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The Impact of COVID-19 Pandemic on Opioid Crisis in the U.S.

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Abstract: Opioid overdoses caused more than 500,000 deaths from 1999 to 2018 in the US and are now seen as an ongoing epidemic. It is still unclear how the opioid epidemic is affected by the recent COVID-19 pandemic in the US. The objectives of this paper are to find the correlation between COVID-19 and the opioid epidemic, determine if racial disparities in opioid overdose have been enlarged due to the pandemic, and investigate the moderating effects of telehealth on overdose rate and COVID-19. To study the correlation between COVID-19 and the opioid epidemic, This paper applys the least square regression method using different measures of COVID-19, such as total COVID-19 deaths and total COVID-19 cases, and different measures of opioid overdose deaths, such as the increase rate and death rate due to overdose. Surprisingly, this paper found a negative correlation between COVID-19 and overdose deaths, which suggests the existence of competing mortality risks between COVID-19 and drug overdoses. To further understand the heterogeneity in the impact of COVID-19 on racial disparities in opioid overdoses, this paper calculated the increase in drug overdose death rates between 2019 and 2020 for different race groups. This paper found that the Asian and Black/African American communities had the highest increases in the rate of drug overdose deaths. This paper then evaluated the role of telehealth in moderating the correlation between drug overdose and COVID-19 by using the Interstate Medical Licensure Compact (IMLCC). The IMLCC reduces the cost of providing telehealth support and induces the provision of telehealth services substantially. Specifically, this study compares the correlation between COVID-19 and the increase in the age-adjusted death rate due to drug overdose in IMLCC participation states and non-participation states. The correlation for non-participation states was greater than that of participation states, suggesting that telehealth has a moderating role between COVID-19 and drug overdose deaths. This paper's findings first suggest that a re-work of the education system for physicians that teaches providers about biases against different race groups may help diminish racial disparities in opioid treatment and thus decrease the overall rate of overdose deaths. Furthermore, states that are most affected by COVID-19 should receive more federal funding in order to build better healthcare systems to treat those in need. More resources should also be dedicated to expanding telehealth, as it offers a promising low-cost solution to those unable to access in-person medical appointments and vital opioid treatment and reduces the impact of COVID-19 on the opioid epidemic.

Keywords: Opioid, COVID-19, Overdose, Telehealth, Racial Disparity, CDC, IMLCC

1. Introduction

Opioid overdose deaths have been an ongoing drug epidemic in the US since the 1990s, with 500,000 people dying due to an opioid overdose from 1999-2019 [1]. The opioid epidemic was sparked by a new generation of prescription opioids and how they were prescribed. In the late 1970s, physicians treated pain as a fifth vital sign, meaning pain had the same care requirements as blood pressure, temperature, respiratory rate, and heart rate. This coupled with opioids being labeled as "non-addictive" by Purdue Pharma caused a massive spike in prescription rates; opioids were being prescribed when other safer options were available. Sales for opioids and pain killers quadrupled from 1999 to 2013, which were also the years when opioid overdose deaths were at their highest [2]. With the introduction of the COVID-19 pandemic and the alterations it has caused for healthcare systems and its availability, it is unclear how opioid overdoses have been affected. COVID-19 restrictions, such as lockdowns, and social distancing, have

led to economic burdens at the community level, causing many people to face financial struggles and negative emotions [3]. Psychological difficulties, behavioral changes, and substance abuse may be a result of the economic burdens that have become worse during the COVID-19 due to the climbing unemployment rate. The stress of the pandemic pushes people to seek an escape through drugs. Furthermore, substance abusers have a harder time getting help during the pandemic; social distancing, compromised healthcare systems, and lockdown all work against them [4].

COVID-19 restrictions however aren't the only factor that may affect opioid overdoses in the US. Race disparity in drug overdose, specifically in opioid overdoses, has been prevalent even before the pandemic [5]. In a pre-COVID-19 study, 397 black and white patients' pain was measured on a scale of 0-10, with 0 being the lowest pain and 10 being the highest pain. On average, black patients had a score of 6.7 and white patients had a score of 5.6. Despite these results, it was shown that white patients were more likely to receive opioid analgesics (painkillers) compared to black patients. The reasoning behind this gap may be, as van Rynand Burke suggests, because physicians view the black community as less compliant. Unfortunately, the racial disparities may only be heightened in the COVID-19 pandemic [6].

When it comes to the solution to mitigate the effect of COVID-19 on drug overdose, or even the health care system in general, Telehealth is among one of the most promising tools [7]. Telehealth has been very prevalent over the course of the COVID-19 pandemic. It offers a favorable solution for patients to seek help during the lockdown, where person-to-person contact is restricted. A drug called buprenorphine is used to treat opioid addictions, its use reduced opioid death rates by about 50% [8]. Under the Ryan Haight Act, patients can only be prescribed buprenorphine by meeting a physician in person. To combat this restriction during the pandemic, the Drug Enforcement Agency (DEA) and Substance Abuse and Mental Health Service Administration (SAMHSA) decided to alter the act, allowing buprenorphine to be prescribed via telehealth. Not only does this allow much easier access to needed opioid addiction treatment, but it also allows physicians - who have obtained a federal prescribing waiver - to prescribe buprenorphine in multiple counties [8]. Another important policy that affects telehealth care provision is the Interstate Medical Licensure Compact. If the states join this compact, providers in this state can deliver telehealth services across the state border line, mainly through telehealth, among all participating states [9].

This paper has three objectives. The first goal is to find the correlation between the COVID-19 pandemic and the opioid epidemic in the US from 2019 to 2020. The second aim of this study is to examine whether the racial disparities in opioid overdose have been enlarged during the pandemic. The last objective is to investigate the moderating effects of telehealth between drug overdose rate and COVID-19, exploiting the variation in the participation of the interstate medical licensure compact. Understanding the correlation between COVID-19 and opioid overdose, examining the racial disparities, and further evaluating the role of telehealth as a potential solution can inform better policymaking and allocation of public funding, and eventually reduce social inequity and improve population health.

2. Data and Methods

2.1. Data

2.1.1. CDC COVID-19 Dataset

The COVID-19 death information is obtained from the CDC, which tracks the United States COVID-19 Cases and Deaths by State dataset caused by COVID-19 in each state [10]. This dataset was merged with the CDC WONDER dataset by state and year to construct the Correlation between COVID-19 and drug overdose death.

2.1.2. CDC WONDER Dataset

CDC Wonder database provided drug overdose death information [11]. The mortality rate includes age-adjusted mortality and mortality rate by 6 races categories, including American Indian or Alaska Native (AIAN), Asian, Black or African American, More than one race, Native Hawaiian or Other Pacific Islander (NHOPI), and White, in different counties from 2018-2020. With this data, this paper was able to construct results for drug overdose death rates across different races in six representative states and an increase in the rate of drug overdose death for different races. This paper can only observe the death data on drug overdose from the CDC WONDER data. However, since more than 70.6% of the drug overdose death involves opioid use in 2019, this paper uses the drug overdose death as the variable in the following analysis.

2.1.3. U.S State Participation in Compact

IMLCC (Interstate Medical Licensure Compact) provided information on state participation in the IMLCC compact which allows for streamlining the licensing process for physicians who want to practice in multiple states [9]. Physicians practicing in multiple states have significantly lower administrative costs to provide telehealth and thus, a higher prevalence of providing telehealth. Using this data, this paper was able to filter states into two categories, participation and non-participation, allowing us to find the correlation between telehealth status and increase rate of age-adjusted death rate due to drug overdose.

2.2. Methods

This paper first conducted a descriptive analysis of the mean death rate across different races in six representative states and different races from 2018-2020. To examine the racial disparity in the drug overdose death during the pandemic, This paper used the formula: increase rate = (death rate in 2020 - death rate in 2019)/death rate in 2019. This paper then calculated the increase in the rate of drug overdose death for different races in all US states. This paper also calculated the mean increase rate of drug overdose deaths for the 4 different races across all states.

Then, this study found the least square regression line

between different measures of COVID-19 cases and severity and drug overdose death rates. The goal of this method was to find the correlation between COVID-19 cases and severity (y) and drug overdose death rates (x). This study was trying to find the least-square (LS) regression line ($y = a + bx$) that minimizes the sum of squared errors.

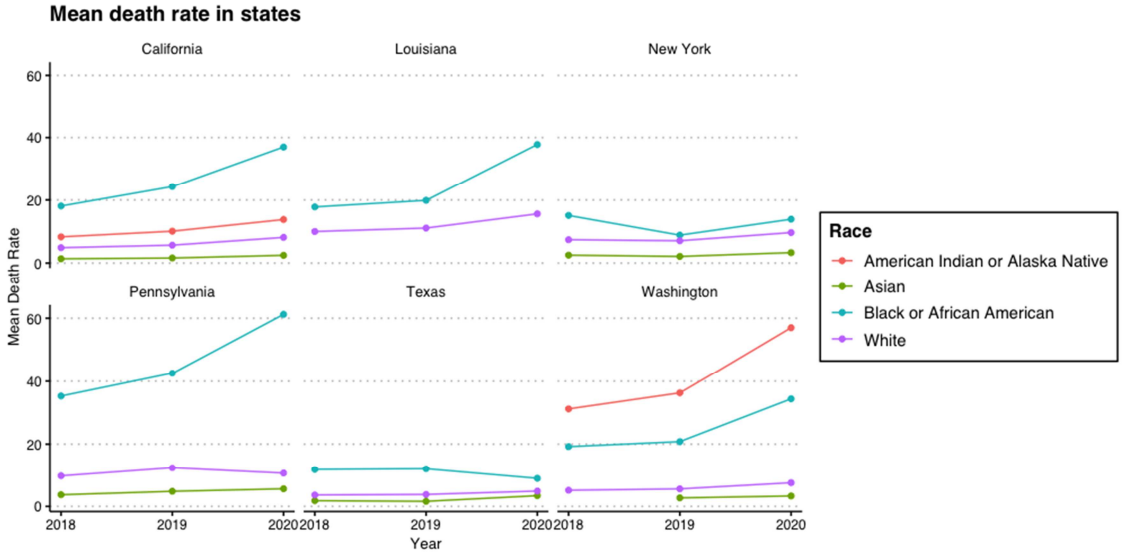
$$\Sigma_i e_i^2 = \Sigma_i (y_i - \hat{y}_i)^2 = \Sigma_i (y_i - a - bx_i)^2$$

Correlation between COVID-19 and drug overdose death are obtained from the following equations: Slope is obtained from $b = r \cdot s_y/s_x$ and the intercept is obtained from $a = \bar{y} - \text{slope} \cdot \bar{x}$ where sy is the standard deviation of y, sx is the standard deviation of x, $\bar{y}$ is the mean of y and $\bar{x}$ is the arithmetic mean of x. The slope indicates how much the response changes are associated with a unit change in x on average. The data analysis and processing working are conducted using R.

To further examine the moderating effect of telehealth on COVID-19 and drug overdose death, this study calculated and compared the correlation between COVID-19 and increase rate of age-adjusted death rate due to drug overdose in IMLCC participation states and non-participation states.

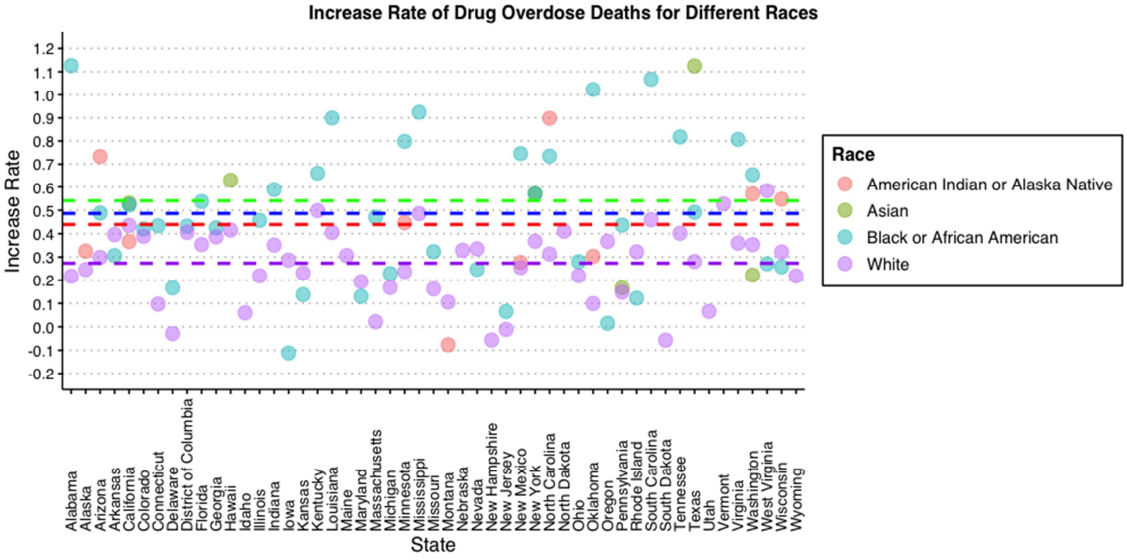
3. Results

Figure 1 X-axis shows the years from 2018-2020 and the Y-axis shows the mean death rate by drug overdoses for every 10,000 residents. The graph shows the correlation between the years and means death rate across 6 different states and 4 different races. Each race is represented by a different color.



Note: Some states have missing lines because the number of deaths of that race is less than 10, therefore insufficient data.

Figure 1. *Drug overdose death rate across different races in six representative states.*



Note: Increase rate = (death rate in 2020 - death rate in 2019)/death rate in 2019

Figure 2. *Increase in the rate of drug overdose death for different races.*

In general, drug overdose death rates are increasing across all states shown. However, in most states shown the Black or African American community appears to be the highest and the Asian community is shown to be the lowest. Almost all the Black of African American lines show a significant jump from 2019-2020. The reasoning behind this could be because of the racial disparities in treatment for African American individuals (e.g. Whites have a higher chance to receive opioid analgesics, 45.7% vs 32.2%). There are also variations across the states shown, this could be a result of the different financial statuses or different policies within the states [12].

Figure 2 X-axis shows the 51 different states in the US in alphabetical order and the Y-axis shows the increase rate of drug overdose deaths. Each color represents a race and the colored dotted lines represent the average increase rate of drug overdose deaths for that race.

Overall, across all states, Whites have the smallest average increase rate of drug overdose death and Asians have the highest (between 2019-2020, 2020 is the first year of pandemic). This suggests that COVID-19 had the largest initial impact on the Asian community (could be due to lack of data points, however) and the African American community while whites had the lowest average increase rate of drug overdose deaths. This could be a result of racial disparities in opioid treatment or cultural/population differences [13].

Table 1 present the results of the correlation between a set of variables that measure the COVID-19 pandemic and another set of variables that measure the drug overdose rate. X1 measures the COVID-19 deaths which provides more information on the severity or how constrained the healthcare resources are while X2 measures the COVID-19 cases which provide more information on the spread of COVID-19. A higher X1 value may also indicate how severe a pandemic is by showing the COVID-19 deaths. Y1 measures the age-adjusted death rate which reflects the reweighted death rate adjusted by the population size of each age group. Y2 measures the increase rate of death rate from 2019 to 2020 by calculating: (age-adjusted drug overdose death rate in 2020 - age-adjusted drug overdose death rate in 2019)/age-adjusted drug overdose death rate in 2019. Y3 measures the increase in age-adjusted drug overdose death rate from 2019 to 2020.

Table 1. *Correlation between COVID-19 and drug overdose death.*

	Age-adjusted death rate due to drug overdose (death per 10,000) (Y1)	**Increase rate of age-adjusted death rate due to drug overdose (Y2)**	**Increase in the age-adjusted death rate due to drug overdose (Y3)**
Total number of COVID-19 deaths per 10,000 residents (X1)	1.335 (4.020)	-0.037 (0.0478)	-0.901 (1.554)
Total number of COVID-19 cases per 10,000 residents (X2)	-0.167 (0.079)	-0.000 (0.001)	-0.037 (0.031)

Note: Standard error is indicated in below the correlation.

Table 1 shows the correlation between different measures of COVID-19 and drug overdose death. Each cell represents the unit change of Y for one unit change of X, and one unit is in terms of people per 10,000 residents. For instance, one unit increase in X1 (1 additional COVID-19 death per 10,000 residents) resulted in Y1 (Age-adjusted death rate due to drug overdose) increasing by 1.335 persons per 10,000 residents.

Cell (X1, Y1) indicates that 1 additional COVID-19 death per 10,000 residents is positively correlated with 1.335 additional death due to drug overdose per 10,000 residents in 2020. Therefore, the number of COVID-19 deaths and the death rate due to drug overdoses have a positive correlation. This means that as COVID-19 death rates rise, the number of drug overdose deaths also rises.

All other cells have a negative value, which means a negative correlation. This indicates as the X variable increases, the Y variable decreases. Cell (X1, Y2) indicates that 1 additional COVID-19 death per 10,000 residents is correlated with a 0.037 decrease rate of drug overdose per 10,000 residents between 2019 (pre-pandemic year) and 2020 (the start of the pandemic). And Cell (X1, Y3) indicates that 1 additional COVID-19 death per 10,000 residents is correlated with a 0.901 decrease in the drug overdose death rate between 2020 and 2019. The negative correlation implies the potential competing mortality risk between COVID-19 and drug overdose. The higher number of COVID-19 deaths, the lower number of opioid overdose deaths there are as COVID-19 deaths may reduce the amount of opioid abusers and thereby reduce the opioid overdoses.

Cell (X2, Y2) has an extremely small negative value, indicating 1 additional COVID-19 death per 10,000 residents is correlated with a 0.000 increase rate of drug overdose per 10,000 residents. This extremely small magnitude of correlation suggests that COVID-19 deaths and the increase rate of drug overdose have no correlation. Cells (X2, Y1/Y3) may have multiple reasons for a negative correlation, such as different city population densities, economic conditions, and geographic location. For example, cities with higher population density and higher income levels may be hit harder by COVID-19 due to the infectious nature of the disease. But these cities don't necessarily have a worse mortality rate of drug overdose due to the social welfare systems, such as Medicaid, or health care systems that is supported by the local financial system [14]. Therefore, more information and future research are needed to find conclusive reasoning.

Note that the magnitude (numbers shown) of the five correlations is small, while the standard error is large. This suggests that the current aggregated data may be too noisy to identify the correlation, which is a statistical challenge for this study.

Table 2 presents the results on the moderating effects of telehealth by comparing participating and non-participating

states in the IMLCC compact. X1 measures the total COVID-19 deaths which provides information on the severity or how constrained the healthcare resources are. X2 measures the total COVID-19 cases which prove information on the spread of healthcare. Y measures the drug overdose increase rate (age-adjusted) and it's divided into participating and non-participating states. This helps compare the moderating effects of telehealth.

Table 2. *Moderating effect of telehealth.*

	Increase rate of age-adjusted death rate due to drug overdose (Y)	
	Participation states	**Non-participation states**
Total number of COVID-19 deaths per 10,000 residents (X1)	0.043 (0.075)	0.080 (0.063)
Total number of COVID-19 cases per 10,000 residents (X2)	-0.001 (0.001)	0.000 (0.001)

Note: Standard error is indicated in below the correlation.

Table 2 shows the correlation between the total number of COVID-19 deaths and cases in participating and non-participating IMLCC states. One unit change in the total number of COVID-19 deaths per 10,000 residents resulted in the increase rate of drug overdose death among participating and non-participating states to increase by 0.043 and 0.080, respectively. This means there is an upwards trend between the total number of COVID-19 deaths (X1) and increase rate of drug overdose among participating and non-participating states.

The correlation between the total number of COVID-19 cases per 10,000 residents (X2) and the increase rate of age-adjusted death rate due to drug overdose among participating states and non-participation states (Y) is close to 0. This means that regardless of state participation in the IMLCC compact, telehealth has almost no moderating effect on the number of COVID-19 cases. On the other hand, the correlation between the total number of COVID-19 deaths per 10,000 residents (X1) and the increase rate of age-adjusted death rate due to drug overdose among participating states and non-participation states is positive. The magnitude of correlation for non-participation states is larger than that of participation states, meaning for 1 additional increase in the total number of COVID-19 deaths, there are higher increase rates in drug overdose deaths in non-participating states than for participating states. Therefore, telehealth plays a moderating role between COVID-19 deaths and drug overdose in participation states by allowing treatment to reach those in need during the lockdown [15].

4. Conclusion

In summary, this paper finds that the Black or African American community has the highest drug overdose death rates in the six representative states. Racial disparities in treatment for African American individuals may be one of the causes. Furthermore, by calculating and plotting the increase in the rate of drug overdose death rates for 4 different races in all the US states from 2019-2020, this paper finds, on average, Asian and Black or African American communities have the highest increase in the rate of drug overdose deaths. These results suggest that COVID-19 had the largest initial impact on the Asian and Black African American communities. This study also found a negative correlation between COVID-19 and overdose deaths; meaning the more COVID-19 deaths there are, the lower the drug overdose deaths. A potential competing mortality risk between COVID-19 and drug overdose could have led to this negative correlation. To further understand the role of telehealth in moderating the correlation between COVID-19 and drug overdose, this paper exploited the variation in IMLCC and found that even though there is a positive correlation between COVID-19 deaths and drug overdose in both participating and non-participating states, participating states have a smaller magnitude of correlation. This highlights that telehealth has a moderating effect on COVID-19 deaths and drug overdose in participating states.

The findings of this study on racial disparity suggests that education systems for healthcare workers should increase awareness and invest more time in education about the racial disparities in drug overdose, especially after the pandemic. Vulnerable populations and minority groups are affected more by COVID-19 in terms of drug overdoses. It is important for physicians to be aware of biases they may have against certain races and work towards eliminating them to ensure effective treatment. Therefore, educating physicians to be more self-conscious about racial disparities may help in lowering the drug overdose rates, especially for vulnerable populations. Also, policymakers should increase the resources allocated to these vulnerable populations to reduce the racial disparity from the demand side.

States are affected differently by COVID-19, depending on the existing infrastructure, economic development, and policy responses to the pandemic. States should be given increased federal funding, specifically those that have been most affected by COVID-19, in order to build a stronger and better support system for those affected by COVID-19 and opioid abuse. Maintaining the availability of healthcare institutes and critical resources, such as PPE equipment, buprenorphine, and behavioral addiction therapy is crucial for minimizing the negative impact of the pandemic on the existing opioid crisis.

Access to opioid treatment, such as buprenorphine, is an issue for those that live too far or are unable to visit a physician. Telehealth offers a promising solution to provide low-cost and accessible care for those who need drug overdose treatment. Instead of expensive and costly in-person care, patients in need of help can access treatment via phone remotely. More resources should be dedicated to expanding telehealth for it to help more people in need. For example, introducing a federal loan repayment program may encourage

physicians to obtain an IMLCC compact, therefore increasing the number of physicians that can help using telehealth.

5. Limitations

The data used in the paper was only aggregated information on drug overdose without any individual-level information such as demographics, housing, etc. This limited the scope of this study's findings as it couldn't distinguish the exact reason why COVID-19 affects drug overdoses. Furthermore, this paper couldn't investigate which population groups, such as low-income or high-income people, were more affected by COVID-19. Another limitation of this study is that the mortality data collected was drug overdose death data, not specifically opioid overdose death data, meaning the findings may be partly driven by the overdose death due to other reasons. Finally, this paper can only study the short-term relationships between COVID-19 and opioid overdose deaths. Future research is needed to understand the long-term impact of the COVID pandemic on opioid overdoses.

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