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Identifying #addiction concerns on twitter during the COVID-19 pandemic: A text mining analysis

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ABSTRACT

Background: The 2019 Novel Coronavirus (COVID-19) is responsible for thousands of deaths and hospitalizations. To curb the spread of this highly transmissible disease, governments enacted protective guidelines for its citizens, including social distancing and stay-at-home orders. These restrictions on social interactions can be especially problematic for individuals managing or recovering from addiction given that treatment often involves access to services and resources that became limited or even unavailable at this time. Social media sites like Twitter serve as a space for users to post questions and concerns about timely topics and allow for researchers to track common themes among the public. The goal of this study was to identify how the public was discussing addiction on Twitter during the COVID pandemic.

Methods: We performed a text mining analysis to analyze tweets that contained "addiction" and "covid" to capture posts from the public that illustrated comments and concerns about addiction during the COVID-19 pandemic. We report on 3,301 tweets captured between January 31 and April 23, 2020. The study was conducted in the United States, but contained tweets from multiple countries.

Results: The most prevalent topics had to do with services offered by Acadia Healthcare and Serenity Healthcare Centers, attempts to manage time while home, difficulties of coping with alcoholism amidst rising sales of alcohol, and attention to ongoing health crises (e.g., opioids, vaping). Additional topics included affordable telehealth services, research from France on the relationship between nicotine and COVID-19, concerns about gambling addiction, and changing patterns in substance misuse as drug availability varies.

Conclusions: Analyzing Twitter content enables health professionals to identify the public's concerns about addiction during the COVID-19 pandemic. Findings from text mining studies addressing timely health topics can serve as preliminary analyses for building more comprehensive models, which can then be used to generate recommendations for the larger public and inform policy.

KEYWORDS

Addiction; COVID-19; text mining analysis; social media; health communication

INTRODUCTION

In December 2019, a cluster of pneumonia cases in Wuhan, China was reported to the World Health Organization (WHO) that would eventually lead to the outbreak of an emerging disease spread throughout the rest of the world in a matter of months, causing thousands of deaths, hospitalizations, and severe economic collapses. The 2019 Novel Coronavirus (COVID-19) was first identified outside of China on January 13, 2020, declared a Public Health Emergency of International Concern by the WHO on January 30, 2020, and declared a pandemic on March 11, 2020. Throughout the spring and summer months of 2020, COVID-19 continued to spread throughout the world leaving behind a trail of destruction. As governments and health organizations scrambled to enact protective guidelines and recommendations for its citizens in an effort to curb the spread, the public took to social media to voice their questions, concerns, and anxieties.

Fighting addiction during a pandemic

Social distancing guidelines and stay-at-home orders enacted by governments across the globe meant that individuals
were encouraged to avoid contact with others and not leave their homes unless it was essential. In the United States, large gatherings were prohibited, non-essential businesses were closed, and people were asked to maintain at least six feet of space from one another in some states.4 The social distancing measures in place meant that people coping with addiction were prevented from attending group counseling sessions, meeting with therapists or other care providers in-person, and engaging in physical activities with other members of their communities.

The impact of social distancing on vulnerable populations
Social distancing forced people to the confines of their homes for an extended amount of time and in some cases, had little contact with the outside world. Many individuals afflicted with addiction struggle with isolating behaviors at baseline, which may have contributed to their addictions in the first place.5 This population is now at an increased risk of relapsing or in some cases, worsening their addiction by exploring other risky behaviors and avenues during these difficult times (e.g., experimenting with unfamiliar illicit drugs, spending more time gambling online).6,7

It is also important to note that addictive behaviors take on many forms, and those involving the use of cigarettes, vaping, marijuana, methamphetamine, and opioids can cause harm to the respiratory system, making these individuals more susceptible to developing a respiratory infection, such as COVID-19.5,9 Furthermore, according to the National Institute on Drug Abuse (NIDA), individuals with substance use disorder are more likely to experience homelessness or incarceration, putting them at an increased risk of contracting and transmitting severe infectious diseases such as COVID-19, HIV, and viral hepatitis.10 During this period of social distancing, alcohol sales increased,11 online gambling became more prevalent,12 and registrations for medical marijuana rose.13 Additionally, the unemployment rate in the United States soared during this period, leaving millions of Americans to grapple with the burden of job insecurity and facing an uncertain future. This created a dangerous landscape for individuals struggling with or recovering from addiction. Given the firestorm of factors brought on by the COVID-19 pandemic that can exacerbate attempts to cope with addiction, it is critical for public health officials and practitioners to identify concerns about addiction raised by the public.

Health messaging and crisis communication
Multiple messaging frameworks have been applied to understand how the public communicates during a health crisis, yet attempts to communicate with the public during these crises often fail to adhere to best practices because of inconsistent messaging or a lack of public trust.14–16 Effective messaging is critical for mitigating panic and stopping the spread of misinformation.17–18 The ubiquity and rapid advancement of new communication technologies allow for the exchange of information in real-time and can facilitate emergency-management efforts.19 Organizations like the Centers for Disease Control and Prevention (CDC) have used social media to host question-and-answer sessions to address concerns about Ebola and the Zika virus.20–21 Recently, CNN hosted a series of global town halls with the help of Facebook and Instagram to provide the public with information about COVID-19 from a panel of experts.22 Health information needs to be delivered in a timely manner, audience-centered and targeted based on group- and individual-level characteristics, and transmitted over media used by the intended recipients.23 Although it is not always possible to implement all of these health communication components (especially in the face of a new and poorly understood health threat like COVID-19), identifying the points of discussion generated by the public can help communication specialists and public health professionals disseminate effective messaging strategies.

Conversations about health on social media
To communicate with large audiences during an ongoing health crisis, individuals and organizations may turn to social media sites like Twitter, which can serve as a space for users to post questions and concerns about timely topics and allow for researchers to track common themes among the public.24 Text mining analyses have been used to understand the public’s reactions to a variety of critical health topics including the opioid epidemic,25 foodborne E. coli outbreaks,26 the Zika virus,27 the Ebola virus,28 and electronic cigarette regulations.29 Analyzing Twitter content not only enables public health professionals to identify the public’s concerns to these health threats, but allows for the identification of top influencers and information sources, as well.30,31 This is beneficial during times of uncertainty and a rapidly changing information environment, as is the case during the COVID-19 pandemic.

Study goals
Given the utility of Twitter as a platform for capturing reactions to health threats, the goal of this study is to examine how the global public was discussing addiction on Twitter during a phase of the COVID pandemic by identifying the most prevalent emerging topics associated with tweets about COVID and addiction. To address this, we analyzed tweets that contained #addiction and #covid in an effort to capture posts from the global public that illustrated questions, comments, or concerns about addiction during the COVID-19 pandemic. In this study, we report on 3,301 tweets captured between January 31 and April 23, 2020 containing both of the hashtags “covid” and “addiction.” This allowed us to capture a broad array of tweets during the peak of the pandemic in an effort to identify how Twitter users were talking about COVID-19 in combination with addiction.

Methods
Data acquisition and definitions
A text analytic process was used to identify topics and extract meanings contained in unstructured textual data.
Social mentions were collected using NUVI software. The term “textual analytics” has developed over time to encompass techniques including data mining, machine learning, natural language processing, and information seeking. Essentially, text mining analyses are used to make sense of unstructured text by identifying patterns and emerging topics within these larger sets of textual data. “Social mentions” refers to each occurrence or time a specific topic is referenced online via a social media channel. “NUVI software” is a (software as a service) platform that gathers social media channel conversations in real time to enable organizations and researchers to view, respond, and/or engage with relevant comments/posts. “Monitor creation” involves the human process of selecting specific query terms, determining a time period, and choosing which social media channels to use for the topic of interest. “Robotic messages” describe “an agent that communicates more or less autonomously on social media, often with the task of influencing the course of discussion and/or the opinions of its readers.” “Topic modeling” is a “type of statistical modeling for discovering the abstract ‘topics’ that occur in a collection of documents.”

Because our focus was on conversations surrounding COVID and addiction, a monitor was created that included both words. In other words, for the messages to be included in the analysis, both of the words – COVID and addiction – must have appeared in the same message. Social mentions were captured during a period of January 31, 2020 through April 23, 2020 and included 11,289 global Twitter messages. The majority of the tweets came from the United States, but tweets from other countries including Canada, the United Kingdom, France, and Australia were also captured in the analysis. Given that “research involving publicly available data does not require Institutional Review Board (IRB) review” and all of the data used in this study are publicly available from Twitter, IRB approval was not obtained.

To understand further conversations taking place among Twitter users on the COVID/addiction topic, duplicate tweets (retweets) and robotic (bots) messages were removed prior to the topic modeling. A Python script written to remove retweets and robotic messages was used and resulted in a total of 5,459 mentions. Doing so allowed the researchers to extract messages that may tend to amplify certain viewpoints or distort the public conversations. Mentions were then analyzed separately using text-mining software, SAS Text Miner 15.1. SAS employs a series of algorithms that select words that are used together frequently to build the topic groups. In this instance, the program identified 14 topic groups using 3,301 messages (described in Table 1).

**Text analytics**

SAS Text Miner provides the ability to parse and extract information from text, filter and store the information, and assemble tweets into related topics for introspection and insights from the unstructured data. After the unstructured data was cleaned using the Python script, the initial step in Text Miner was to extract and create a dictionary of words using a natural language processor (NLP). Using the Text Parsing node, each message was divided into individual words. These words were listed in a frequency matrix and words that contributed little to the understanding of the topic such as auxiliary verbs, conjunctions, determiners, interjections, participles, prepositions, and pronouns, were excluded from the analysis.

Following, a Text Filter node was used to exclude words that appeared in less than four messages, as a conservative measure to reduce noise. A single author with knowledge of the subject matter visually inspected and manually removed unrecognizable terms (e.g., emojis, etc.). The words initially included (and excluded) in the analysis were visually inspected to ensure accuracy and identify unrecognizable symbols and letter groups for exclusion. The parsing process handled by the software involves sorting all of the words into separate terms and assigning a numerical identifier to them. Words that are not essential (“of”, “and”, “but”) are removed. After the software completes this process, the filter feature allows the researcher to review the output and remove unrecognizable characters and/or strings of letters. A single reviewer (the second author) followed a systematic process to maintain objectivity. This same process has been used in multiple studies examining public reactions to health crises on social media.

With the inclusion criteria set, the Text Topic node was used to combine terms into topic groups. This clustering divided the document collection into groups based on the presence of similar themes using expectation maximization (EM) clustering. After visually examining each of the created topics, a 14-topic solution most clearly illustrated the main themes. Lastly, the researchers reviewed the individual messages of the final topic groups to interpret the final themes. This was accomplished by individually reviewing the actual messages from each cluster or topic to arrive at the description that appears in Table 1. Figure 1 depicts an overview of these topics.

**Results**

Globally, approximately 31% of the mentions originated in the United States, 5% in Canada, and 4% in the United Kingdom, less than 1% in France and Australia. Within the U.S. 12% of the messages originated from New York, 11% from California, 7% from Texas and less than 1% from Ohio and Massachusetts.

Fourteen mutually exclusive topics emerged from the public’s tweets. Tweets contained both “covid” and “addiction” during January 31, 2020 through April 23, 2020. The majority of the tweets addressed the following topics: services provided by Acadia Healthcare including its newly established behavioral health crisis hotline and how multiple countries were responding to unemployment rates; self-care at home and finding activities to alleviate anxiety; difficulties of coping with alcoholism while social distancing; increased sales in alcohol; losing sight of public health epidemics like the opioid crisis and vaping; affordable telehealth services and insurance coverage; questions about outdoor activities
Table 1. Topics and descriptions – January 31–April 23, 2020.

<table>
<thead>
<tr>
<th>Topic ID</th>
<th>Topic Description</th>
<th>No. of tweets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acadia, stockholder, meeting, annual, business</td>
<td>621</td>
</tr>
<tr>
<td>2</td>
<td>Thing, feel</td>
<td>563</td>
</tr>
<tr>
<td>3</td>
<td>Alcohol, withdrawal, lockdown, drink</td>
<td>417</td>
</tr>
<tr>
<td>4</td>
<td>Opioid, vaping, lung, epidemic, covid</td>
<td>393</td>
</tr>
<tr>
<td>5</td>
<td>Health, health insurance, affordable, telehealth service, furlough</td>
<td>242</td>
</tr>
<tr>
<td>6</td>
<td>Storytellers, story, marcus, beach</td>
<td>227</td>
</tr>
<tr>
<td>7</td>
<td>France, nicotine, smoke, smoker, research</td>
<td>222</td>
</tr>
<tr>
<td>8</td>
<td>AAC, labs, center, treatment, test</td>
<td>178</td>
</tr>
<tr>
<td>9</td>
<td>Gamble, brendan, dom, fevola, gambling addiction</td>
<td>175</td>
</tr>
<tr>
<td>10</td>
<td>Serenity, centers, update, addiction, safety</td>
<td>156</td>
</tr>
<tr>
<td>11</td>
<td>Ultra-orthodox, internet, israel, jew, bezeq</td>
<td>51</td>
</tr>
<tr>
<td>12</td>
<td>Vaccine, evans, advance team</td>
<td>22</td>
</tr>
<tr>
<td>13</td>
<td>District cases, details, awaited, Pradesh, nagar</td>
<td>21</td>
</tr>
<tr>
<td>14</td>
<td>Cocaine, cartel, price, border, peru</td>
<td>13</td>
</tr>
</tbody>
</table>

Information about Acadia Healthcare’s Annual Meeting and Acadia’s new behavioral health crisis hotline to connect users with treatment channels, number of cases and death rates around the world, economic responses from countries in North and South America and the European Union, research being conducted on vaccines

Stories about individual suffering, the importance of self-care and managing depression and anxiety, benefits of gaming and watching television while staying at home, concerns about health care workers dying from exposure to COVID-19

Difficulty of coping with alcoholism while staying at home, lack of access to de-addiction services like Alcoholics Anonymous, social media users posting images of drinking, mentions rising alcohol sales and concerns about alcoholism in Germany, Iran, South Africa, the United States

Losing sight of other public health issues like opioid overdoses and vaping epidemic, debate about dangers of being a smoker and susceptibility to COVID

Accessing telehealth services for addiction and mental health care, providing affordable health insurance for furloughed employees

Questions about beaches/pools opening and social distancing as weather warms in California, stories about what people are doing at home, unemployment rates in the United States

Research in France on nicotine preventing the virus from entering cells, nicotine patches as a potential treatment for the hospitalized, COVID cases in France

American Addiction Centers (AAC) testing admitted patients, patients seeking addiction treatment during COVID, challenge of social distancing for those with substance use disorders, organizations like Silver Linings Recovery Center, Mountain Peak Recovery, and Meridian to provide services for drug and gambling addictions

Alliance for Gambling Reform criticizing public figures for promoting online poker games, concerns about gambling addiction, increased online presence of organizations like the Sports Betting Community, video games as a positive outlet for those stuck at home, opportunities for gamblers to take a break from gambling since casinos are closed

Links to the United Kingdom’s Serenity Addiction Centers (substance abuse and behavioral mental health networks)

Changing internet and media use habits among Israel’s Ultra-Orthodox Jewish communities, importance of accessing the internet for timely updates and for working at home, the European Union’s economic response, addressing COVID-19 in the prison system in Alabama

University of Montana researching a COVID-19 vaccine with funding from the National Institutes of Health

Research from France suggests nicotine might help protect people against COVID-19

Concerns about Peru’s cocoa farmers, regulating legal market, changes in availability of drugs, people changing the kinds of drugs they use

and social distancing; and research from France showing the potential benefits of nicotine for decreasing susceptibility to COVID-19.

Additional topics referred to how multiple organizations treating individuals with substance use disorders were attempting to reach out and provide services to these populations, concerns about gambling addiction and the increased availability of online poker games, increases in time spent using the internet and playing online games within certain communities (e.g., ultra-Orthodox Jewish), and changing patterns in substance misuse as drug availability varies.

Discussion

Social media sites like Twitter can provide insight into the public’s comments and concerns about addiction during the COVID-19 pandemic. These types of text mining studies on timely health topics serve as preliminary analyses for building larger, more comprehensive models that can be used to generate recommendations for the larger public and inform policy.25,36 Our findings suggest that Twitter can serve as a useful outlet for disseminating information about addiction treatment services and as a platform for users to be candid about their struggles. Addiction treatment and behavioral health care leaders can serve as advocates and use their platforms to reach large audiences, through multiple social media platforms and interactive forums. The following sections further contextualize the study’s findings by reviewing how these emerging topics fit within the larger discussion of COVID-19 and addiction.

Primary topics- treatment options and affordable services, depression, multiple types of addiction

The five most prevalent topics had to do with providing alternative forms of treatment channels (e.g., crisis hotlines), ensuring that telehealth services are covered under...
health insurance, coping with alcoholism during lockdown, and recognizing ongoing epidemics (i.e., opioid use and vaping). Behavioral treatment facilities like Acadia Healthcare (mentioned in the tweets corresponding with the first topic) play a crucial role in delivering services to individuals coping with addiction and have faced unique challenges to providing these services during the COVID-19 pandemic, which include providing remote access and telehealth services, ensuring those who need care seek out resources in times of social distancing, and adhering to recommended guidelines from the CDC and WHO. Tweets about alternative treatment services mentioned counseling sessions over video conferencing platforms and specialty service hotlines, as well as calls for affordable and accessible telehealth services for those who became unemployed. There were also tweets describing coping with depression and the importance of self care. On its website, Acadia Healthcare suggests that individuals can protect their mental well-being by limiting news intake, paying attention to sources of information, and using video calling platforms to stay connected with others. The latter of these suggestions points to a recurring theme throughout multiple topics- the debate about the use of technology and media during in times of social distancing. For instance, the WHO supported the #PlayApartTogether initiative, which promoted the idea of keeping one’s self entertained with video games, even though the WHO had labeled video game addiction as a mental health disorder in 2019. From a health messaging perspective, this contradiction makes it difficult to know who to listen to and what recommendations to trust during a health emergency. Similarly, just as social media can provide a sense of connection, some of the tweets described the difficulty of seeing posts and pictures of drinking on social media while attempting to manage alcohol consumption. Finally, one of the most prevalent topics had to do with how other public health crises like vaping and the opioid epidemic had fallen to the background, even though they are contributing to an over-burdened health care system. This suggests that resources and channels of communication still need to remain available for those dealing with addiction.

Secondary topics- nicotine use, addiction centers, vaccine research, sociocultural practices

Additional emerging topics had to do with conflicting information on the relationship between nicotine use and susceptibility to COVID-19, resources for individuals managing addictions, the promotion of sports betting, technology use among religious communities, and vaccine research. Some of these points that users raised had to do with how certain groups and communities were managing the impact of COVID, including economic recovery efforts made in the European Union, regulations of Peru’s coca market, COVID-19 rates within the Alabama prison system, and increases in online shopping and video conferencing among

Figure 1. Overview of Topics: In clockwise fashion, most frequently mentioned topics that were included in tweets with both #COVID and #Addiction. (AAC = American Addiction Centers). Larger circles are indicative of a larger number of tweets associated with the topic.
ultra-Orthodox Jewish communities in Israel ("Bezeq" referring to an Israeli telecommunications company). The tweets about COVID-19 in the prison system and changing internet behaviors among this religious group point to larger challenges that need to be addressed when communicating with the public about health threats; namely, advocating for vulnerable populations and tailoring messages based on religious and cultural practices. For example, Israel struggled to keep coronavirus rates down within Orthodox Jewish communities due to the continued participation in large gatherings, tension between religious and government leaders, and a lack of smartphone use and television consumption. This illustrates the need for community leaders, medical and public health experts, and communication professionals to work together in an effort to design messages that are sensitive to cultural customs. Finally, tweets regarding vaccine developments can go unheeded if messages do not resonate with the audience. 

Future directions for research—problem gambling, telehealth counseling, misinformation

Future studies on discussions about COVID-19 in social media would benefit from delving into three areas: the potential for gambling addiction with increased access to online betting, opportunities for providing counseling and group sessions through telehealth, and the identification of misinformation from unreliable sources. Problem gambling (and time spent online more broadly) is an important topic for public health officials to track as the risk for gambling addiction has become a widespread health threat that continues to rise, especially with the increased availability of online gambling games. Tweets captured in this study represented two sides of the video/online gaming argument. On one hand, some Twitter users expressed concern about the increased prevalence of online poker games (promoted by public figures like Brendan Fevola, Dom Thomas, and the Sports Betting Community) but on the other hand, some users suggested that online and video games serve as an outlet for people who are forced to remain at home. Stay-at-home orders might also provide a beneficial break for those who are unable to go to the casinos and/or place sports bets in-person. Given all of this, it is important to note that not all forms of addiction appear malignant at the surface or are easily identifiable (e.g., internet addiction). Similarly, there have been increases in screen time during stay-at-home orders meaning more time spent playing video and online games and posting on social media, which can develop into problematic behaviors, but can also serve as a necessary outlet.

Although these findings are descriptive rather than prescriptive, they have the potential to serve as a springboard for understanding how stay-at-home orders can intensify an existing problematic behavior by creating new addictive behaviors (e.g., online gaming, betting) used for passing the time or self-medicating. Going forward, it will be imperative for healthcare providers to take thorough social and psychiatric histories from their patients managing or in recovery from addiction, and to avoid rushing through previously entered, auto-filled patient data. Lifestyles will change drastically from the pandemic because of disrupted routines and limited access to critical resources for those managing addiction. It will be crucial for healthcare providers to continue diversifying their interdisciplinary teams (counselors, therapists, social workers, etc.) and to rely upon an integrative approach involving multiple specialists in order to provide adequate care for these vulnerable populations. Further, there are new telehealth frontiers to explore as virtual meetings and counseling sessions continue to gain traction.

The tweets in this study captured conversations about addiction during COVID-19 in multiple countries. Social media data allows researchers to capture a multi-national perspective, which is especially insightful during times of a global pandemic. For example, research from France on the preventive effects of nicotine was mentioned multiple times. This also suggests that Twitter can be useful for identifying opportunities for misinformation like that nicotine patches may be a way to buffer the effects of coronavirus and that smokers may be less susceptible to COVID-19. There has been a lot of misinformation during the COVID-19 pandemic as multiple conspiracy theories make their way through social media. Identifying misinformation can be just as useful as identifying accurate information because it gives health professionals the opportunity to counter false information with facts.

Limitations and conclusion

This study is limited in that it only includes Twitter data. Future studies could build on this work by extending the timeline to capture tweets after the peak of the pandemic, and by identifying accounts from top Twitter influencers and/or expert health organizations like the World Health Organization and Centers for Disease Control and Prevention to make comparisons between health experts and the public in their discussions about addiction. Future studies should also monitor increases in sedentary behavior and problem gambling as a result of the pandemic. An additional limitation to consider is that a single author sorted tweets and another author reviewed the clusters for emerging topics. Future studies could expand on this by including external reviewers or auditors to enhance the reliability of this process. Additionally, the text mining analytic method used in this study and in past work is not typically grounded in a theoretical context.

Future work could benefit from using this method as a tool for applying theories in novel ways, especially those that address health messaging and crisis communication. As noted in a previous section, health communication plays a critical role in crisis management, but recommendations can go unheeded if messages do not resonate with their audiences. Communication specialists and medical experts need to work together to identify and respond to...
salient topics of concern among at risk groups, such as those coping with or recovering from addiction. The current findings provide a steppingstone for gauging the public’s discussion about COVID-19 and addiction. This can help addiction counselors, public health officials, and policymakers gain insight into how people are attempting to cope with addiction and recovery during these unprecedented times, what questions and concerns they have, and what resources and services need to be made available.

Disclosure statement
No conflict declared

Author’s contributions
E. Glowacki developed the idea for this study and wrote the literature review, findings, and discussion sections. G. Wilcox led the analysis and the writing of the methods. J. Glowacki contributed to the literature review and discussion sections. All authors have approved the final article.

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