Examining social media, citizen engagement and risk communication: A smart city perspective

By

Tamanna Dalwai (Muscat College, tamanna@muscatcollege.edu.om); Menila James (Muscat College, menilajames@muscatcollege.edu.om); Nujood Al Haddabi (Independent Researcher, nujoodalhaddabi@gmail.com); William Webster (University of Stirling, william.webster@stir.ac.uk); Arockiasamy Soosaimanickam (University of Nizwa, arockiasamy@unizwa.edu.om); Abdullah Mohammed Alshukaili (University of Nizwa, a.alshukaili@unizwa.edu.om)

Abstract

Governments around the world have had a varied response to social media adoption to communicate and engage their citizens. For the official purpose, social media has been used to create awareness of policies, ongoing projects, and new and other important public announcements. The smart city concept is predominantly based on the technology implementation that is expected to create sustainable economic development and improved quality of life. Oman 2040 strategy has aimed to achieve Smart Cities as a national ambition. During the pandemic, social media became an invaluable tool for the direct transmission of important information directed toward saving lives. This chapter aims to investigate the communication strategies and level of citizen engagement during COVID-19, through the Ministry of Health (MoH) Twitter posts in Oman. It also examines the risk communication strategies by MoH. The social media posts are analysed for the pandemic's initial six-month period in Oman which began on 24th February 2020. A total of 1,722 COVID-19-related tweets were analysed. The content analysis of the tweets suggested the MOH preferred to use the push strategy of communication during the COVID-19 period. The tweets were predominantly communicating the risk related to the pandemic. This study is expected to benefit the governments, health agencies, community and researchers as it provides insights on citizen engagement and risk communication strategies.

Keywords: e-participation, social media, Twitter, Oman, COVID-19, risk

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1. Introduction

Citizen engagement is very vital in developing successful smart cities as it permits governments to respond to the requirements of the dynamic environments, taking decisions in the best interest of the public. Smart cities are known to offer innovative solutions that boost the day-to-day affairs of their citizens through the use of Information and Communication Technology (ICT) in the healthcare, transportation, energy consumption and education sectors [1,2,3,4]. The rising urban thickness is expected to have significant levels of contamination, higher gridlock and social osmosis. It is a major contributing factor to smart city development [5]. Social media offers powerful platforms for smart city governments to connect, engage and associate with citizens, especially in crisis management [6]. Citizen engagement is predominant in crisis management, as it enhances the society's capacity to effectively mitigate the various phases of the emergency. Enlisting citizen trust and cooperation is one of the major roles of the government's risk mitigation process during a health crisis [7]. The government's social media platforms play an important role in participating the public to combat the pandemic such as COVID-19. Previous public health risks and the COVID-19 pandemic share a lot of common characteristics with other crises, for instance, a high level of uncertainty, unexpected rapid, misinformation, economic inflation, new political regulation, development and short triggering events. The need for online engagement for the government is a part of risk management to provide trusted information about crisis stages, raise awareness and promote behavioural changes, rumour control, and cultivate information security behaviour against scams. Furthermore, the potential of social media platforms to spread information faster is the main advantage of using them during public health crises [8].

According to Górska et al [9], in an emergency or disruptive situation, communication is crucial for protecting and ensuring citizens' safety and it became a priority to ensure that reliable information is available for citizens to protect themselves. However, the online engagement for government organisations during a health crisis is not only limited to obtaining information but also extends to participation in the decision-making process. Studies on communication strategies highlighted the importance of engaging citizens in the decision-making process regarding the development of their local governments and communities and it led to more effective government management [10, 11]. The use of social media allows governments to receive feedback that enhances the ability to manage health crisis such as the COVID-19 pandemic.

COVID-19 had a multi-level impact on society's lives, including social, political, and environmental, and a massive effect was on the communication strategies between government and the public. Previous studies on crisis communications found that most governments in the past failed to find ways to communicate with citizens during a crisis. However, we are in the information technology revolution, which is the right opportunity to develop communication strategies before and after a crisis. Furthermore, local governments in many countries found social media platforms the right ways to communicate with a citizen during COVID-19 [8. 9, 12]. Facebook, Twitter and YouTube are possibly the most common social media platforms appropriate for LGs to engage with the citizens and spread information. In some countries, Twitter is used to approach the citizen while Facebook has been used in other areas [8].

According to Górska et al. [9], there are three strategies used by the government to engage during COVID-19, which are based on the content, language, and tone of posts shared by the cities. The tweets or posts are classified as Business as usual (Usual), We are great! Just observe (Great), and We are in this together (Together). The descriptive statistics of the study show that the “Together” strategy involving the networking tactics of communication was the predominant strategy in COVID-19 posts across all social media platforms. Thus, using the model proposed by Górska et al [9], this study examines the communication strategies observed by the Sultanate of Oman's Ministry of Health (MoH) Twitter account. In addition, this chapter explores the tweets from the risk management strategies perspective advocated by [13].

The research makes vital contributions to the extant literature about government communication on the pandemic. The case of Oman’s Ministry of Health (MoH) serves as how public institution applies strategies for engagingly communicating with the public during the pandemic. The government applied the push strategy of communication whereby most of its tweets were classified in the “We are great! Just observe" category. Media-rich tools such as the use of videos were more prevalent in the first few months of the crisis, and it was followed by more hashtags in the following months. Citizen engagement measured by the number of likes was high in the initial few months of the pandemic. Thus, the use of the selected communication strategy may be seen as successful in the initial months when the unknown related to the pandemic was much higher. The study also contributes to the risk management strategies adopted by the MoH. As expected, the communication strategies focused more on the risks, followed by the efficacy related to the pandemic. From a smart city perspective, effective risk management strategies will augment the reliability of the government and diffuse any public fears.

This chapter is discussed as follows: section 2 presents an overview of the literature review; section 3 discusses the methodology adopted by the study; section 4 presents the results and discussions related to the tweets classifications in terms of communication and risk management and lastly, section 5 discusses the conclusions, recommendations and limitations of the study.

2. Literature Review

Citizen engagement is critical for the establishment and achievement of a modern city. Citizens are no more viewed to be passive technology and service consumers only but are expected to serve an extended role of an active contributor to ideas [14]. Social media serves to be an effective communication tool in a period of crisis for the citizens and governments. This section reviews the prior studies related to the smart cities' framework, risk management and government responses to the pandemic.

2.1 Smart city: characteristics and pillars

Smart cities are those that have well-established connections of ICT, physical, social and business infrastructure [1]. Intelligence from the perspective of smart cities refers to the ability or technique to make informed decisions

Bhushan et al [5] described a smart city as an interplay of four important characteristics that include: sustainability, smartness, urbanization and quality of life. The sustainability of a smart city is built upon certain key attributes that address social issues, infrastructure and governance, environment, health and economics. Smartness is associated with the improvement of social, economic and environmental benchmarks. Quality of life is measured through the financial and emotional well-being of its citizens. Whereas urbanization is the outcome of rural transformation achieved through improvement in the infrastructural, economical, technological and governing attributes.

Additionally, a smart city is based on four major themes or pillars that consist of: physical, institutional, social and economic infrastructure [5]. Physical infrastructure through smart energy, building renovation, green urban planning, and green buildings ensures resource sustainability and smooth city operations. Institutional infrastructure is an integration of national, civic, public and private organisations that contributes to the enhancement of smart city governance. The social infrastructure consists of human capital, quality of life and intellectual capital and contributes to the sustainability of a smart city. Economic infrastructure

ensures the growth of the economy and leads to job creation by enhancing e-business and e-commerce. This chapter seeks to contribute to the social and institutional infrastructure that enhances smart city governance. Citizen engagement is a key attribute for decision-making and easy governance. This requires effective government communication strategies which are addressed through the social infrastructure. Table 1 summarizes the studies related to social media usage during the pandemic. The findings report no consistent application or usage of social media by the local government. While it was noted by several studies as an important tool for better preparedness for COVID-19, some also reported its misusage due to misinformation.

Table 1: Summary of studies addressing the use of social media for crisis management

Authors	Year	Findings
Selerio et al. [15]	2022	Social media was important for public health policy development, monitoring and controlling misinformation, and managing citizen behaviour and response.
Gorska et al. [9]	2022	Social media was used by the local government for managing pandemic-related crisis communication. Specifically for Poland, the together communication strategy was applied.
Young et al. [16]	2022	Social media was an important surveillance method for COVID-19 health policy compliance.
Abbas et al. [17]	2021	Excessive usage of social media contributed to providing emotional, informational and peer support.
Gesser-Edelsburg [18]	2021	The research argued that there exist discrepancies in health and risk communication in the existing literature. The article recommended engaging the public on social media for encouraging informed decision-making.

Vraga and Bode [19]	2021	The use of correct infographics on social media reduced misperceptions about science-related COVID-19 prevention strategies but did not affect misperceptions regarding COVID-19 prevention.
Malecki et al. [20]	2021	The research advocated adopting a risk communication strategy that should be planned carefully, accept the public as partners, endure transparency and honesty, communicate with compassion, and evaluate and reassess strategies.
Bridgman et al. [21]	2020	More misinformation was communicated through social media such as Twitter whereas the inverse applied to news media.
Zhou et. al. [22]	2021	Social media supported the communication of accurate information about the pandemic and facilitated the public to move to the next normal.
Camilleri [23]	2021	There is scope for institutions and organizations to incorporate digital and social media for pandemic-related information and risk management plans.

2.2 Online engagement and risk management.

According to studies on crisis management, emergency communications have been comprised of two broad categories, risk communication, and crisis communication. Crisis communication is defined broadly as the “collection, processing, and dissemination of information required to address a crisis" [24] which is the part not related to our research specifically. Risk communication focuses on the "identification of risks to the public health and efforts to persuade the public to adopt healthier, less risky behaviours” [25]. The primary concern of risk communication is to find out the likelihood of probable harm and identify and communicate methods to reduce the harm. Additionally, the impetus of risk communication was primarily found in the health communication domain [26].

The usage of social media platforms has been remarkably increasing in times of acute crisis, and many health organizations use social media platforms to interact and foster public participation to facilitate decision-making during the crisis. However, the government's online engagement has not been only in the public health sector but in many crises, for instance, hurricanes, earthquakes, and even terrorist attacks. Online engagement played a significant role for local governments and World Health Organization (WHO) to communicate critical health-related information to the public over recent years. Furthermore, social network tools have been accelerating the dissemination of information about the risk as evidenced by the 2009 H1N1 influenza epidemic [26]. The related literature on emergency communication highlights the importance of online engagement to the government organisation during broader risk events as well as the previous public health crises [13]. One of the risk management practices done by the worldwide governments during the COVID-19 pandemic is placing effective risk communication practices on Twitter, including the use of messages promoting self-efficacy.

According to Slavik et. al [13], one way to measure online engagement and examine the type of communication is through Twitter accounts. Twitter uses tools such as the number of retweets (shares of a tweet on Twitter or other platforms), number of likes (number of times users agreed with a tweet), and number of replies (a tweet has been mentioned on or responded to). Furthermore, retweets have been associated as an effective tool to measure online engagement. The research studies have highlighted those strategies such as hashtags, URLs, and user mentions can increase online engagement on the government's social media accounts, especially (Twitter and Facebook) during COVID-19, thus engaging citizens in the risk management approaches and decision-making [8]. Pang et al/ [8] have conducted a research study on "engagement of Government Social Media on Facebook during the COVID-19 Pandemic in Macao". The posts derived from the Macao SAR government Facebook data regarding online engagement have been classified into 7 categories which include plans and measures, public health messages, rumour control, latest news, appreciations, community resilience, and press conference. The online engagement was frequently updated during different stages of the pandemic.

The risk communication coding used by Slavik et al [13] to determine and understand the risk management strategies on the tweets includes six exclusive coding variables: corrective, risk, efficacy, concern, uncertainty, and experts. Tweets were classified as ''corrective'' if the tweets were amended to remove incorrect information about the COVID-19 pandemic or aimed to control misinformation spread. Tweets were classified as ''risk'' if they included

information helping the reader to make a judgment about the risk of contracting COVID-19 or experiencing health complications due to COVID-19. Moreover, the tweet category “risk” includes tweets containing information on absolute risks, relative risks and high-risk population identification. The tweets under the “efficacy” category refer to the ability of an individual or community to execute an action or activity, successfully resulting in some tangible benefit to health or a reduction of harm related to COVID-19. Tweets acknowledging the fears, concerns, worries, or anxiety associated with the COVID-19 pandemic were classified as “concern”. Tweets were classified as ‘’experts’’ if they directly or indirectly mentioned some agreement, coordination or collaboration between individuals, public health experts and/or other credible health organizations.

2.3 Government social media and COVID-19

Social media play a significant role in connecting people and providing an update on the latest news about COVID-19. Social media empowered the citizens in addressing social issues to a great extent during the lockdown period due to the COVID-19 pandemic [10]. The primary medium used by the governments to spread information and provide awareness about COVID-19 was social media platforms. Research studies prove that the use of social media in crisis time is an accurate decision to minimize losses and reach the majority of citizens. Government organizations use social media to update and share accurate information about the general public's critical conditions within a minimum time which is the primary importance responsibility to minimize losses [10]. During the COVID-19 crisis management, government social media platforms became the major source for communicating important information to all main stakeholders such as community citizens, hospital staff, government officials, and non-governmental associations, which even helped to minimize the loss and reduce anxiety and confusion [9,10]. Government organizations have noticeably activated their social accounts during the COVID-19 to manage the risk, update news and reports, control rumours and distribute donations among the affected citizens. For several countries, governmental social media accounts enhanced the publicity of government affairs and became a new channel serving the population. In crisis management, especially during a public health crisis, every single piece of information become valid to stakeholders [27].

According to Broniatowski et al. [28], significant attention has been dedicated to deciding the reliability of the information provided on social media platforms regarding the COVID-19

pandemic. Furthermore, in health crisis management, there is a high probability of conveying misinformation to the citizens about the illness, vaccines, and political situation, and there are no particular reasons behind that. Research on governmental social media platforms found that even though there is a vast amount of information available about COVID-19, it was difficult to rate the reliability of the source of information. It was also observed that there is an increase in the percentage of local government-sponsored propaganda among the non-credible or less credible sources suggesting that COVID-19 may also be used for political purposes and advantages. However, the research studies highlighted that government around the world effectively uses social media platforms to disseminate information to citizens and the international public. Social media acts as a bridge between governments and citizens in disseminating timely information in fighting the pandemic. Thus, social media is a blessing for the world during the Covid19 outbreak, when social media platforms support governmental organizations and the World Health Organization (WHO) to keep updating citizens about rumours and misinformation [10].

The dynamics of the COVID-19 pandemic often require quick responses and fast decision making which are very similar to the handling of public health crises [9]. Studies have proved that citizen e-participation through government social media platforms is a new form of democratization, enabling citizens to participate in the decision-making process related to the development of their local governments and communities. In crisis management, citizen involvement in decision-making reduces the risk, controls misinformation and obtains the normal life of communities [9]. The increase of public engagement in governmental social media enables the citizens to engage in the decision-making process through sharing ideas, feedback, and complaints on policy implementation and provision of government services [14].

According to public administration research, a primary concern for the local government is the citizen's trust and worldwide government officials are constantly worried about its decline and continually working to gain their citizens' trust [10]. The higher trust in local government is positively correlated to public engagement [29]. In addition, there are factors affecting government trust e.g., perception of government institutes' transparency, citizen's socio-psychological features, and achievements of the government. Government institution trust is an important determinant in calming down the public during a crisis. However, the research studies highlighted the relationship between citizens' trust in government on civic engagement through government social media accounts (GSMAs) during COVID-19. The trust in government moderates the relationship between citizen participation in GSMAs and online

civic management, such that the higher the trust, the stronger the relationship and vice versa. The researchers found that governments and crisis management cells used GSMAs to reach citizens and gain high trust and engagement. The trust in government has positively translated through citizens' civic behaviour during COVID-19. For example, governments were successful in providing awareness to the citizens on the importance of social distancing, wearing masks, washing hands, and strictly following the government instructions and rules from time to time [10, 30, 31].

3. Methodology and Data

3.1 Data Collection

The data for this study was collected from the "Ministry of Health" Twitter account. The tweets were extracted for the period, 23rd August 2019 to 24th August 2020, resulting in a total of 2,945 posts. Oman reported its first COVID-19 case on 24th February 2020. Thus, using this as a mid-point period, the tweets before and during the pandemic are collected for six months each. During the pandemic period (24th February to 24th August 2020), there were a total of 2017 posts. Before the pandemic, 928 tweets were published by the MoH. For each tweet information was captured on text content, number of likes, number of reposts, and number of comments. Also, the URLs of the pictures and videos uploaded were captured to help determine the media type.

3.2 Inter-coder reliability and data analysis

This study employed two undergraduate students to code the tweets which were mostly in Arabic. The students were given the training to familiarise themselves with the coding norms. To ensure the inter-reliability, 15% of sample tweets were randomly and independently coded. The Kappa value for the categories was above 0.90. The results confirmed high inter-reliabilities and thus were acceptable.

3.3 Coding

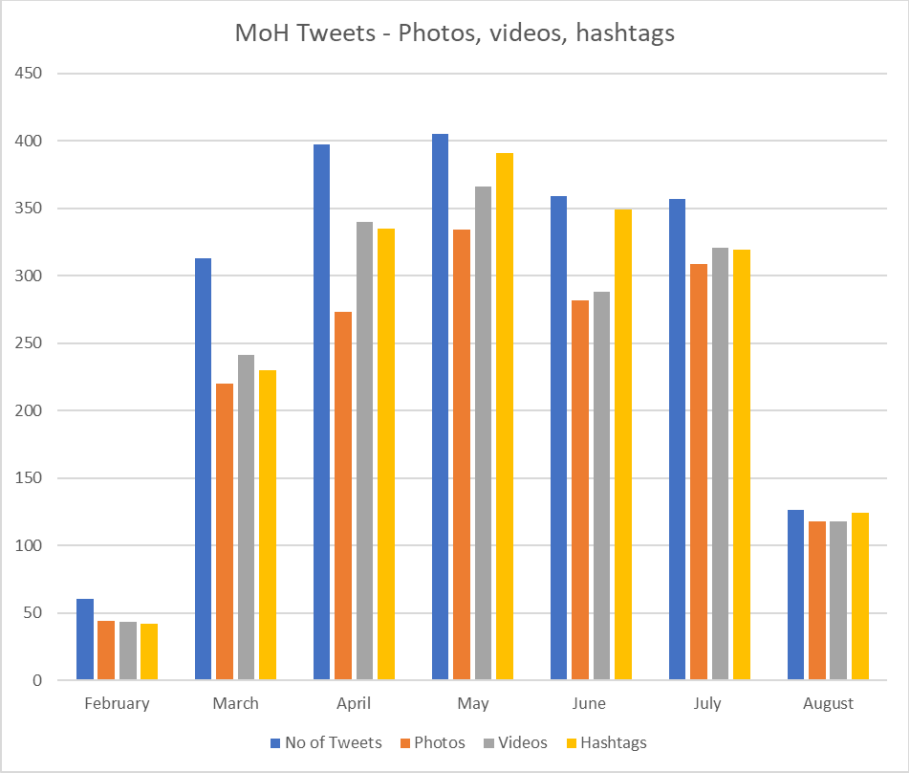
The tweets were coded for two major categories, communication, and risk management strategy. All the tweets published after the first reported case of COVID-19 were coded for three communication strategies adopted by Gorska et al. [9]: Business as usual (Usual), We are great! Just observe (Great) and We are in this together (Together). This was similar to Mergel's [32] communication strategy whereby the usual strategy was similar to pull; the great strategy was closer to push, and together was similar to networking. The tweets which were specific to

Covid-related information were coded for risk management strategy. There were 6 nonmutually exclusive coding variables: corrective, risk, efficacy, concern, uncertainty and experts.

4. Results and Discussion

Figure 1 presents the usage of the media-rich tools in the first six months after the announcement of COVID-19 cases in the Sultanate of Oman. A total of 2017 tweets were posted in the six months after the first case of COVID-19 was detected in the Sultanate of Oman. The tweets published were consistent across the months. May was the highest usage of photos, videos or hashtags in comparison to the other months. The usage of photos across the months ranged from 11 to 17%. This similar usage was noticed for videos and hashtags as well in the tweets.

Figure 1: Month-wise tweets engagement using media-rich tools during COVID-19

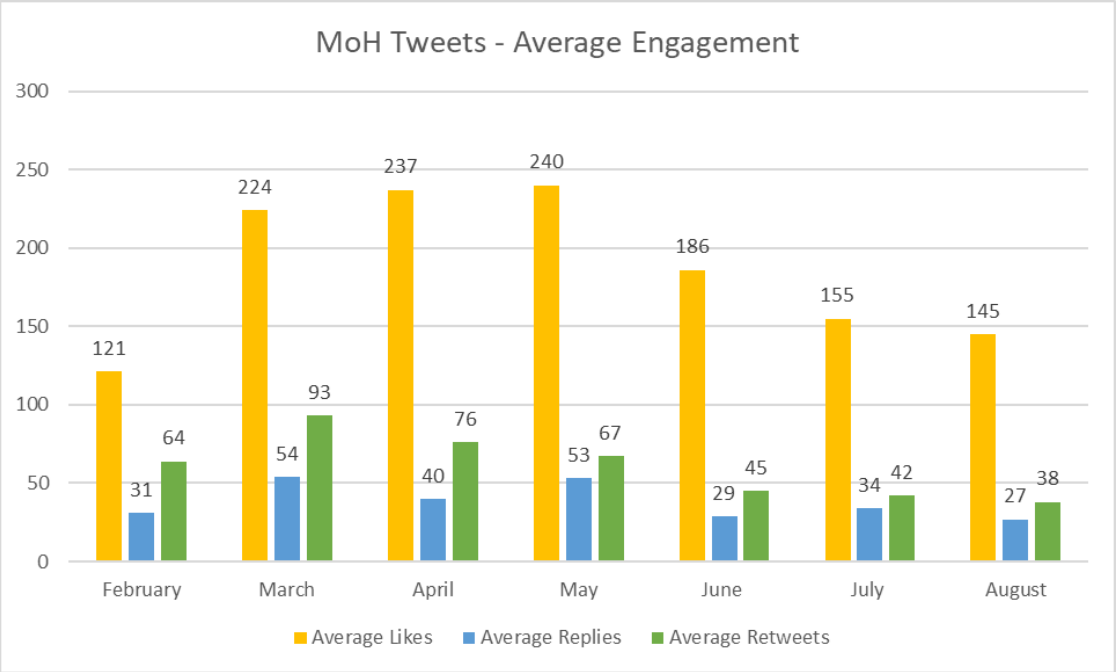


Source: Authors

Figure 2 presents a graphical overview of the citizen engagement that was evoked through the tweets during the pandemic. The initial few months (March to May 2020) saw an average of 12% likes for the tweets. The replies and retweets were considerably less. This analysis

highlights the limitations in the engagement of the citizens with the Twitter handle of MOH. While the news of the pandemic was fairly new and with a lot of unknowns, citizen engagement did not see a similar response.

Figure 2: Month-wise tweets citizen engagement during COVID-19



Source: Authors

Table 2 presents the descriptive statistics of COVID-19-related tweets specifically. The 2017 tweets over six months during the pandemic had a mix of related and non-related COVID-19 tweets. Using content analysis, the COVID-19-related tweets were specifically identified and coded for the different communications strategies of: "Business as usual", “We are great just observer”, and “We are in this together”. These three strategies reflected Mergel’s [32] push, pull and networking strategies respectively. A total of 1722 COVID-19-related tweets were identified in 2017 which reflects an emphasis of 85% on the pandemic. The communication statistics adopted by the MOH was about 70% on “We are great just observe”. This strategy reflected the MOHs push strategy. This is a consistent approach that resonates with the social media usage of the Royal Oman Police in Oman [6]. Poland's government in comparison focused more on the push strategy. It may be argued that while MOH is a government-owned institution, it wanted to build more confidence in its citizens during the pandemic by adopting

a push strategy and showcasing the efforts in dealing with the same. The highest average likes were given for the "We are great just observe" strategy followed by tweets related to "Business as usual". This suggests that the citizen was also expecting to receive such forms of communication. The average retweets were highest when the tweets were in the category of "We are in this together".

Table 2: Descriptive statistics of COVID-19-related tweets with different communication strategies

	Business as Usual			We are great just observe			We are in this together		
Variable	Obs	Mean	Max	Obs	Mean	Max	Obs	Mean	Max
nlikes	91	190.35	1845	1212	212.73	2654	419	182.45	1731
nreplies	91	20.1	313	1212	54.5	1603	419	21.95	487
nretweets	91	48.96	644	1212	63.37	695	419	71.29	1255
photos	91	0.76	1	1212	0.79	1	419	0.74	1
video	91	0.82	1	1212	0.84	1	419	0.87	1
hashtags	91	0.91	1	1212	0.91	1	419	0.97	1

Table 3 presents the risk management strategies adopted in its tweets related to the pandemic. Most of the tweets were either adopting risk communication strategies or varying between efficacy and corrective strategies. As this was an early stage in the pandemic, it was expected that the government would communicate the risk related to COVID-19. This attracted the highest average engagement in terms of likes, replies and retweets. Concerns related to the pandemic were followed with the next highest engagement with the public. The use of hashtags was more predominant for efficacy or expert-related risk communication strategies. Retweets were lowest for tweets that communicated some form of uncertainty which also reflected citizen responsibility.

Table 3: Descriptive statistics of COVID-19-related tweets with different risk strategies

	Corrective			Risk			Efficacy		
Variable	Obs	Mean	Max	Obs	Mean	Max	Obs	Mean	Max
nlikes	201	160.04	1104	964	229.48	2654	378	172.27	1096
nreplies	201	19.96	448	964	64.04	1603	378	18.96	253
nretweets	201	67.36	581	964	68.75	695	378	58.61	553
photos	201	0.74	1	964	0.84	1	378	0.7	1
video	201	0.81	1	964	0.89	1	378	0.83	1
hashtags	201	0.87	1	964	0.93	1	378	0.95	1

Table 3: Contd...

	Concern			Uncertain			Expert		
Variable	Obs	Mean	Max	Obs	Mean	Max	Obs	Mean	Max
nlikes	91	202.54	1731	36	129.33	585	52	192.6	1096
nreplies	91	29.29	487	36	13.28	129	52	19.77	216
nretweets	91	61.98	1255	36	32.83	175	52	45.13	280
photos	91	0.51	1	36	0.72	1	52	0.81	1
video	91	0.6	1	36	0.78	1	52	0.85	1
hashtags	91	0.89	1	36	0.78	1	52	0.96	1

Table 4 presents Pearson's correlation between the communication strategies, citizen engagement and media richness tool. The push strategy represented by "Business as Usual" is significantly and positively correlated to the usage of hashtags. The "We are great just observe" communication strategy is significantly and negatively related to all the citizen engagement representatives and media richness tools. This suggests that as the MOH tweeted more from a push strategy perspective the citizen engagement reduced. Additionally, increased usage of this strategy led to less use of photos and videos. The networking strategy of “We are in this together” is as per expectation significantly and positively related to the citizen engagement expressed through the number of likes.

Table 4: Correlation of communication strategies with citizen engagement and media richness tools

Variables	Business as Usual	We are great just observe	We are in this together
nlikes	0.03	-0.082***	0.119**
nreplies	-0.02	-0.100***	0.04
nretweets	-0.08	-0.121***	0.05
photos	0.14	-0.160***	-0.05
video	0.1	-0.142***	-0.02
hashtags	0.296***	-0.03	-0.01

**** p<0.01, ** p<0.05, * p<0.1*

Table 5 presents the correlation between the risk management strategies, citizen engagement and media richness tools. None of the risk communication strategies was significantly related to citizen engagement except for “concern”. This as per expectation evoked a smaller number of likes as the tweets focused more on concern-related communication. Efficacy and concern were significantly and positively related to the usage of photos. The usage of videos and hashtags reduced with the increase in tweets related to risks.

Table 5: Correlation of risk management strategies with citizen engagement and media richness tools

Variables	Corrective	Risk	Efficacy	Concern	Uncertain	Expert
nlikes	-0.04	-0.01	-0.01	-0.187*	-0.06	-0.08
nreplies	-0.02	-0.04	0.07	-0.14	0.07	-0.12
nretweets	-0.07	-0.02	-0.04	-0.13	-0.07	-0.11
photos	0.05	-0.063*	0.141***	0.177*	0.2	-0.283**
video	0.05	-0.068**	0.04	0.232**	0.25	-0.22
hashtags	0.140**	-0.091***	0.02	0.08	0.296*	-0.04

**** p<0.01, ** p<0.05, * p<0.1*

5. Conclusion

This study examined the tweets posted by the Ministry of Health during the early period of the pandemic from 24th February to 24th August 2022. The tweets were analysed to identify the prominent communication strategy adopted by the MOH and how it is associated with citizen engagement and media richness tools. The study concluded that MOH adopted the push strategy of communication in the early crisis stages. Similarly, during the early stages, the MOH tweets were also classified for risk management communication techniques. The MOH tweets were predominantly on communicating the risks related to the pandemic.

This study offers some useful practical implications for the MOH Twitter account management. There can be a clearer understanding of the crisis management cycle. As the MOH adopted heavily the push strategy through its tweets, it would be a good initiative to engage equally in a networking strategy. This would enhance citizen engagement and in times of crisis ease compliance with the government initiatives. As suggested by Soyata et al. (33), effective government communication during times of crisis especially at an early stage would protect and ensure citizen safety.

The research suffers from certain limitations. The study focused exclusively on the Twitter account of the MOH of Oman. Though the study can be generalised to other Twitter accounts of other governmental agencies within Oman, future research can cover more Twitter accounts to have wider applicability to the GCC region. Citizen engagement is measured in terms of likes, retweets or replies but combined their usage may be put to a different use. The tone of the tweets was not examined in this research and thus it can be taken up for future study.

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