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Harnessing the Power of Social Media to Understand the Impact of COVID-19 on People Who Use Drugs During Lockdown and Social Distancing

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Abstract

Objectives: This paper uses a social media platform, Reddit, to identify real-time experiences of people who use drugs during the COVID-19 lock-down.

Methods: Reddit is a popular and growing social media platform, providing a large, publicly available dataset necessary for high performance of machine learning and topic modeling techniques. We used opioid-related “subreddits,” communities where Reddit users engage in conversations about drug use, to examine COVID-19-related content of posts and comments from March to May 2020. This paper investigates the latent topics of users’ posts/comments using Latent Dirichlet Allocation (LDA), an unsupervised machine learning approach that uncovers the thematic structure of a document collection. We also examine how topics changed over time.

Results: The final dataset consists of 525 posts and 9,284 comments, for a total of 9,809 posts/comments (3,756 posts/comments in *r/opiates*, 1,641 in *r/OpiatesRecovery*, 1,203 in *r/suboxone*, and 3,209 in *r/Methadone*) among 2,342 unique individuals. There were 5,256 posts/comments in March; 3,185 in April; and 1,368 in May (until May 22). Topics that appeared most frequently in COVID-19-related discussions included medication for opioid use disorder (MOUD) experiences and access issues (22.6%), recovery (24.2%), and drug withdrawal (20.2%).

Conclusions: During the first three months of the COVID-19 pandemic, people who use drugs were impacted in several ways, including forced or intentional withdrawal, confusion between withdrawal and COVID-19 symptoms, take-home MOUD issues, and barriers to recovery. As the pandemic progresses, providers and policymakers should consider these experiences among people who use drugs during the early stage of the pandemic.

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Conflicts of Interest: None

Keywords

COVID-19; substance abuse; social media; machine learning; opioid use disorder

INTRODUCTION

Over the past decade, an increasing number of social media platforms such as Facebook, Twitter and Reddit have been used to understand public health epidemics, primarily due to the real-time nature of the data¹⁻⁴. Social media has been used by researchers to understand issues such as mental health self-disclosure⁵, patient experiences with chronic diseases⁶, the relationship between electronic cigarette use and mental illness⁷, marijuana regulations⁴, and suicide among youth⁸. In this paper, we used Reddit, a publicly available social media platform that provides a worldwide network of communities based on people's interests⁹. Reddit communities, also known as "subreddits," cover different topics and allow people to share news, content, or thoughts, and comment on other people's posts anonymously, providing them the opportunity to openly discuss drug use without concerns of stigmatization or criminal repercussions. This anonymity eliminates biases that may arise from self-reported data, such as social desirability bias, which often limits research that uses other social media platforms, electronic health records, and public health surveillance data. Reddit is also an increasingly popular platform, providing a large dataset necessary for high performance of machine learning and topic modeling techniques. During the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic that causes coronavirus disease (COVID-19), people who use drugs have accessed opioid-related subreddits to communicate how COVID-19 has influenced their addiction experiences, such as availability of drugs, coping with withdrawal, and identifying information and support on obtaining drug treatment within this new environment.

Self-quarantine and social distancing orders, which have been widely implemented to prevent the spread of COVID-19, have limited the availability of essential services utilized by people who use drugs, such as access to medication for opioid use disorders (MOUD), syringe services and treatment/recovery clinics^{10,11}. Social isolation, economic devastation, and disruptions to their licit and illicit drug supply during the pandemic have resulted in a surge of overdose deaths¹²⁻¹⁴.

New regulatory guidelines were created by SAMHSA to reduce interruption of treatment and ensure people who use drugs during this ongoing public health crisis have access to care, particularly for individuals receiving MOUD such as methadone and buprenorphine. In the US, these new guidelines include expanded use of telemedicine¹⁵. Telemedicine allows health-related services to be delivered remotely using telecommunications technology and audio-visual communication¹⁶. To avoid disruption of addiction services during the COVID-19 pandemic, these guidelines have changed to allow in-home telemedicine visits for all patients, regardless of type of insurance or MOUD, and telemedicine no longer requires delivery via a HIPPA-compliant platform^{15,17}. The new guidelines for methadone dispensing permit a take-home dosage for 14 days for non-stable clients and 28 days for

stable clients¹⁸. This is a significant shift in medication management. Historically, staff supervised administration of daily doses of methadone to patients at the clinic site.

Despite new regulatory responses that improved prevention and treatment services for people who use drugs during the COVID-19 pandemic, little is known about how these individuals are managing their addiction and recovery and responding to the rapidly changing environment. This paper investigates the latent topics of users' posts and comments using Latent Dirichlet Allocation (LDA)¹⁹, which is an unsupervised machine learning approach that uncovers the thematic structure of a document collection. We identified the topics people who misuse opioids were discussing on Reddit from March through May 2020 of the COVID-19 pandemic and how these topics have changed over time. We examined how people on the Reddit social media platform communicated about their experiences and concerns to cope with COVID-19 and social distancing. In our analysis of subreddits during these first three months of the lockdown, we identified and are reporting on three major overlapping topics: MOUD take-home experiences, withdrawal, and recovery-related conversations. This paper also provides several potential implications for continued access to treatment during the pandemic and adaptation of the new treatment guidelines for substance use services.

METHODS

Data Source

The analysis relied on nonidentifiable, public data and was exempted by the Columbia University Human Research Protections Office. We collected posts and comments from four opioid-related subreddits: *r/opiates*, *r/OpiatesRecovery*, *r/suboxone*, and *r/Methadone* from March 1st, 2020 to May 22nd, 2020. To filter out a subset of posts that are highly relevant to discussions around the COVID-19 pandemic, we built a search engine based on Elasticsearch²⁰ for the collected opioid-related Reddit posts. We used a set of COVID-19-related keywords as queries (Appendix A) and returned a ranked list of relevant posts. To compute the ranking score with respect to the query term, we used the classical machine learning approach based on TF-IDF²¹ (term frequency - inverse document frequency) as the textual features for each post and used BM25 (Best Matching) similarity algorithm²². We removed the posts whose ranking score were below 10 (threshold determined empirically) and maintained the rest of the posts along with their comments as our dataset for further analysis in this study. The final dataset consists of 525 posts and 9,284 comments, a total of 9,809 posts/comments to analyze (3,756 posts/comments in *r/opiates*, 1,641 in *r/OpiatesRecovery*, 1,203 in *r/suboxone*, and 3,209 in *r/Methadone*). There were 5,256 posts/comments in March; 3,185 in April; and 1,368 in May (until May 22). The 9,809 posts/comments analyzed in this study belonged to 2,342 unique individuals.

Topic Modeling for Content Analysis

To discover the topics discussed in the posts and comments, we used a modified version of LDA¹⁹, called LF-LDA²⁶, suitable to learn human-interpretable topics from a small corpus. Topic models such as LDA¹⁹ have seen wide application in biomedical text mining²³, political analysis²⁴, social media analysis²⁵ for modeling document content by learning

document-to-topic and topic-to-word distributions from the co-occurrence of words within documents. One drawback of the generic LDA models is that they require a large set of documents to properly learn the latent topics. Since our document collection is relatively small (i.e., 9,809 posts and comments), we used a modified version of LDA (LF-LDA²⁶) that is able to learn latent topics from small corpora by leveraging word embeddings learned from a large corpus. Word embeddings have become the de-facto representation for modeling word semantics in natural language processing tasks. To learn these word embeddings, we used *Word2vec*²⁷ trained on Google News and fine-tuned on our opioid-related Reddit datasets. The LF-LDA replaces the topic-to-word Dirichlet multinomial component of LDA which generates the words from topics by a two-component mixture of a Dirichlet multinomial component (regular LDA) and a word embedding component. A hyper-parameter (λ) gives the probability of a word being generated by the word embedding topic-to-word model. We experimented with various values of λ , and $\lambda=0.6$ (also recommended by the LF-LDA paper)²⁶ gave us the best interpretable topics. This indicates that better word-topic distributions are produced when information from the large external corpus is combined with corpus-specific topic-word multinomials. To select the number of topics, we experimented with several values (3, 5, 10, 15, 20), and 10 was the number which gave us the most coherent topics as judged by two addiction scientists.

After 10 topics were identified using machine learning techniques, investigator judgement was used to interpret the themes. Specifically, a team of three addiction scientists examined each topic's keywords and agreed on theme titles that best described each topic.

In addition, we identified the topics that appeared most frequently (over 20%) throughout all posts and comments and analyze how each topic change over time from March to May 2020. Since each posting can involve multiple topics, we used Jensen-Shannon divergence²⁸ to quantify the relatedness between topics.

RESULTS

Topics Discussed and Changes over Time

The 10 topics, 20 most frequent words in each topic, and the human-assigned labels are shown in Table 1. The LF-LDA model allowed us to interpret the following topics: topic 1 (supply shutdown), topic 2 (social words), topic 3 (drug names, dosing), topic 4 (asking for information; help), topic 5 (clinic/doctor), topic 6 (withdrawal), topic 7 (MOUD experiences and access issues), topic 8 (COVID symptoms), topic 9 (negative consequences of addiction), and topic 10 (recovery). The four topics that appeared most frequently (over 20% of all posts) included: topic 2 (24.9%), topic 6 (20.2%), topic 7 (22.6%), and topic 10 (24.2%). Because topic 2 (social words) was highly correlated with a majority of topics and did not identify information other than commonly used social interaction words (e.g., “lol,” “dude,” “yeah,” etc.), we chose not to include this topic in further analyses.

Figure 1 displays the strength of association between all topic combinations (we used 1-d as metric where d is the Jensen-Shannon divergence between topics). Looking at our most frequent topics, topic 7 (MOUD experiences and access issues) was correlated most

strongly with posts containing topic 1 (supply shutdown; 0.58), topic 5 (clinic/doctor; 0.72), topic 9 (negative consequences of addiction; 0.58), and topic 10 (recovery; 0.57); topic 6 (withdrawal) was correlated most strongly with posts containing topic 3 (drug names; 0.83), topic 8 (COVID symptoms; 0.66), and topic 10 (recovery; 0.79); topic 10 (recovery) was correlated most strongly with topic 3 (drug names; 0.63), topic 6 (withdrawal; 0.79), and topic 9 (negative consequences of addiction; 0.76). Table 2 provides examples of topic modeling on posts containing COVID-19 related information concerning the topic associations described above.

Figure 2 shows how each of the 10 topics change over time, where the unit of analysis was a month (March, April, May), while Figures 3a–d show word frequency changes for our top frequent topics: topic 7 (MOUD experiences and access issues), topic 6 (withdrawal), and topic 10 (recovery), in addition to topic 3 (drug names).

Below, we will describe the conversations and word changes over time for the most frequently discussed topics: MOUD experiences and access issues (topic 7), withdrawal (topic 6), and recovery (topic 10), as well as their correlated topics. Conversations on topic 7 gradually decreased from March to May. Conversations on topic 1 decreased over time, conversations on topic 5 remained similar from March to May and conversations on topic 9 increased over time, with specific words such as “people,” “use,” “drug,” and “die” increasing in May. Conversations on topic 6 remained stable from March to May.

MOUD experiences and access issues (Topic 7)—Topic 7 (MOUD experiences and access issues) was correlated most strongly with topic 9 (negative consequences of addiction), topic 1 (supply shutdown) and topic 5 (clinic/doctor). Conversations on these topics included discussions about closed treatment centers, overcrowded methadone clinics, and problems obtaining extra medications. Individuals experienced the following challenges: **a) substance use treatment programs closures** prevented individuals from receiving their MOUD and other essential services offered by these programs; **b) methadone clinic overcrowding** at the clinics that were open during lockdown and social distancing, which made individuals concerned of catching COVID-19 at the clinic; **c) limited MOUD take-homes** prevented people who rely on MOUD from securing take-home medications and many reported altering their dosage of MOUD (e.g. using a lower dose than prescribed) and attempting to stockpile their medication to deal with the potential threat of running out; **d) switching MOUD** from methadone to buprenorphine to avoid having to visit the methadone clinic, or from oral buprenorphine to the injectable version to avoid access barriers; and **e) financial barriers to accessing MOUD**. People discussed losing their job during the pandemic and not having insurance to pay for MOUD. Contrastingly, people reported telemedicine as a helpful way to access services. Individuals reported receiving quick responses from providers linking them to treatment and many described it as a simple process.

Withdrawal related conversation (Topic 6)—Topic 6 (withdrawal) was correlated most strongly with posts containing topic 3 (drug names) and topic 8 (COVID-19 symptoms). Individuals discussed withdrawal from MOUD during the COVID-19 pandemic as well as illicit drugs used to get high (e.g., heroin and fentanyl). Withdrawal often

resulted in relapse or replacing their usual drug of choice (MOUD or illicit substance) with alternatives. Additionally, many individuals expressed confusion as to whether they were experiencing symptoms of withdrawal or symptoms of COVID-19 and were reluctant to visit healthcare settings for COVID-19 symptoms because they felt providers would stigmatize them for their drug use. The word “withdrawal” increased from March to April and then decreased in May, while “help” and “dose” increased gradually from March to May. The mention of drug names (topic 3) increased over time. Specifically, “use,” “fentanyl,” “heroin,” “pill,” and “opiate” gradually increased from March to May. “Suboxone” also increased substantially from March to May, while “methadone” decreased. Most COVID-related words gradually decreased from March to May, including “sick,” “virus,” “symptom,” “covid,” “worry,” “die,” and “risk.” Contrastingly, “hospital” gradually increased from March to May. Conversations related to withdrawal include: **a) withdrawal from illicit drugs taken to get high** (e.g., heroin and fentanyl). Due to availability and pricing changes in the illicit drug market, access to their drug of choice might be limited. People complained that social distancing orders prevented physical contact with drug suppliers. People also reported financial barriers to buying drugs due to job loss and intentional withdrawal (see “Recovery-Related Issues” below); **b) withdrawal from MOUD** (e.g., methadone, buprenorphine, suboxone) due to treatment center closures, limited take-home dosages, and issues accessing telemedicine, as discussed above. Many said this withdrawal resulted in relapse. (see “Recovery-Related Issues” below); **c) alternative illicit drug usage**. Drug names were also correlated with withdrawal symptoms because many individuals described what they were replacing their unavailable preferred drugs (illicit or MOUD) with to help cope with withdrawal (“*I ran out tramadol and need an alternative. I have three bottles of zoloft and tequila*); **d) confusion as to whether they were experiencing symptoms of withdrawal or COVID-19**. Symptoms that individuals believed could be attributed to either condition included temperature fluctuations (hot/cold flashes), loss of appetite, runny nose, chills, vomiting, cough, headache, light cramping, shortness of breath, fever, sneezing, yawning, anxiety, insomnia, depression, and diarrhea. Many also reported experiencing anxiety and paranoia (“*constantly afraid*,” “*pure panic*,” “*become a hypochondriac*,” “*absolutely freaking out*,” “*paranoid*”) from not knowing whether they were experiencing withdrawal or COVID-19. Many also reported that they have not been sick since taking opioids or methadone, and they worry that if they were to get COVID-19 that the opioids or methadone might mask the symptoms and they would be asymptomatic (“*Well known fact that opioid addicts never suffer from minor illness (flu, colds) because the opioids mask any symptoms.*”); **e) stigmatization by healthcare providers**. Withdrawal symptoms and COVID-19 symptoms were also mentioned together in discussions about feeling stigmatized by their healthcare provider for their drug use. Consequently, individuals feared not receiving appropriate treatment for either condition.

Recovery related conversation (Topic 10): Topic 10 (recovery) was correlated most strongly with topic 3 (drug names), topic 6 (withdrawal), and topic 9 (negative consequences of addiction), with conversations centering around drug names and dosages being used to self-medicate withdrawal symptoms during self-quarantine. In general, conversations on topic 10 (recovery) increased over time from March to May. Regarding word frequencies, “clean,” “help,” “love,” and “friend” increased in May. “Relapse” also increased in

May. Recovery related issues included: **a) self-medication to maintain recovery.** They mentioned using prescription drugs (e.g., Zoloft, Valium, Xanax, Gabapentin, Diazepam, Clonidine, Seroquel), alternative treatments such as THC/CBD and Kratom, and over-the-counter solutions (DayQuil, NyQuil, Imodium, vitamins). Many individuals discussed avoiding hospitals or clinics for fear of contracting COVID-19 or being stigmatized by doctors and instead discussed tips regarding self-medicating withdrawal symptoms; **b) home detox.** Many individuals mentioned the potential benefits of self-quarantine on their recovery, such as using the time in quarantine as an opportunity to abstain from opioids, enter recovery in the comfort of their own homes, and change their lifestyles. Many individuals reported using this time to taper off their MOUD or quit “cold turkey.” Nevertheless, others expressed concern and doubt regarding home detox during this time.

DISCUSSION

The purpose of this paper is to examine the topics and challenges people who use drugs were discussing on the social media platform Reddit during the first three months of the COVID-19 pandemic, while social distancing measures were implemented across the world. We also examined how the conversation topics changed over time during these three months. The findings show that the most highly discussed topics were related to take-home MOUD, drug withdrawal, and recovery. The frequency of conversations about MOUD experiences and access issues were discussed less frequently over time, conversations about withdrawal remained stable over time, and discussions about recovery were more frequent over time. These results suggest that people either experienced fewer MOUD access issues over the course of the pandemic or they became accustomed to the challenges of receiving their medications and therefore discussed it less, and people either became more interested in recovery over time or faced increasing barriers to recovery. Further qualitative analyses are needed to better understand each individual topic identified in this study and why these discussion topics changed as the COVID-19 pandemic progressed.

We found several challenges that individuals in this study reported regarding take-home MOUD, withdrawal and recovery. Regarding MOUD experiences and access issues, people discussed closed treatment centers, overcrowded methadone clinics, and problems obtaining extra MOUD dosages. Some people discussed losing their jobs and having no insurance to cover the cost of MOUD. Many individuals who were able to access telemedicine services discussed it as a helpful option, but a significant number were unsure about how to seek these services. Regarding withdrawal, individuals discussed withdrawing from MOUD as well as illicit drugs used for the purpose of getting high (e.g., heroin and fentanyl). Withdrawal often resulted in relapse or replacing their usual drug of choice (MOUD or illicit substance) with alternatives. Additionally, many individuals expressed confusion as to whether they were experiencing symptoms of withdrawal or symptoms of COVID-19 and were concerned about being stigmatized by providers for their drug use, if they needed to access healthcare services. Individuals discussed prescription and non-prescription drug names and dosages that they were using to self-medicate withdrawal symptoms during self-quarantine. People also discussed using their time in quarantine as an opportunity to abstain from opioids and change their lifestyles, while also admitting fear of relapse due to the shut-down of recovery-related activities (e.g., AA/NA meetings, gyms, social events).

Social media platforms such as Reddit can be used by addiction clinicians to learn about specific challenges and experiences of people who use drugs. Because Reddit users openly discuss and exchange dialog on stigmatized issues, this platform serves as a rich tool for clinicians to become better informed about people who use drugs. This study's findings have important implications for providers treating people who use drugs as they apply the new guidelines for provision of telemedicine and take-home MOUD. First, many individuals reported fear of attending overcrowded methadone clinics and concerns about receiving sufficient dosages of methadone take-homes. These fears led to several individuals switching treatments to buprenorphine, suboxone, or injectable buprenorphine, despite these medications not being their first choice of treatment. Second, many people reported losing their jobs and insurance and, thus, being unable to continue their usual MOUD, resulting in withdrawal and relapse. Moreover, even with new telemedicine and take-home guidelines, many individuals still faced barriers to receiving the treatment that they need. Third, diversion (e.g., sharing MOUD with a friend) and self-dosing (e.g., stockpiling medication) MOUD appeared to be more common when individuals received insufficient take-home doses and attempted to solve the issue on their own. Fourth, people reported mixing over-the-counter and prescription drugs with MOUD to ameliorate withdrawal symptoms when they did not have enough take-homes and indicated that they were not fully informed on what the effects would be of different drug combinations.

This study's results are not without limitations. The anonymity of Reddit users does not allow us to characterize the demographics or geographic extent of the study population. Although COVID-19 has spread across the world, some countries have been impacted significantly worse than others. We are unable to compare what topics individuals in different geographic regions were discussing, but expect that experiences are heterogeneous across geographic borders as COVID-19-related responses and regulations have varied drastically. However, 2020 statistics show that Reddit's audience comes mainly from the United States, making up approximately 49% of all users, followed by users from the United Kingdom (8%), Canada (8%), Australia (4%) and Germany (3%).²⁹ Similarly, emerging evidence demonstrates that racial and ethnic minorities have been particularly burdened by COVID-19³⁰⁻³³, and we are unable to compare Reddit posts across different race and ethnic groups. Lastly, individuals included in this study were not clinically verified to have an opioid or other substance use disorder, and some users may not share personal content and interests but rather report second-hand experiences.

People who use drugs have been significantly impacted by the COVID-19 pandemic. This study demonstrates areas in which they have been most impacted: many are experiencing forced or intentional withdrawal, confusion between withdrawal and COVID-19 symptoms, issues receiving MOUD, and the everyday battles of recovery. We hope the COVID-19 epidemic can be an opportunity to inspire more healthcare systems and communities to embrace the treatment of opioid use disorder with medications and to find creative solutions to the problems presented here.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

- Schmidt CW. Trending Now: Using Social Media to Predict and Track Disease Outbreaks. *Environ Health Perspect*. 2012;120(1):a30–a33. doi:10.1289/ehp.120-a30 [PubMed: 22214548]
- Charles-Smith LE, Reynolds TL, Cameron MA, et al. Using Social Media for Actionable Disease Surveillance and Outbreak Management: A Systematic Literature Review. *PloS One*. 2015;10(10):e0139701. doi:10.1371/journal.pone.0139701 [PubMed: 26437454]
- Tang L, Bie B, Park S-E, Zhi D. Social media and outbreaks of emerging infectious diseases: A systematic review of literature. *Am J Infect Control*. 2018;46(9):962–972. doi:10.1016/j.ajic.2018.02.010 [PubMed: 29628293]
- Park A, Conway M. Tracking Health Related Discussions on Reddit for Public Health Applications. *AMIA Annu Symp Proc*. 2018;2017:1362–1371. [PubMed: 29854205]
- Choudhury MD, De S. Mental health discourse on reddit: Self-disclosure, social support, and anonymity. *Proc 8th Int Conf Weblogs Soc Media ICWSM 2014*. Published online January 1, 2014:71–80.
- Foufi V, Timakum T, Gaudet-Blavignac C, Lovis C, Song M. Mining of Textual Health Information from Reddit: Analysis of Chronic Diseases With Extracted Entities and Their Relations. *J Med Internet Res*. 2019;21(6). doi:10.2196/12876
- Sharma R, Wigginton B, Meurk C, Ford P, Gartner CE. Motivations and Limitations Associated with Vaping among People with Mental Illness: A Qualitative Analysis of Reddit Discussions. *Int J Environ Res Public Health*. 2017;14(1). doi:10.3390/ijerph14010007
- Sumner SA, Galik S, Mathieu J, et al. Temporal and Geographic Patterns of Social Media Posts About an Emerging Suicide Game. *J Adolesc Health Off Publ Soc Adolesc Med*. 2019;65(1):94–100. doi:10.1016/j.jadohealth.2018.12.025
- Homepage - Reddit. Accessed July 24, 2020. <https://www.redditinc.com/>
- Becker WC, Fiellin DA. When Epidemics Collide: Coronavirus Disease 2019 (COVID-19) and the Opioid Crisis. *Ann Intern Med*. Published online April 2, 2020. doi:10.7326/M20-1210
- Khatiri UG, Perrone J. Opioid Use Disorder and COVID-19: Crashing of the Crises. *J Addict Med*. Published online May 12, 2020. doi:10.1097/ADM.0000000000000684
- Jasmine Silvia M, Kelly Z. The Escalation of the Opioid Epidemic Due to COVID-19 and Resulting Lessons About Treatment Alternatives. *Am J Manag Care*. 2020;26(7):e202–e204. doi:10.37765/ajmc.2020.43386 [PubMed: 32672917]
- Wan W, Long H. ‘Cries for help’: Drug overdoses are soaring during the coronavirus pandemic. *Washington Post*. <https://www.washingtonpost.com/health/2020/07/01/coronavirus-drug-overdose/>. Accessed July 22, 2020.
- Katz J, Goodnough A, Sanger-Katz M. In Shadow of Pandemic, U.S. Drug Overdose Deaths Resurge to Record. *The New York Times*. <https://www.nytimes.com/interactive/2020/07/15/upshot/drug-overdose-deaths.html>. Published July 15, 2020. Accessed July 22, 2020.
- Samuels EA, Clark SA, Wunsch C, et al. Innovation During COVID-19: Improving Addiction Treatment Access. *J Addict Med*. 2020;14(4):e8–e9. doi:10.1097/ADM.0000000000000685 [PubMed: 32404652]
- Telehealth Programs. Official web site of the U.S. Health Resources & Services Administration Published April 28, 2017. Accessed July 22, 2020. <https://www.hrsa.gov/rural-health/telehealth>
- U. S. Department of Justice, Drug Enforcement Administration. (DEA-DC-022)(DEA068) DEA SAMHSA buprenorphine telemedicine (Final) +Esign.pdf Accessed September 22, 2020. [https://www.deadiversion.usdoj.gov/GDP/\(DEA-DC-022\)\(DEA068\)%20DEA%20SAMHSA%20buprenorphine%20telemedicine%20\(Final\)%20+Esign.pdf?mc_cid=8dffbc637&mc_eid=d4494a732e](https://www.deadiversion.usdoj.gov/GDP/(DEA-DC-022)(DEA068)%20DEA%20SAMHSA%20buprenorphine%20telemedicine%20(Final)%20+Esign.pdf?mc_cid=8dffbc637&mc_eid=d4494a732e)

18. Substance Abuse and Mental Health Services Administration (SAMHSA). FAQs: Provision of methadone and buprenorphine for the treatment of Opioid Use Disorder in the COVID-19 emergency. Published online April 21, 2020. Accessed September 25, 2020. <https://www.samhsa.gov/sites/default/files/faqs-for-oud-prescribing-and-dispensing.pdf>
19. Blei DM, Ng AY, Jordan MI. Latent Dirichlet Allocation. *Journal of Machine Learning Research*. Published online January 2003:993–1022.
20. Elasticsearch: The Official Distributed Search & Analytics Engine. Elastic. Accessed July 27, 2020. <https://www.elastic.co/elasticsearch>
21. Baeza-Yates R, Ribeiro-Neto B. *Modern Information Retrieval*. AMC Press New York; 1999. Accessed September 22, 2020. <http://web.cs.ucla.edu/~midrag/cs259-security/baeza-yates99modern.pdf>
22. Robertson S, Zaragoza H. The Probabilistic Relevance Framework: BM25 and Beyond. *Found Trends Inf Retr*. 2009;3(4):333–389. doi:10.1561/1500000019
23. Bisgin H, Liu Z, Kelly R, Fang H, Xu X, Tong W. Investigating drug repositioning opportunities in FDA drug labels through topic modeling. *BMC Bioinformatics*. 2012;13(15):S6. doi:10.1186/1471-2105-13-S15-S6
24. Grimmer J. A Bayesian Hierarchical Topic Model for Political Texts: Measuring Expressed Agendas in Senate Press Releases. *Polit Anal*. 2010;18(1):1–35.
25. Cha Y, Cho J. Social-network analysis using topic models. In: *Proceedings of the 35th International ACM SIGIR Conference on Research and Development in Information Retrieval*. SIGIR '12. Association for Computing Machinery; 2012:565–574. doi:10.1145/2348283.2348360
26. Nguyen DQ, Billingsley R, Du L, Johnson M. Improving Topic Models with Latent Feature Word Representations. *Trans Assoc Comput Linguist*. 2015;3:299–313. doi:10.1162/tacl_a_00140
27. Mikolov T, Sutskever I, Chen K, Corrado G, Dean J. Distributed Representations of Words and Phrases and their Compositionality. *ArXiv13104546 Cs Stat*. Published online October 16, 2013. Accessed September 22, 2020. <http://arxiv.org/abs/1310.4546>
28. Sievert C, Shirley K. LDAvis: A method for visualizing and interpreting topics. In: *Proceedings of the Workshop on Interactive Language Learning, Visualization, and Interfaces*. Association for Computational Linguistics; 2014:63–70. doi:10.3115/v1/W14-3110
29. Tankovska H. Reddit: traffic by country. Statista. Published January 28, 2021. Accessed March 24, 2021. <https://www.statista.com/statistics/325144/reddit-global-active-user-distribution/>
30. Chowkwanyun M, Reed AL. Racial Health Disparities and Covid-19 — Caution and Context. *N Engl J Med*. 2020;383(3):201–203. doi:10.1056/NEJMp2012910 [PubMed: 32374952]
31. Garg S. Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019 — COVID-NET, 14 States, March 1–30, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69. doi:10.15585/mmwr.mm6915e3
32. Coronavirus - Michigan Data. Accessed July 24, 2020. https://www.michigan.gov/coronavirus/0,9753,7-406-98163_98173---,00.html
33. Shah M, Sachdeva M, Dodiuk-Gad RP. COVID-19 and racial disparities. *J Am Acad Dermatol*. 2020;83(1):e35. doi:10.1016/j.jaad.2020.04.046 [PubMed: 32305444]

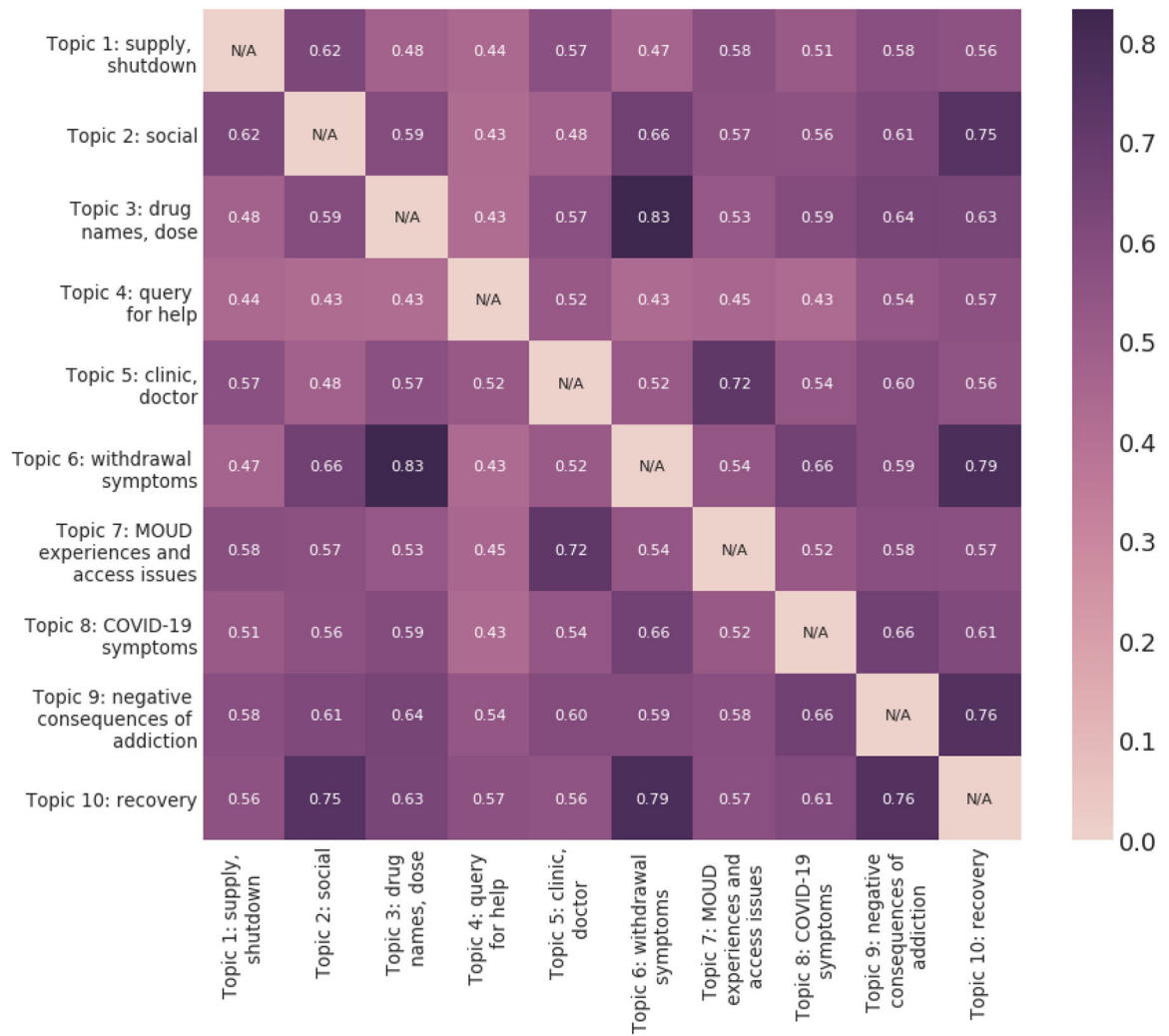


Figure 1:
Correlation of topics (1 – d), where d=Jensen Shannon divergence

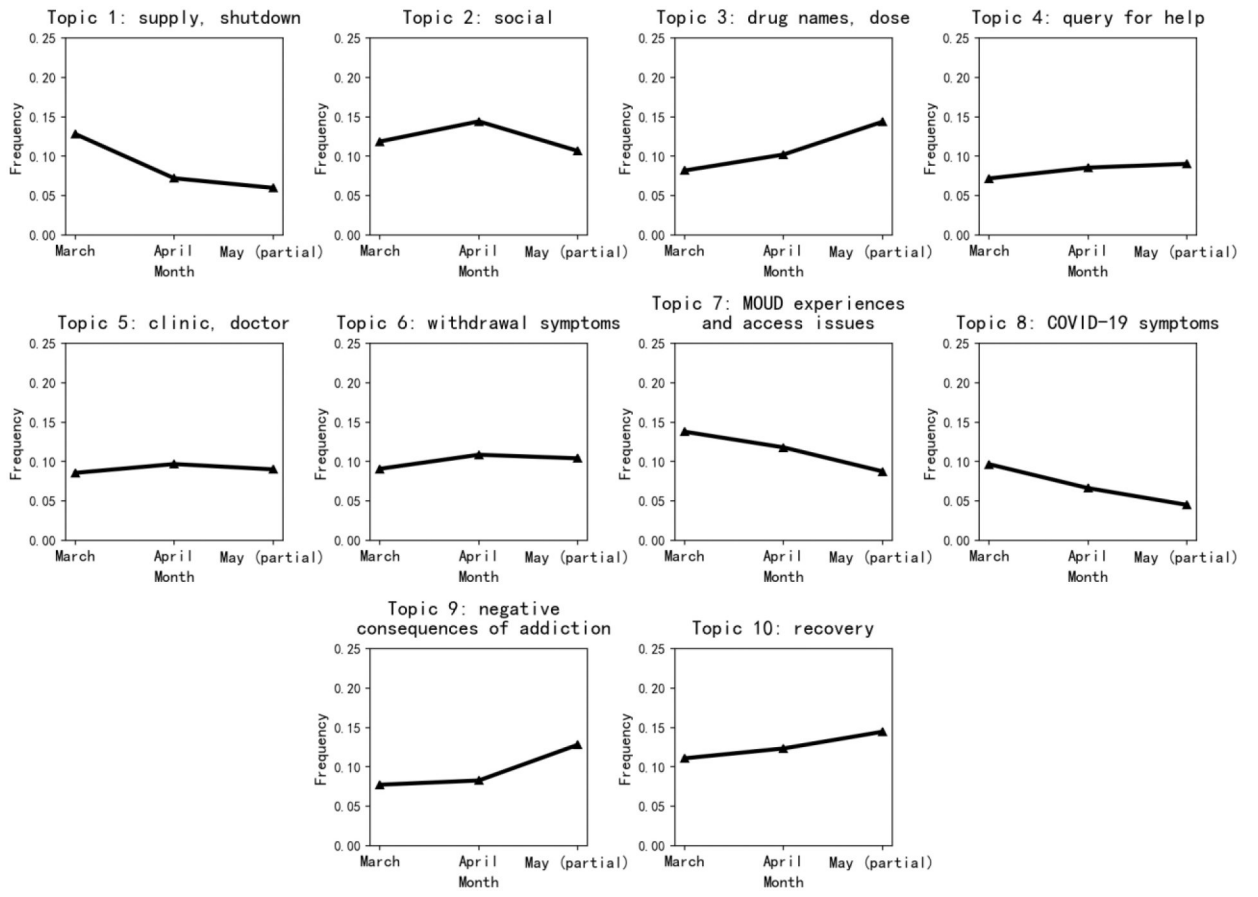


Figure 2: Topics discussed over time, from March 1 to May 22, 2020, by month.

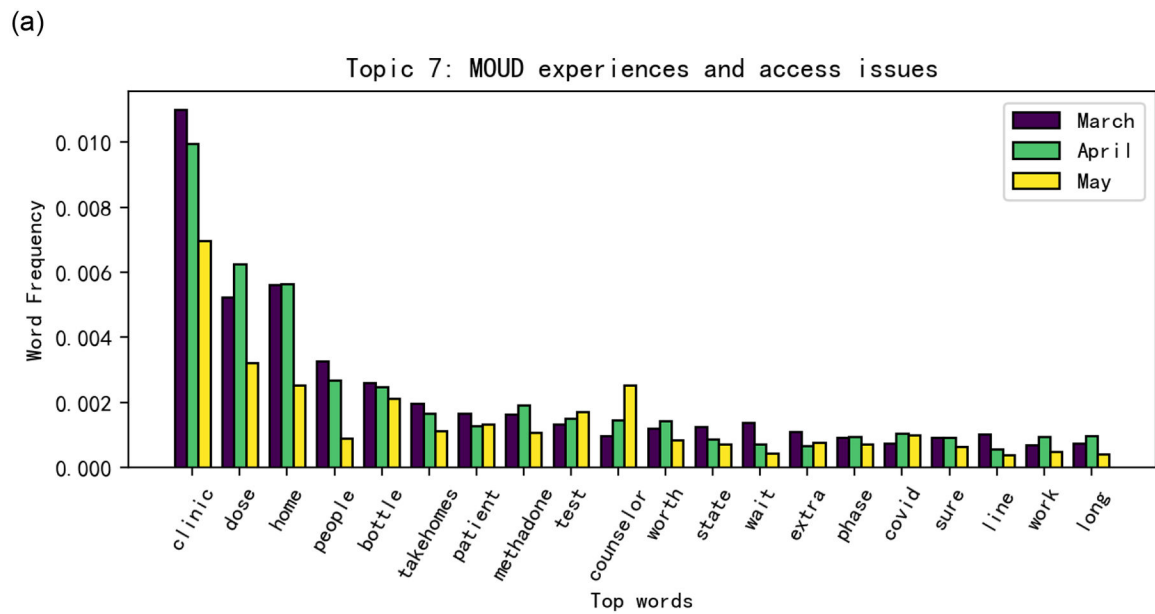


Figure 3.

Word Frequency for topics discussed over time, from March 1 to May 22, 2020, for (a) Topic 7: MOUD Experiences and Access Issues, (b) Topic 6: Withdrawal, (c) Topic 10: Recovery, and (d) Topic 3: Drug Names/Dose. Frequency of a word (w) for a topic (t) in a month (m) is computed by the total count of word w under topic t (each word in a post/comment is assigned to a topic) in month m , normalized by the total number of words in post/comments in month m .

Table 1:

Topics identified in the 10-topic model, the 20 most frequent words within each topic, a title for each topic based on human interpretation, and the percentage of posts containing each topic

Topic id	Representative words for each topic	Topic title based on human interpretation	Percentage of posts containing the topic
1	people hand state live money work close lot supply store area pay shut virus hard outside city country home face	supply, shutdown	18.3%
2	fuck shit lol money people bad happen good friend dope man let dude lose long run buy yeah pill sell	social	24.9%
3	use dose methadone suboxone good sub high taper fent heroin pill opiate work long oxy withdrawal drug fentanyl kratom tolerance	drug names, dose	19.8%
4	thank post use info question ask maybe check sure send information comment online sorry help link talk hear edit share	asking for info; help	17.2%
5	doctor script pharmacy clinic pain patient doc sub appointment ask prescribe prescription med medication insurance suboxone able office state work	clinic, doctor	18.1%
6	help use withdrawal good bad sleep taper anxiety kratom dose long detox opiate work lot symptom sub cold gabapentin pain	withdrawal symptoms	20.2%
7	clinic dose home people bottle takehomes patient methadone test counselor worth state wait extra phase covid sure line work long	MOUD experiences and access issues	22.7%
8	sick virus opiate symptom bad covid people hospital worry die risk immune flu doctor lol corona high cough case cause	COVID-19 symptoms	14.9%
9	people methadone use drug addict good help fuck shit bad treatment addiction life die point overdose post lot change person	negative consequences of addiction	19.2%
10	good clean use life work stay hard help hope thank love luck recovery best friend people great addiction relapse family	recovery	24.2%

Table 2.

COVID-19-related example posts/comments with topic modeling percentage rates

Topics Correlated	Representative COVID-Related Posts/Comments
Topic 7(MOUD experiences)	
Topic 1 (supply, shutdown)	<p>(Topic 7 --> 68.70%; Topic 1 --> 18.70%); My city is in lockdown with shelter in place orders I just started MAT about a month ago at my clinic As of right now I am still having to go in for my daily dose and the nurses informed me that they are stopping UAs as COVID can potentially spread through urine feces so even though I have been clean I do not have the opportunity to prove that to them to work towards phasing up until the dust settles I spoke with my counselor today as I'm a bit concerned since I live with several at risk people and I may be able to get takehomes because of this but I'm not holding my breath and at the moment I will be going in for my daily dose indefinitely through the apocalypse Kinda upset about this but at least my clinic is still open and I am not completely fucked having to go without a dose at all Update went in this morning and they are giving everyone at least a week's worth of takehomes now they sent me off with takehomes and said they are probably going to give me weeks worth when I come in next</p>
Topic 5 (clinic, doctor)	<p>(Topic 5 --> 62.92%; Topic 7 --> 21.25%); I'm going to see my doctor today to refill my oxy script I'm due for a refill on I'm going to ask if he'll let me fill it today so I don't have to go back out I don't have a car and I can only get to my appointment and pharmacy by subway which I really don't want again in two days off I don't have to I've been working from home since last week just to not ride the train Had anyone asked for an early script due to the COVID outbreak What did your doctor say</p>
Topic 9 (negative consequences)	<p>(Topic 9 --> 80.87%; Topic 7 --> 18.37%); I disagree with what you're saying I do not think that just because some people shouldn't be trusted this should give methadone clinics the authority to decide who gets the privilege of when and how to take this medicine Even one case of abusing this power is not worth keeping the bad methadone patients from having takehomes in my opinion You say covid deaths are preventable with medical care like this is a burden and risk those who can't be trusted with takehomes should endure and just hope they either don't catch it or can shoulder the massive medical costs if they don't die That is ridiculous and devalues human life it is entirely preventable by clinics doing the right thing Sure diversion happens sure ODs happen this happens even more so with other much more widely prescribed opiates and you don't see them controlling those the same way You need to get out of the mindset that we are all worthless junkies that cannot be trusted there is a global pandemic that millions are going to die from and this needs to change Lives can be saved if the attitude and laws are changed I do agree with what some of you are saying and maybe some people really can't or shouldn't be trusted with takehomes but this is a public health crisis and life or death for some people things need to change Look at the amount of power and discretion some of these clinics have over people Human life that can be saved should be and just because there is a war on drugs attitude and enormous stigma against opioid addicts doesn't mean that this treatment that has saved lives and society much larger burdens should be treated the way that it is especially now</p>
Topic 6 (withdrawal)	
Topic 3 (drug names)	<p>(Topic 7 --> 41.16%; Topic 3 --> 25.66%; Topic 6 --> 17.91%); So I ran out of my methadone days ago and have really been struggling with withdrawal I've been taking kratom along with any other type of opiate I could find None of them were really working not sure if the kratom was blocking them or I just wasn't taking enough but I took IR release morphine ER morphine hydrocodone and oxy's the most being mgs of oxy at once Anyway I didn't feel any type of high I'm not even sure it gave me any relief from the withdrawals I take mgs of methadone and I've been doubling it for a few years so needless to say my tolerance is really high Anyway today I was able to score some oxy's laced with fentanyl I have never had fentanyl so I cut them in half and wow I gotta say they were great This is the first time I have been able to feel any pills since I started methadone yrs ago Not only did they get me high but they completely took my withdrawals away Anyway I like an idiot called my counselor on Wednesday and told her I had messed up somehow and ran out I had gotten days worth due to Covid I didn't know what to do and I was really sick and I really thought they'd help me But they would not help me I had told her I had only ran out since Tuesday Monday being my last dose and I get my refills tomorrow on Friday so days but in reality I ran out the prior Tuesday today Thursday being days And they would not help me so me confessing was all in vain she said if it was getting really bad I'd have to go to the ER cause they would not dose me sooner So two questions if anyone has experience with this is this typical or if I would of told her the truth that I had been out for days at the time would they have dosed me or would it have been the same outcome And also I'm sure I will be drug tested tomorrow what will happen once I piss dirty for all of the above I mean what did they expect me to do they wouldn't help me and I was in hell She said my take homes would possibly be reduced to a week's worth which I'm sure that's only because of this COVID Does anyone know what the procedure is for my situation I'm hoping and praying I don't lose my take homes forever or I don't think I will stay in treatment I've never had any issues prior I was a phase the highest phase they have I have maybe times in the years pissed dirty and lost my phase but then quickly got it back I just don't know what to expect tomorrow any info will be appreciated thx</p>
Topic 8 (COVID)	<p>(Topic 8 --> 54.57%; Topic 6 --> 37.43%); Mate I've had the same thought I considered going out and trying to get infected I could go through withdrawal in hospital and it might not be so bad there Plus if I go on the ICU then they sedate you and maybe I'd be so out of it I could just get through the withdrawal and not remember much of it I considered doing it even knowing the ICU is a fatality rate But I decided against it I didn't want to give more work to hospital staff and risk others etc Plus one of the girls I talk to on her caught coronavirus and ended up in hospital and she just got her partner to bring her the pills she needs in a sock So she didn't detox at all lol</p>

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Topics Correlated	Representative COVID-Related Posts/Comments
Topic 10 (Recovery)	
Topic 3 (drug names)	(Topic 3 --> 70.86%; Topic 10 --> 17.41%; Topic 4 --> 10.52%); Hey thanks for the link I'll take a look And I totally agree whilst on the methadone I didn't feel high but since switching to bupe I feel totally different so it must of been having more of an effect on me than I realised In hindsight I can see I had the tiredness like you said and it made me lazy too just like H did My fiancé calls it Diet Heroin because I still seemed like I was using when I was on it apparently just not as much The switch over was rough yeah I waited hours before taking my first mg dose as suggested by my addiction keyworker he was either far too optimistic with his timeline or just doesn't like me because I spent days totally bed bound and only semi lucid with precipitated withdrawal but I expected it to be difficult so thought I might as well make the switch whilst I'm stuck at home off work on furlough due to COVID restrictions Best decision I ever made it definitely feels like a much more suitable drug for what I want to get out of MAT All the best
Topic 6 (withdrawal)	(Topic 10 --> 32.70%; Topic 5 --> 30.00%; Topic 6 --> 21.89%); Day clean I finally slept last night it was the best gift I could get in my life My brain is still off but I'm at least soonest feeling somewhat normal I'm stressed about my Klonopin script my psychiatrist isn't returning my calls because of covid I desperately need an apt I've been on it for years Last time I stopped taking my benzos I had a seizure Just want to catch a break lol I never even abuse my benzo script I have days to sort this out Trying to keep my mind clear of things to not worry about but it just doesn't seem I can be able to What a cluster fuck life is I'm trying to just keep positive
Topic 9 (negative consequences)	(Topic 10 --> 71.78%; Topic 9 --> 14.54%; Topic 5 --> 13.22%); I'm back Again I got sober again back in August of last year after a series of vicious relapses and overdoses It was my fourth attempt at sobriety and quite literally I have been in either an inpatient facilities or sober living since I turned Thankfully most of that time has been in sobriety but times I haven't been sober have been progressively more and more devastating I've traumatized my family and my girlfriend multiple times especially my gf who has been with me through every up and down but at times just barely This last time I got sober I was at that jumping off point where I so badly wanted all of the insanity to end but was convinced I could NEVER get better I just thought I was doomed until a series of extremely unlikely events happened at just the right time I hadn't picked up since then and up until about a week ago my sobriety was different than any other period I've had before I was happy I had a fantastic support group a great sponsor my relationship strengthened I was a part of my family again I started going back to school and this month I finally started looking for apartments to lease For the first time I understood why people said they were grateful to be addicts those suggestions people gave me truly showed me this new way of life Then this virus started Now don't get me wrong I do not blame those outside circumstances on my relapse but it was just this perfect storm of shit I work an essential job so I have been stressed about possibly exposing the people I love to COVID So I started to slightly avoid family Then I couldn't hit physical meetings so I hardly was able to see my support group I couldn't start making many amends I was working a step program so I felt stagnant in my program My girlfriend struggles with isolation not an addict though so our relationship was getting rocky And my dad started to drink again To put icing on the cake I couldn't visit my doctor to get my monthly vivitrol shot anymore either Then the cravings hit BADLY I did what I've done so many times before I didn't reach out I didn't get vulnerable I tried to fight a fight alone that I know that I can NEVER win So tonight I drove down to the block and picked up for the first time in almost months I am begging myself to just use this once and by the time shit gets back to normal I'll hop back on the wagon like nothing ever happened But honestly I hate myself more just thinking about that I just feel so fucked right now But on a good note this shit is fire and even only taking a key bump for safety I am smizzle smashed So I'll be back around for a bit