. We find that all embedded media types are penalized relative to text posts in user propensity to share and like on Facebook. This finding was unanticipated, and it highlights the idiosyncratic nature of communication outcomes across social media platforms. Specifically, links received the most substantial penalty in expected engagement — a 39 percent decrease — as compared to a 26 percent decrease for videos. A text post on Facebook from the Prime Minister is predicted to receive a considerable 14757 engagements. If the post embeds a link, that drops to 7394, while between these extremes we expect videos to receive 10398 likes and shares, and images 9824.

Health officials carrying out crucial public health communications efforts on Facebook should take into account the negative effect of non-text media. The same post which maximizes the spread and reception of public health information on one platform may not do so elsewhere, again due to either user preferences or platform-specific algorithmic processes. Public health authorities face uncertainty and common sense heuristics, or even evidence backed mechanisms, may not apply across all information pathways.

In addition to decisions about which platforms to use and what kind of media to share, officials often choose to make use of platform specific content attributes. One such attribute is the "hashtag" on Twitter, which allows users to tag their tweets with one or more specific terms, and to connect them with other posts containing that tag. Previous findings suggest on the Twitter platform the use of hashtags have played a critical role in crisis communication, and their theorized effect on the spread of public health information is intuitive (Chatfield and Reddick 2018). Accordingly, in Panel C Column 2 we find that government accounts are effective in attaining higher levels of engagement by adding hashtags to their messages, with an expected 12 percent increase in engagements per hashtag.[9] COVID-19

9. In a separate test using discrete dummy variables for different counts of hashtags, we do not find diminishing returns to their use in greater numbers. There appears to be a constant additive effect associated

related tweets with 3 hashtags would therefore receive a larger expected bump in engagement than posts which contain images.

Our estimate for the effect of post frequency successfully replicates prior findings that on Twitter the more an account tweets each day the fewer engagements they experience per tweet. The effect is sizable, with the coefficient in Column 2 translating to a decrease of 4.5 percent for every one point increase in average tweets per day (which is 3.3 on average across account-days in our Twitter data). This provides evidence of a trade-off; public health officials must balance the engagement produced by every post against the negative effect of a high daily tweet count. However, we do not identify a similar dynamic on Facebook. This trade-off is in addition to the apparent need to balance the use of the most effective media on Twitter, videos, with the higher levels of cost involved in their production. These findings further demonstrate the manifold considerations of those who seek to maximize engagement with their health communications.

4.1.2 Level of Government and Engagement with Public Health Information

Having shown that type of embedded media, among other features, is a significant determinant of post engagement in public health communications, we now move to the second main explanatory variable of interest: the originating account.

Panel B in Table 1 shows coefficients for government account type. Holding accounts for large city governments as the reference category, we find that who posts is often more important than what is posted. Column 1 shows that tweets about COVID-19 from the Prime Minister's and premiers' accounts receive a significant advantage in user engagement, even when controlling for followers. We find 727 percent more engagements when a tweet comes from the account of the Prime Minister relative to the account of a large city government, while tweets from premiers' accounts experience 702 percent more. As our model predicts that a text tweet from a city government account will receive only 37 engagements, a text tweet from the Prime Minister is predicted to receive 312 engagements, or 303 for a premier.

with the engagement related to additional hashtag use.

For comparison, we only expect mayors of large cities to experience a 196 percent increase in engagement relative to city government accounts when tweeting about COVID-19 (for a predicted value of 112 combined retweets and favorites).

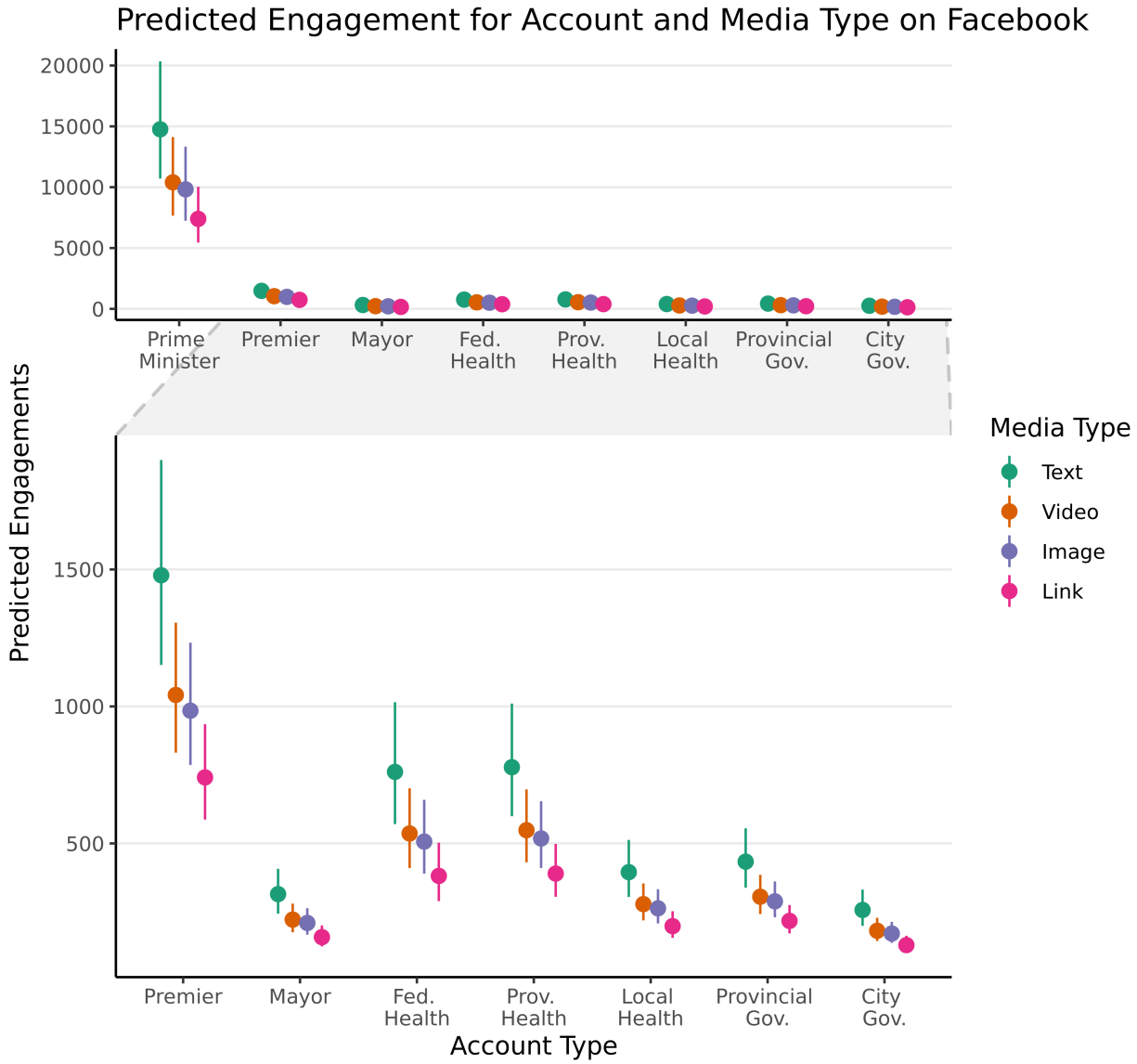

Figure 4: Predicted Engagement with Facebook Posts

For public health authorities, the story is somewhat different. The public engages substantially more with public health information from provincial accounts. Provincial health authorities generate 301 percent more expected engagements than city governments (152 predicted engagements), compared to 190 percent for local health authorities (109 engage-

ments), and 168 percent for federal health accounts (101 engagements). We did not anticipate that federal health authorities would receive less engagement than their provincial and local counterparts. The large effects associated with provincial health authorities and premiers evidences high engagement with provincial public health efforts by the public on Twitter.

Turning to Facebook, we again find evidence of persistent cross-platform variation. The Prime Minister stands alone in achieving the highest engagement (a tremendous increase in expected engagements of 5640 percent relative to city governments) — a clear divergence from our analysis of Twitter, where the Prime Minister and premiers generate similar levels of engagement. After posts by the Prime Minister, which our model expects to generate an average of 14757 engagements (compared to 257 for the account of city governments), premiers experience the second highest expected engagements, 475 percent that of city governments (an average of 1479 engagements), while mayors of large cities receive a considerably smaller bump over city governments of only 23 percent (an average of 315 engagements). This again contrasts with our findings on Twitter, where for mayors the expected increase is about eight times that size. Unlike on Twitter, federal health authorities on Facebook receive an overall high level of expected engagements, following premiers, the Prime Minister, and nearly matching their provincial counterparts. We find across platforms provincial health authorities hold a leading place in public engagement, consistently placing third after the Prime Minister and premiers.

4.2 Qualitative analysis

The quantitative analysis above has provided direction on how account types and types of embedded media matter for engagement on both Twitter and Facebook. However, the substantive content of posts is evidently a critical determinant of overall levels of engagement and is not accounted for in our quantitative model. We therefore turn to a second exploratory and theory-building step of the nested mixed method: the qualitative analysis. We use the residuals from the large-N analysis (specifications reported in Columns 1 and 3 in Figure

1) to identify content that performed unusually well or poorly. We reviewed 300 over- and underperforming tweets and Facebook posts to identify otherwise unaccounted for content-related features. Each feature described below appeared frequently among posts within the category, although note that the features identified are not necessarily unique to each category. In the subsequent discussion, we then summarize these findings to formulate communication strategies for policy makers.

4.2.1 Overperformers

We begin by reviewing posts from Facebook and Twitter that received more engagement than predicted. We find that posts containing personal appeals are among some of those with the largest divergence between expected and actual performance. In addition to such appeals, overperforming posts often leveraged networks of influencers, popular culture references, or direct requests for donations or re-posts to maximize their reach. We also find that health directives that include high quality media, such as animations, were especially well shared.

4.2.1.1 Directly addressing the public

Overperforming posts often feature personalized language, with direct addresses to citizens using the imperative form. They call on the public to follow health directives such as social distancing, self-isolation, and other preventative hygiene measures to decrease the spread of the virus. The following tweet from the Prime Minister Justin Trudeau is exemplary (111589 engagements received versus 1247 predicted)[10]:

> Stay home. It doesn't matter that the weekend's almost here - if you choose to gather in groups or hang out with your friends, you're putting yourself, those around you, and our health care workers at risk. So take this seriously. Do the right thing and stay home this weekend.[11]

10. An identical post was also posted and widely engaged with on Facebook. See: `https://web.archive.org/web/20200330142347/https://www.facebook.com/JustinPJTrudeau/posts/10158744870575649` (posted March 27, 2020).

11. `https://web.archive.org/web/20200520202440/https:/twitter.com/JustinTrudeau/status/1243681744294948865` (posted March 27, 2020).

Even though our model predicted that text would receive less engagement than tweets with additional media on Twitter, personalized messages with clear instructions can spread quickly. This is not just an effective strategy for the Prime Minister, as evidenced by its successful emulation by leaders at other levels of government; see the following tweet by Calgary Mayor Naheed Nenshi (2567 engagements, 96 predicted):

> Calgary, I've been saying three things so far when it comes to our COVID-19 response. Clean hands, clear heads, open hearts. With the situation evolving, I've got three more. Stay home, be kind, save lives.[12]

Health authorities have also used this strategy to attain favorable results. Consider this tweet from Health Canada and Public Health Agency of Canada (4434 engagements, 84 predicted):

> Everyone has a role to play to protect the health and safety of Canadians from COVID-19. Simple actions, like washing your hands often, can help limit the risk in Canada.[13]

Or this Facebook post by the City of Winnipeg Regional Health Authority (4218 engagements, 152 predicted):

> Please share! It only takes one person to infect many. DON'T be that one. We all MUST socially (physically) distance NOW. Learn how at www.covid19manitoba.ca. Stay SAFE, Stay STRONG Manitoba.[14]

These direct requests that include a strong emphasis on the personal responsibility, necessity, and urgency to act are effective. Several of these posts were also accompanied by an infographic regarding the effects of social distancing on number of infections, which we also identify as a successful strategy for engagement below. We also see that overperforming posts often use the word "we" to invoke unity while sharing health directives and making calls for personal responsibility during the pandemic. The following tweet from Ontario Premier Doug Ford is representative of this pattern (4421 engagements, 284 predicted):

12. https://web.archive.org/web/20200408180640/https://twitter.com/nenshi/status/1240066289562865665 (posted March 17, 2020).

13. https://web.archive.org/web/20200330030702/https://twitter.com/GovCanHealth/status/1239890763237949440 (posted March 17, 2020).

14. https://www.facebook.com/winnipegregionalhealthauthority/photos/a.181339427135/10156621199262136 (posted April 1, 2020).

> My first priority is keeping all Ontarians safe. Today I ordered the mandatory closure of all non-essential workplaces effective March 24th at midnight. If you can work from home you may continue to do so. We will remain vigilant and strong, and we will get through this together.[15]

4.2.1.2 Influencers and celebrities

A second effective strategy among overperforming tweets is to employ the power of high-audience celebrities and influencers to share messages, or alternatively include references to popular culture. See the following tweet from Missiauga Mayor Bonnie Crombie in which she directly asks for retweets to collect donations through a "retweet challenge" to match influencer Mohamad Fakih's donations (510 engagements, 38 predicted):

> President & CEO ParamountFoods mohamadfakih8 will donate $1 for every RT of this post, up to $10K to help the #Mississauga Food_Bank feed families impacted by #COVID19. Let's get retweeting #Mississauga! Donations can also be made online at: https://t.co/AQiNHNBKhx [16]

The Mayor also later thanked NBA player RJ Barrett with higher-than-expected engagement.[17] Another clear appeal for this type of assistance comes from Quebec Premier François Legault, wherein he also explictly employs the aforementioned strategy (3030 engagements, 188 predicted):

> (Translated) I ask that our young leaders, our artists, our Olympic champions, and our influencers employ their social media following to help us slow the propagation of the virus. Together, we will win this battle. [18]

Referencing popular culture can also achieve uncharacteristically high levels of engagement. For example, reference to the popular Star Wars franchise likely increased engagement with the following Health Canada and Public Health Agency of Canada tweet (3748 engagements, 342 predicted):

15. https://web.archive.org/web/20200405091901/https://twitter.com/fordnation/status/1242169280453632002 (posted March 23, 2020).
16. https://web.archive.org/web/20200530014329/https://twitter.com/BonnieCrombie/status/1247987472501440515 (posted April 8, 2020).
17. https://web.archive.org/web/20200503012329/https://twitter.com/BonnieCrombie/status/1252614296011497474 (posted April 21, 2020).
18. https://web.archive.org/web/20200322035009/https://twitter.com/francoislegault/status/1239959026542182402 (posted March 17, 2020).

> Unwashed hands are the path to the dark side. Unwashed hands lead to germs; germs lead to illness; illness leads to suffering. This #StarWars day and every day, #washyourhands frequently for at least 20 seconds with soap and water. #MayThe4thBeWithYou #COVID19 [19]

These types of posts can further mobilize the population, highlight the broader consequences of the virus, and encourage people to take action.

4.2.1.3 Infographics and high-quality media content

A final engagement-producing strategy was the use of simple text posts with an attached infographic or other high-quality media products. See the following tweet by Health Canada and Public Health Agency of Canada (4328 engagements, 119 predicted):

> Symptoms of #COVID19 may take up to 14 days to appear and include fever, cough and difficulty breathing. Contact a health care professional if you have travelled recently and develop these symptoms. #coronavirus[20]

That post contains a well designed infographic illustrating the symptoms of COVID-19 accompanied by a short descriptive text. This can be an effective strategy on Facebook as well, as shown by this Facebook post by the Quebec Ministère de la Santé et des Services sociaux which was accompanied by an animated video which contained additional information (23010 engagements, 616 predicted):

> (Translated) Masks are not the best protection against viral infections like coronavirus (COVID-19). The best way to protect yourself from COVID-19 is to respect well-known hygiene practices: cough in your elbow, throw out your used tissues, wash your hands, maintain distance, stay home. Protecting yourselves saves lives. Get more information: https://www.quebec.ca/sante/problemes-de-sante/a-z/coronavirus-2019/[21]

Another example is a post by the Provincial Health Services Authority of British Columbia that featured a poetic text written and performed by Julia Pileggi in a hospital setting with

19. https://web.archive.org/web/20200509132846/https:/twitter.com/GovCanHealth/status/1257318079723302914 (posted May 4, 2020).
20. https://web.archive.org/web/20200429054007/https://twitter.com/GovCanHealth/status/1243221783567904769 (posted March 26, 2020).
21. https://www.facebook.com/SanteServicesSociauxQuebec/posts/3030790776983528 (posted March 31, 2020).

short clips of nurses collectively reciting the message "I am your nurse" and which ends by thanking nurses (5289 engagements, predicted 187):

> This team loves like family, rooting for you to win. I won't give up on you, compassion lives in this skin." Poetic words are timeless. COVID-19 is a moment in time that we will get through together. Thank you to nurses everywhere – for your care before the pandemic emerged and long after it passes. #IAmYourNurse #CNA2020 #IND2020 #Nurses2020 #NationalNursingWeek #YearoftheNurse[22]

The posts above are illustrative of common features in the top 300 overperforming tweets and Facebook posts. We next turn to the posts that performed much worse than expected.

4.2.2 Underperformers

Of the tweets that received far less engagement than predicted (those posts with the largest negative residuals), we observe that content tends to underperform when it is limited to negative news, provides less useful or poor quality information, or focuses narrowly on politics or specific policy announcements. Note that though these posts do not receive high levels of engagement their content may still contain important public health information.

4.2.2.1 Negative news

A feature common among underperforming posts is negative news such as descriptive information about the numbers of confirmed cases, hospitalizations, and deaths. In a Facebook post by Quebec Premier François Legault (1926 predicted, 1180 received) which read: "(Translated) Important things to remember today"[23], he provides an update on the current state of COVID-19 in the province. While the attached video included information updating Quebecers on the state of the virus in the province, the initial image displayed at the beginning of the video showed a tally of infections, hospitalizations, and deaths. Content which focused on rising counts of cases and deaths, documenting the spread of the virus in a

22. `https://www.facebook.com/watch/?v=233697477914191` (posted May 11, 2020).
23. `https://www.facebook.com/FrancoisLegaultPremierMinistre/videos/824980004647784/` (posted April 1, 2020).

region, were consistently less shared. See this tweet by Alberta Premier Jason Kenney (865 predicted, 244 received):

> In today's #COVID19AB update, there are 106 new cases, for a total of 1,181 infections in Alberta. Sadly, two more have passed away. Yesterday, we lost five people - one of which was a woman in her 20s. Each one of these lives was precious and tragically cut short.[24]

News about layoffs was similarly not widely engaged with. See this tweet by Edmonton Mayor Don Iveson (139 predicted, 14 received):

> First let me acknowledge the heart wrenching news Adam had to deliver earlier today about temporary layoffs. I know it was an incredibly difficult decision for administration — and it saddens me that hardworking, dedicated folks will have to be temporarily laid off. #COVID19[25]

These posts share somber news without providing information that suggests desired behaviours to offset these outcomes. The lack of engagement with this type of content appears consistent with psychological literature on information avoidance, where people may be more likely to avoid information they believe to be negative, a phenomenon that is particularly pronounced for information regarding personal health (Sweeny et al. 2010).

4.2.2.2 Low quality media

While high quality media content tends to overperform, we identify a reciprocal and opposite pattern among low quality media products. Posts which embed low quality media receive a considerable penalty in actual versus expected engagement. Take this Facebook post by New Brunswick Premier Blaine Higgs (1159 predicted, 74 received):

> (Translated) The best tool for avoiding infection and spreading of COVID19: thoroughly washing your hands.[26]

24. `https://twitter.com/jkenney/status/1246631054951084032` (posted April 4, 2020).
25. `https://twitter.com/doniveson/status/1244769701391032320` (posted March 30, 2020).
26. `https://www.facebook.com/PremierBlaineHiggs/posts/3623955204312828` (posted March 11, 2020).

The video contains a voice-over of the Premier washing his hands for 3 minutes with poor audio quality and confusing framing. Another example is the following tweet from the City of Toronto (84 predicted, 9 received) which includes a redundant video clip that provides no information beyond that already in the text:

> Calling all #CityofTO golfers! Golf courses are open for the 2020 season. Practise #physicaldistancing and stay 2 metres (6 ft), or the length of two golf clubs, apart. More guidelines at: http://toronto.ca/explore-enjoy/.[27]

Poorly produced content tends to not attract engagement, even if it contains valuable health information.

4.2.2.3 Playing politics or policy announcements

A third group of underperforming posts and tweets highlighted other political considerations such as intergovernmental cooperation, budget issues, or specific policy announcements. Take the following tweet by Newfoundland and Labrador Premier Dwight Ball (940 expected, 253 received):

> Tomorrow I will meet with my counterparts in Opposition to discuss COVID-19. We must unite with common purpose to protect the health and well-being of all Newfoundlanders and Labradorians.[28]

The message here is one of political unity, but it does not transmit important health information and instead emphasizes the politics of the situation. This does not appear to be an engagement-producing strategy. Here is another example from a tweet by Toronto Mayor John Tory (220 expected, 28 received):

> Today, the City released an update on the financial impacts of #COVID19. We are experiencing a financial pressure estimated at $65 million a week. This pressure is driven by reduced TTC revenues and other decreased revenues, coupled with increased costs https://t.co/9f24pbpSzS.[29]

27. `https://twitter.com/cityoftoronto/status/1264195599529902081` (posted May 23, 2020).
28. `https://web.archive.org/web/20200708163651/https://www.facebook.com/premierofnl/photos/2874584919273681` (posted March 15, 2020).
29. `https://web.archive.org/web/20200404220213/https://twitter.com/JohnTory/status/1246187321197842434` (posted April 3, 2020).

Similarly, policy announcements do not effectively engage the public on social media. This tweet by Saskatchewan Premier Scott Moe is illustrative of this phenomenon (263 expected, 76 received):

> The SK Small Business Emergency Payment will provide direct financial support to small & medium businesses that have had to temporarily close/significantly curtail operations due to COVID19 Now is the time to pull together & help our local businesses in any way we can #COVID19SK https://t.co/GJ2miZQwpU.[30]

On Facebook, this post by Manitoba Premier Brian Pallister performed with a similarly poor level of engagement (398 expected, 86 received):

> Our government is extending $45 million in direct financial support to Manitoba seniors during #COVID19 through the NEW Seniors Economic Recovery Credit, which will deliver a $200 tax credit to each recipient. Learn more here: https://bit.ly/3fq08og #covid19MB.[31]

These policy announcements, particularly those around wage subsidies or financial assistance to targeted populations, can be an important part of a government response. However, we find that social media does not appear to be a particularly effective medium to spread awareness of such programs.

Collectively, these underperforming posts share a common feature: while they are posted during the pandemic and utilize a hashtag or key term to indicate that they are about the pandemic, they do not provide high-quality and actionable health related information. During the pandemic, the public consistently engaged with content that was useful and direct, while they exhibit a lower rate of engagement with policy announcements, political discussions, negative information such as reports of death rates and new cases, and poorly produced media.

5 Discussion and conclusions

Social media offers distinct opportunities and challenges for governments seeking to communicate important health information during times of crisis. While engagement may appear

30. `https://web.archive.org/web/20200418161243/https:/twitter.com/premierscottmoe/status/1248422842800041984` (posted April 9, 2020).

31. `https://www.facebook.com/BrianPallister/posts/2355934494509554` (posted May 5, 2020).

to be difficult to predict, we find that significant variance in engagement can be explained through examining a critical set of factors. Governments can "boost" their signal on these platforms during health crises. In this discussion, we highlight four lessons from the Canadian case for practitioners who seek to maximize the effectiveness of their social media responses during the COVID-19 pandemic or during future crises.

First, who posts can often be more important than what is posted. National and sub-national leaders have large audiences and can engage even larger numbers of social media users to share their message. The head of the national government (in Canada the Prime Minister) sets the tone as the main and most effective messenger of government health communication across social media platforms. Sub-national health authorities and elected heads also play a key role in informing the public. Federal and local health authorities may wish to collaborate with these higher-profile messengers on communicating health directives to citizens to ensure their content reaches the intended audience. Federal health authorities should carefully consider the difference between engagement with public health information promoted on their own platforms, and information promoted by the Prime Minister.

Provincial authorities must also be strategic in their promotion of public health information on social media, remaining cognizant of the importance of including premiers in any crucial communication efforts. Even more, our findings serve as a reminder to large city governments that, despite the leading role they may play in implementing public health policy at the local level, they are at a clear disadvantage relative to provincial and federal authorities when it comes to public engagement with information they share. It follows that large cities should therefore operate in conjunction with provincial and federal government for public health communication.

Second, concise messages with clearly formulated health directives tend to receive widespread engagement. Asking the population directly to perform the behaviour you want them to do can be an effective strategy, and can communicate messages far more widely than other strategies. This also highlights a feature of social media communication: the most effec-

tive messages tend to be the simplest. This also means that governments should not expect more complicated directives to receive the same engagement as simpler ones. Detailed policy updates fall into the latter category, where the level of detail is prohibitive to widespread propagation on social media networks.

Third, creativity, media and media quality matters. Pairing information about COVID-19 with the appropriate media is a key strategy. Utilizing influencer networks, pop-cultural references, and celebrity call-outs can be effective strategies as well, although they are rarely used. Particularly during times of crisis, governments may wish to employ those strategies more frequently. Conversely, extensive policy-related messages and video and infographics of lower quality can suppress engagement.

Fourth, government bodies should be thoughtful about how they approach information shared on each platform. Governments frequently post near-identical messages on both Facebook and Twitter, despite content performing differently on the two platforms. Although COVID-related content achieves proportionally much more engagement on Facebook, we find that Twitter is more well suited for local policy makers such as mayors and municipal health authorities. Video is the most effective tool on Twitter while text messages containing concise health directives achieve more traction on Facebook. Finally, more-frequent messages on Twitter face a penalty while we do not observe the same dynamic on Facebook.

The analysis above is subject to important caveats. First, we have focused this analysis on the important role that social media can play, but our survey findings (as shown in the supplementary materials) do indicate that many receive their news from television or traditional print or online news. Any public health strategy must continue to reach these non-social media populations. Second, we have stressed the importance of engagement given the evidence that repeated exposure to messaging can change attitudes and behaviours. Future research should attempt to draw a more direct link between public health campaigns and changed attitudes and behaviors, as opposed to relying solely on the engagement proxy employed here. Third, we have focused on a large but not comprehensive slice of social

media communication in a single country case study. Media elites, other elected officials (including members of opposition parties), and communications on different social media platforms are all crucial elements to consider during health crises. Moreover, it's probable that not all of the mechanisms we've identified travel outside of the Canadian context, and different countries may find dissimilar dynamics.

Nevertheless, we make two critical contributions to existing knowledge about government communication, particularly during public health crises. We identify cross-platform variations in strategy effectiveness and draw attention to specific, evidence-based practices to increase engagement with government health information. We recommend that policy makers and practitioners incorporate these findings into their responses to public health crises on social media.

References

Bacon, Frederick T. 1979. "Credibility of repeated statements: Memory for trivia." *Journal of Experimental Psychology: Human Learning and Memory* 5 (3). 10.1037/0278-7393.5.3.241.

Bail, Christopher A, Lisa P Argyle, Taylor W Brown, John P Bumpus, Haohan Chen, MB Fallin Hunzaker, Jaemin Lee, Marcus Mann, Friedolin Merhout, and Alexander Volfovsky. 2018. "Exposure to opposing views on social media can increase political polarization." *Proceedings of the National Academy of Sciences* 115 (37).

Basch, Charles E., Corey H. Basch, Grace C. Hillyer, and Christie Jaime. 2020. "The Role of YouTube and the Entertainment Industry in Saving Lives by Educating and Mobilizing the Public to Adopt Behaviors for Community Mitigation of COVID-19: Successive Sampling Design Study." *JMIR Public Health and Surveillance* 6 (2). https://publichealth.jmir.org/2020/2/e19145/.

Bonsón, Enrique, Tomás Escobar, and Melinda Ratkai. 2014. "Testing the inter-relations of factors that may support continued use intention: The case of Facebook." *Social Science Information* 53 (3).

Bonsón, Enrique, David Perea, and Michaela Bednárová. 2019. "Twitter as a tool for citizen engagement: An empirical study of the Andalusian municipalities." *Government Information Quarterly* 36 (3). http://www.sciencedirect.com/science/article/pii/S0740624X18304684.

Bonsón, Enrique, and Melinda Ratkai. 2013. "A set of metrics to assess stakeholder engagement and social legitimacy on a corporate Facebook page." *Online Information Review* 37 (5). https://doi.org/10.1108/OIR-03-2012-0054.

Bonsón, Enrique, Sonia Royo, and Melinda Ratkai. 2015. "Citizens' engagement on local governments' Facebook sites. An empirical analysis: The impact of different media and

content types in Western Europe." *Government Information Quarterly* 32 (1). http://www.sciencedirect.com/science/article/pii/S0740624X14001567.

Bonsón, Enrique, Sonia Royo, and Melinda Ratkai. 2017. "Facebook Practices in Western European Municipalities: An Empirical Analysis of Activity and Citizens' Engagement." *Administration & Society* 49 (3). 10.1177/0095399714544945.

Bridgman, Aengus, Eric Merkley, Peter John Loewen, Taylor Owen, Derek Ruths, Lisa Teichmann, and Oleg Zhilin. 2020. "The causes and consequences of COVID-19 misperceptions: Understanding the role of news and social media." *Harvard Kennedy School Misinformation Review* 1 (3). 10.37016/mr-2020-028.

Chatfield, Akemi Takeoka, and Christopher Reddick. 2015. "Understanding Risk Communication Gaps through E-Government Website and Twitter Hashtag Content Analyses: The Case of Indonesia's Mt. Sinabung Eruption." *Journal of Homeland Security and Emergency Management* 12 (2).

———. 2018. "All hands on deck to tweet #sandy: Networked governance of citizen coproduction in turbulent times." *Government Information Quarterly,* Agile Government and Adaptive Governance in the Public Sector, 35 (2). http://www.sciencedirect.com/science/article/pii/S0740624X17300485.

Cho, Moonhee, Tiffany Schweickart, and Abigail Haase. 2014. "Public engagement with nonprofit organizations on Facebook." *Public Relations Review* 40 (3). http://www.sciencedirect.com/science/article/pii/S0363811114000241.

Cinelli, Matteo, Walter Quattrociocchi, Alessandro Galeazzi, Carlo Michele Valensise, Emanuele Brugnoli, Ana Lucia Schmidt, Paola Zola, Fabiana Zollo, and Antonio Scala. 2020. "The COVID-19 Social Media Infodemic." *arXiv:2003.05004 [nlin, physics:physics].* http://arxiv.org/abs/2003.05004.

Dumbrell, Dan, and Robert Steele. 2012. "What are the characteristics of highly disseminated public health-related tweets?" In *Proceedings of the 24th Australian Computer-Human Interaction Conference.* OzCHI '12. Melbourne, Australia: Association for Computing Machinery. https://doi.org/10.1145/2414536.2414555.

Gálvez-Rodríguez, María del Mar, Arturo Haro-de-Rosario, Manuela García-Tabuyo, and Carmen Caba-Pérez. 2019. "Building online citizen engagement for enhancing emergency management in local European government: The case of the November 2015 Paris attacks." *Online Information Review* 43 (2). https://doi.org/10.1108/OIR-09-2016-0286.

Goldberg, Matthew, Abel Gustafson, Edward Maibach, Matthew Thomas Ballew, Parrish Bergquist, John Kotcher, Jennifer R. Marlon, Seth A. Rosenthal, and Anthony Leiserowitz. 2020. *Mask-wearing increases after a government recommendation: A natural experiment in the U.S. during the COVID-19 pandemic.* Preprint. PsyArXiv. https://osf.io/uc8nz.

Gollust, Sarah E., and Joseph N. Cappella. 2014. "Understanding Public Resistance to Messages About Health Disparities." *Journal of Health Communication* 19 (4). https://doi.org/10.1080/10810730.2013.821561.

Graham, Melissa W., Elizabeth J. Avery, and Sejin Park. 2015. "The role of social media in local government crisis communications." *Public Relations Review* 41 (3). http://www.sciencedirect.com/science/article/pii/S0363811115000077.

Hargittai, Eszter. 2020. "Potential Biases in Big Data: Omitted Voices on Social Media." *Social Science Computer Review* 38 (1). https://doi.org/10.1177/0894439318788322.

Haro-de-Rosario, Arturo, Alejandro Sáez-Martín, and María del Carmen Caba-Pérez. 2018. "Using social media to enhance citizen engagement with local government: Twitter or Facebook?" *New Media & Society* 20 (1). 10.1177/1461444816645652.

Herovic, Emina, Timothy L. Sellnow, and Deanna D. Sellnow. 2020. "Challenges and opportunities for pre-crisis emergency risk communication: lessons learned from the earthquake community." *Journal of Risk Research* 23 (3). https://doi.org/10.1080/13669877.2019.1569097.

Jiang, Shaohai, and Christopher E Beaudoin. 2016. "Smoking prevention in China: a content analysis of an anti-smoking social media campaign." *Journal of health communication* 21 (7).

Kim, Cheonsoo, and Sung-Un Yang. 2017. "Like, Comment, and Share on Facebook: How Each Behavior Differs from the Other." *Public Relations Review* 43 (2). http://www.sciencedirect.com/science/article/pii/S0363811116300157.

Liang, Hai, Isaac Chun-Hai Fung, Zion Tsz Ho Tse, Jingjing Yin, Chung-Hong Chan, Laura E. Pechta, Belinda J. Smith, et al. 2019. "How did Ebola information spread on twitter: broadcasting or viral spreading?" *BMC Public Health* 19 (1). 10.1186/s12889-019-6747-8.

Lieberman, Evan S. 2015. "Nested analysis: Toward the integration of comparative-historical analysis with other social science methods." *Advances in comparative-historical analysis.*

Merkley, Eric, Aengus Bridgman, Peter John Loewen, Taylor Owen, Derek Ruths, and Oleg Zhilin. 2020. "A Rare Moment of Cross-Partisan Consensus: Elite and Public Response to the COVID-19 Pandemic in Canada." *Canadian Journal of Political Science/Revue canadienne de science politique.*

Mislove, Alan, and Sune Lehmann. 2011. "Understanding the Demographics of Twitter Users." In *Proceedings of the Fifth International AAAI Conference on Weblogs and Social Media.*

Mitchell, Amy. 2016. *The modern news consumer: News attitudes and practices in the digital era.* Pew Research Center.

Munger, Kevin. 2017. "Tweetment Effects on the Tweeted: Experimentally Reducing Racist Harassment." *Political Behavior* 39 (3). http://link.springer.com/10.1007/s11109-016-9373-5.

Niederdeppe, Jeff, Q Bu, Porismita Borah, David Kindig, and Stephanie Robert. 2008. "Message Design Strategies to Raise Public Awareness of Social Determinants of Health and Population Health Disparities." *The Milbank quarterly* 86.

Nyhan, Brendan, and Jason Reifler. 2010. "When corrections fail: The persistence of political misperceptions." *Political Behavior* 32 (2).

Ophir, Yotam. 2018. "Coverage of Epidemics in American Newspapers Through the Lens of the Crisis and Emergency Risk Communication Framework." *Health Security* 16 (3). https://www.liebertpub.com/doi/full/10.1089/hs.2017.0106.

Organization, World Health. 2017. *Communicating Risk in Public Health Emergencies: A WHO Guideline for Emergency Risk Communication (ERC) Policy and Practice.* World Health Organization.

Organization, World Health. 2020. *Communicating risk in public health emergencies: a WHO guideline for emergency risk communication (ERC) policy and practice.* World Health Organization.

Pennycook, Gordon, Tyrone D. Cannon, and David G. Rand. 2018. "Prior exposure increases perceived accuracy of fake news." *Journal of Experimental Psychology: General* 147 (12).

Polage, Danielle C. 2012. "Making up History: False Memories of Fake News Stories." 10.23668/psycharchives.1323.

Rahim, Afiq Izzudin A, Mohd Ismail Ibrahim, Faizul Nizam A Salim, and Mohd Ariff Ikram Ariffin. 2019. "Health information engagement factors in Malaysia: A content analysis of Facebook use by the ministry of health in 2016 and 2017." *International journal of environmental research and public health* 16 (4).

Ruths, Derek, and Jürgen Pfeffer. 2014. "Social media for large studies of behavior." *Science* 346 (6213). https://science.sciencemag.org/content/346/6213/1063.

Sha, Hao, Mohammad Al Hasan, George Mohler, and P. Jeffrey Brantingham. 2020. "Dynamic topic modeling of the COVID-19 Twitter narrative among U.S. governors and cabinet executives." *arXiv:2004.11692 [physics].* http://arxiv.org/abs/2004.11692.

Sharma, Megha, Kapil Yadav, Nitika Yadav, and Keith C. Ferdinand. 2017. "Zika virus pandemic—analysis of Facebook as a social media health information platform." *American Journal of Infection Control* 45 (3). http://www.sciencedirect.com/science/article/pii/S019665531630918X.

Stone, Jeffrey A., and S. Hakan Can. 2020. "Linguistic analysis of municipal twitter feeds: Factors influencing frequency and engagement." *Government Information Quarterly.* http://www.sciencedirect.com/science/article/pii/S0740624X19304873.

Sweeny, Kate, Darya Melnyk, Wendi Miller, and James A Shepperd. 2010. "Information avoidance: Who, what, when, and why." *Review of general psychology* 14 (4).

Tagliacozzo, Serena, and Michele Magni. 2018. "Government to Citizens (G2C) communication and use of social media in the post-disaster reconstruction phase." *Environmental Hazards* 17 (1).

Thelwall, Mike, and Saheeda Thelwall. 2020. "Retweeting for COVID-19: Consensus building, information sharing, dissent, and lockdown life." *arXiv:2004.02793 [cs].* http://arxiv.org/abs/2004.02793.

Thorson, Emily. 2016. "Belief Echoes: The Persistent Effects of Corrected Misinformation." *Political Communication* 33 (3). https://doi.org/10.1080/10584609.2015.1102187.

Vraga, Emily K., and Leticia Bode. 2017. "Using Expert Sources to Correct Health Misinformation in Social Media." *Science Communication* 39 (5). https://doi.org/10.1177/1075547017731776.

Appendices

A COVID-19 Dictionary

To identify COVID-19 related content, we used a dictionary-based approach with the terms (and french translations) found below:

`covid, corona, epidemic, pandemic, virus, quarantine, n95, n-95, pandemic, epidemic, corona, community spread, self-isolate, self isolate, herd immunity, flatten the curve, work from home, stay home, stay at home, herd-immunity, flatten-the-curve, work-from-home, stay-home, stay-at-home, avoid all non-essential trips, gather in groups, avoid places, avoid public, avoid crowds, avoid gatherings, grocery delivery, avoid large gatherings, avoid small gatherings, and small gatherings, and large gatherings, limit events, limit meetings, self-isolate, isolation, must isolate, social distance, social distancing, six feet, 6 ft, 2 meter, 2 meters, maintain distance`

B Facebook Accounts and Twitter Handles

This section includes all accounts used in the analysis along with their government type and number of posts. Facebook accounts are found in Table 1, while Twitter accounts are found in Table 2.

The following Canadian cities did not have both Twitter and Facebook accounts: Brampton, Calgary, Edmonton, Gatineau, Halifax, Laval, Longueil, Markham, Missisauga, Quebec, Saskatoon, Surrey, and Vaughan. Similarly, the following mayors do not have a presence on both social media platforms: Gatineau, Halifax, London, Longueuil, Quebec, and Surrey. Lastly, the Northwest Territories Health and Social Services Authority (NTHSSA) did not maintain an active social media presence on neither platform during the period of study and was thus excluded.

Table 1: Facebook Accounts and Post Counts by Media Type

	Account Name	Gov. Type	Text	Link	Image	Video
1	CityBrampton	City	0	4	55	10
2	citymississauga	City	1	1	31	4
3	cityofburnaby	City	0	0	15	3
4	cityofcalgary	City	1	23	17	12
5	cityofedmonton	City	2	20	13	6
6	cityofkitchener	City	0	2	27	5
7	cityofmarkham	City	0	1	52	1
8	cityofottawa	City	2	2	35	1
9	cityofsaskatoon	City	0	3	42	1
10	cityofto	City	1	5	55	18
11	CityofVancouver	City	1	3	29	14
12	CityofWindsor	City	1	1	8	8
13	cityofwinnipeg	City	0	1	24	11
14	hfxgov	City	1	2	19	3
15	LondonCanada	City	2	0	40	0

Table 1: Facebook Accounts and Post Counts by Media Type

	Account Name	Gov. Type	Text	Link	Image	Video
16	mtlville	City	1	13	3	1
17	QuebecVille	City	0	11	3	1
18	TheCityofSurrey	City	1	7	29	7
19	thecityofvaughan	City	0	1	16	2
20	villedelavalpageofficielle	City	0	3	17	5
21	VilleDeLongueuil	City	0	4	21	1
22	villegatineau	City	0	1	12	6
23	CCOHS	Fed. Health	0	0	13	0
24	HealthyCdns	Fed. Health	8	2	63	48
25	StatisticsCanada	Fed. Health	2	0	41	1
26	FraserHealthAuthority	Local Health	1	3	49	5
27	middlesex.london.health.unit	Local Health	0	6	39	4
28	ottawahealth	Local Health	22	13	57	13
29	rowpublichealth	Local Health	0	1	17	0
30	santemontreal	Local Health	0	16	9	16
31	TheWECHU	Local Health	23	66	35	52
32	torontopublichealth	Local Health	1	2	45	0
33	VanIslandHealth	Local Health	0	9	20	18
34	winnipegregionalhealthauthority	Local Health	1	5	12	2
35	Berry.Vrbanovic	Mayor	1	2	13	11
36	bonniecrombie	Mayor	6	12	52	37
37	doniveson	Mayor	0	5	6	12
38	drewdilkens	Mayor	18	29	61	30
39	Frank-Scarpitti	Mayor	3	8	44	15
40	jimwatsonottawa	Mayor	0	0	4	1
41	johntoryTO	Mayor	4	8	79	72
42	kennedy.stewart	Mayor	1	13	5	6
43	MarcDemersLaval	Mayor	0	1	3	8
44	MayorBrianBowman	Mayor	1	1	26	2

Table 1: Facebook Accounts and Post Counts by Media Type

	Account Name	Gov. Type	Text	Link	Image	Video
45	MayorCharlieClark	Mayor	7	12	20	3
46	MayorofBurnaby	Mayor	0	0	2	8
47	MBMayor	Mayor	0	2	239	4
48	MTL.ValeriePlante	Mayor	1	3	18	9
49	NaheedNenshi	Mayor	3	4	4	1
50	patrickbrownont	Mayor	0	1	1	2
51	BrianPallister	Premier	0	4	7	18
52	CarolineRangeLake	Premier	1	6	7	1
53	DennisKingPC	Premier	0	0	18	4
54	FordNationDougFord	Premier	0	2	53	61
55	FrancoisLegaultPremierMinistre	Premier	1	1	20	57
56	johnhorganbc	Premier	3	39	21	33
57	kenneyjasont	Premier	1	33	40	62
58	PremierBlaineHiggs	Premier	1	0	5	2
59	PremierJoeSavikataaq	Premier	2	2	13	3
60	premierofnl	Premier	41	9	28	14
61	premiersandysilver	Premier	1	8	1	0
62	PremierScottMoe	Premier	8	18	49	52
63	StephenMcNeilLiberal	Premier	0	9	23	18
64	JustinPJTrudeau	Prime Minister	11	36	11	41
65	GouvQc	Prov. Gov	0	7	4	0
66	GovNB	Prov. Gov	52	8	86	3
67	GovNL	Prov. Gov	5	6	72	34
68	GovofNunavut	Prov. Gov	8	35	12	0
69	govpe	Prov. Gov	24	16	37	17
70	ManitobaGovernment	Prov. Gov	1	1	102	7
71	ONgov	Prov. Gov	1	2	15	0
72	yukongov	Prov. Gov	0	0	32	21
73	albertahealthservices	Prov. Health	11	16	43	28

Table 1: Facebook Accounts and Post Counts by Media Type

	Account Name	Gov. Type	Text	Link	Image	Video
74	ImmunizeBC	Prov. Health	0	6	6	2
75	NovaScotiaHealthAuthority	Prov. Health	0	16	36	8
76	ONThealth	Prov. Health	0	0	60	4
77	ProvincialHealthServices	Prov. Health	0	17	63	7
78	SanteServicesSociauxQuebec	Prov. Health	1	4	27	19
79	SaskHealthAuthority	Prov. Health	17	20	87	16

Table 2: Twitter Handles and Tweet Counts by Media Type

	Handle	Gov	Text	Link	Image	Video
1	City_of_Vaughan	City	13	25	99	13
2	CityBrampton	City	5	25	273	14
3	CityKitchener	City	10	10	43	1
4	citymississauga	City	13	12	157	1
5	CityofBurnaby	City	13	2	22	3
6	cityofcalgary	City	74	59	28	21
7	CityofEdmonton	City	28	92	51	2
8	CityofLdnOnt	City	6	14	179	0
9	cityofmarkham	City	4	7	383	7
10	cityofsaskatoon	City	3	15	109	1
11	CityofSurrey	City	22	42	63	14
12	cityoftoronto	City	141	111	306	59
13	CityofVancouver	City	27	40	170	18
14	cityofwinnipeg	City	28	69	113	14
15	CityWindsorON	City	0	4	22	0
16	hfxgov	City	4	16	14	0
17	MTL_Ville	City	6	22	45	0
18	ottawacity	City	10	23	79	0
19	ville_gatineau	City	11	19	68	1
20	villedelavalqc	City	2	9	13	5
21	VilleLongueuil	City	9	47	6	0
22	villequebec	City	0	28	1	0
23	CCOHS	Fed. Health	0	0	32	0
24	GovCanHealth	Fed. Health	49	109	299	26
25	StatCan_eng	Fed. Health	4	15	107	1
26	Fraserhealth	Local Health	5	12	222	2
27	MLHealthUnit	Local Health	8	50	31	2
28	ottawahealth	Local Health	53	122	128	10
29	ROWPublicHealth	Local Health	3	3	55	0

Table 2: Twitter Handles and Tweet Counts by Media Type

	Handle	Gov	Text	Link	Image	Video
30	santemontreal	Local Health	5	19	27	0
31	TheWECHU	Local Health	8	164	86	0
32	TOPublicHealth	Local Health	43	151	129	0
33	VanIslandHealth	Local Health	16	154	57	5
34	WinnipegRHA	Local Health	11	27	20	0
35	berryonline	Mayor	11	77	73	23
36	BonnieCrombie	Mayor	42	25	118	45
37	charlieclarkyxe	Mayor	10	28	6	2
38	doniveson	Mayor	121	57	10	9
39	drewdilkens	Mayor	29	60	113	24
40	frankscarpitti	Mayor	37	43	130	18
41	JimWatsonOttawa	Mayor	52	17	69	0
42	JohnTory	Mayor	277	97	254	118
43	kennedystewart	Mayor	36	36	23	1
44	MarcDemers_	Mayor	2	0	1	4
45	Mayor_Bowman	Mayor	13	20	90	33
46	MayorofBurnaby	Mayor	0	4	3	9
47	mbmayor	Mayor	45	50	172	17
48	nenshi	Mayor	18	22	4	0
49	patrickbrownont	Mayor	55	29	133	33
50	Val_Plante	Mayor	217	40	54	5
51	BlaineHiggs	Premier	6	0	4	0
52	BrianPallister	Premier	1	32	20	21
53	CCochrane_NWT	Premier	5	15	2	0
54	dennyking	Premier	7	6	17	8
55	fordnation	Premier	18	63	114	54
56	francoislegault	Premier	3	27	23	50
57	jjhorgan	Premier	39	138	22	27
58	jkenney	Premier	17	177	161	77

Table 2: Twitter Handles and Tweet Counts by Media Type

	Handle	Gov	Text	Link	Image	Video
59	JSavikataaq	Premier	38	7	38	3
60	Premier_Silver	Premier	1	22	3	0
61	PremierofNL	Premier	58	36	31	16
62	PremierScottMoe	Premier	45	118	86	44
63	StephenMcNeil	Premier	44	38	42	18
64	JustinTrudeau	Prime Minister	147	231	27	12
65	GouvQc	Prov. Gov	9	39	1	0
66	Gov_NB	Prov. Gov	7	84	165	1
67	GovNL	Prov. Gov	12	97	241	3
68	GOVofNUNAVUT	Prov. Gov	2	63	1	0
69	InfoPEI	Prov. Gov	96	180	339	20
70	MBGov	Prov. Gov	2	155	363	3
71	ONgov	Prov. Gov	16	26	28	1
72	yukongov	Prov. Gov	0	0	73	0
73	GoAHealth	Prov. Health	7	159	4	0
74	HealthNS	Prov. Health	4	10	45	0
75	ImmunizeBC	Prov. Health	0	6	2	0
76	ONThealth	Prov. Health	194	76	135	6
77	PHSAofBC	Prov. Health	2	95	191	18
78	sante_qc	Prov. Health	19	133	16	1
79	SaskHealth	Prov. Health	82	119	84	8

C Surveying Canadians about government information consumption

We use a nationally representative survey of Canadians in order to establish a general picture of the patterns of Canadian consumption of COVID-19 related public health information.[32] We included a battery of questions focused on collecting self-reported consumption of public health information from government sources. We asked: "*Over the past week, which of the following sources of COVID-19 information did you read, watch, or listen to? Please select all that apply.*" Figure 1 plots the proportion of respondents who selected different sources of COVID-19 information against where they self-reported to have received the majority of their COVID-19 related news.

Sources of COVID-19 related information are not consistent across the population according to their primary source of news. Those who primarily consume their COVID-19 news on social media or through traditional news media (newspapers in print or online editions), for example, were less likely than television news consumers to have seen a video of the Prime Minister or their premier. All groups were about as likely to have seen a video of their mayor, at a much smaller proportion overall than the leaders mentioned above. However, these correlations are not persistent across the data. While social media consumers were also relatively less likely to have seen a public health announcement, they were the first or second group by proportion to have been exposed to infographics, to have visited the web pages of the Federal or their provincial governments, or to have received information from a scientific publication.

We find that both the level and types of COVID-19 related content consumed vary according to where individuals receive their news, although videos of the Prime Minister

32. We surveyed 2,522 Canadian citizens 18 years and older using the online panel provider Dynata. The survey was fielded from May 21-27, 2020. National level quotas were set on region (i.e. Atlantic, Quebec, Ontario, and West), age, gender, and language. Respondents were weighted within each region of Canada by gender and age based on data from the 2016 Canadian census.

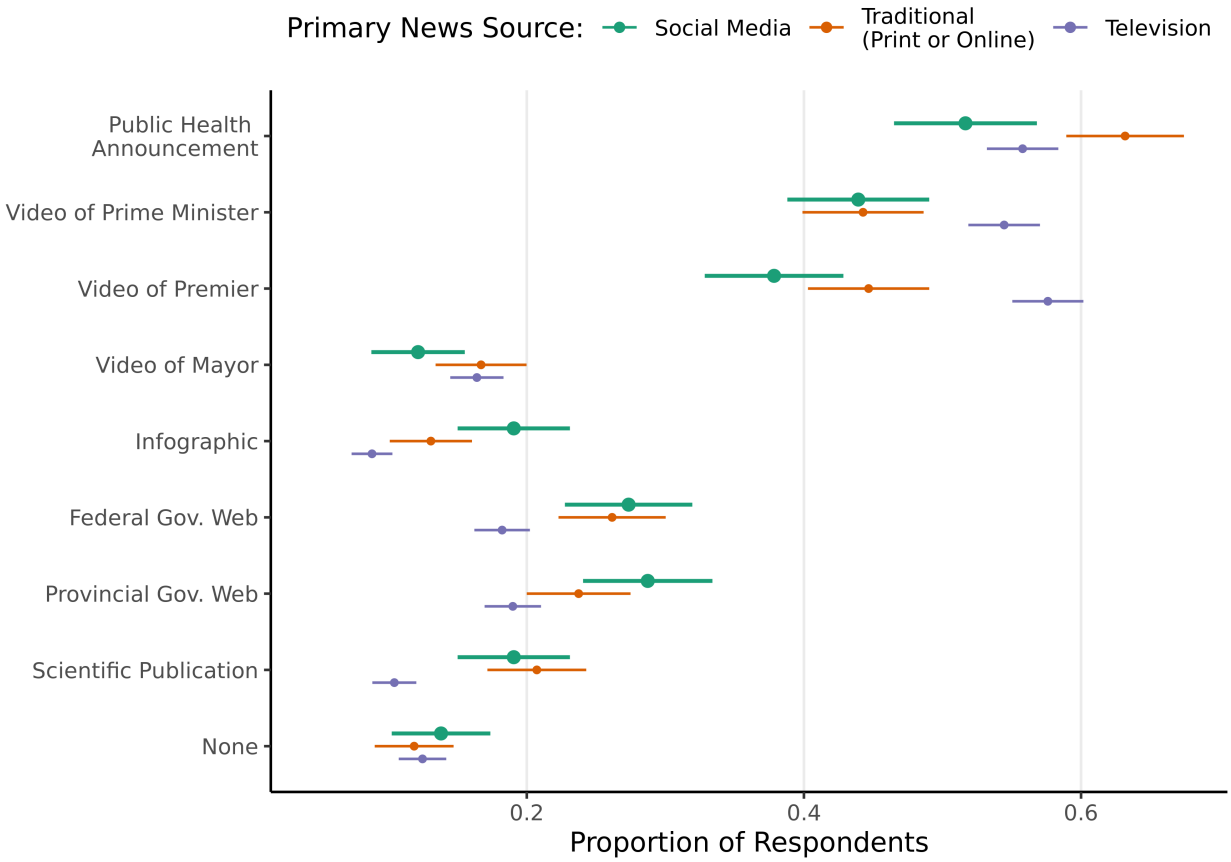

Figure 1: COVID-19 Related Information Sources by Primary News Source

and premiers are some of the most consumed pieces of public health content, regardless of where people receive their news. This stands in contrast to infographics and government web pages, which have been emphasized but appear to have received less engagement from the public.