Coming Apart: The Changing Relationship between Drug Overdose Deaths and Opioid Prescriptions in the United States

By

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Abstract: The United States is in the grip of a drug overdose epidemic, with drug overdoses now taking more lives than suicides, motor vehicle accidents, gun shootings or homicides. We know from research that overdose death rates from heroin and fentanyl surged far ahead of those from prescription opioids after 2010. In this paper, we hypothesize that this change has resulted in a declining correlation between opioid prescription rates and overdose drug deaths among the states since 2010. And we find that, while there were, generally, increasingly strong positive correlations between opioid prescription rates and drug overdose deaths among the states between 2006 and 2010, there have been vastly decreasing correlations ever since then. This pattern implies a possible need for state-level policymakers to shift their focus, from curbing opioid prescription rates to ensuring access to addiction treatment for individuals already facing addiction to opioids.

Keywords: drug overdose crisis, prescription opioids, heroin and fentanyl, medication-assisted therapies

Introduction

In 2017, Americans suffered 70,236 deaths through drug overdoses (CDC 2019), considerably more deaths than they did through any of the following: suicides (nearly 45,000), motor vehicle accidents (40,100), gun shootings (15,549), homicides (17,284) or suicides (nearly 45,000) (Giaritelli 2018). This number was also considerably greater than the 58,220 Americans who died during the Vietnam War and more than four times the number (16,689) who died from drug overdoses in 1999 (Lopez, 2019). It is not hyperbole to say that the U.S. is in the grips of a drug epidemic. But it is also not an overstatement to say that if state agencies are to devise adequate measures to fight this epidemic, they will need to understand its nature and causes. This paper sheds some light on those causes.

If one marks, as some have (e.g., Okie 2010; Quinones 2015), the takeoff of the steep rise in death rates due to drug overdoses as the early 1990s, then, clearly, a major factor in the drug epidemic was the increased medical use of opioids. Until just before the 1990s the medical community had assumed that opioids were highly addictive and to be avoided (Quinones 2015: 15ff). But this attitude changed and a new, relaxed one was reinforced in part by the aggressive marketing of Oxycontin by Purdue Pharmacy after 1995 (Lopez 2019; Okie 2010). A flood of evidence shows that this marketing was a major cause of the initial increase in drug deaths (Hadland et al. 2019).

Of course, the enormous increase in the number of prescription opioids did not occur in a social vacuum. Numerous scholars (e.g., Case and Deaton, 2017; Case and Deaton, 2015a; Case and Deaton, 2015b; Stiglitz, 2015) have pointed to the despair that resulted from job opportunities lost to technical innovation and outsourcing as well as the declining marital fortunes of many Americans (Cherlin, 2009; Kenschaft, Clark and Ciambrone 2016) since the 1980s. This despair led to an unusual potential for many to use and misuse prescription opioids when they became easily available. When the radically increased supply of prescription drugs like Oxycontin met the radically increased despair of many Americans, the drug epidemic took off in earnest.

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considerably greater than the 58,220 Americans who died during the Vietnam War and more than four times the number (16,689) who died from drug overdoses in 1999 (Lopez 2009). It is not hyperbole to say that the U.S. is in the grips of a drug epidemic. But it is also not an overstatement to say that if state agencies are to devise adequate measures to fight this epidemic, they will need to understand its nature and causes. This paper sheds some light on those causes.

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This simple description of the causes of the great rise in drug overdose deaths between, say, 1999 and 2010, when the opioid death rate rose just under 300% and the opioid drug sales rose by just over 300% (Lopez 2019) had at least a couple of policy implications. On the demand side (or why folks were in the market for opioids) there seems to be an implicit call for better social supports: for more satisfying employment opportunities and for family assistance. As far as we can tell, few states seem to have included such policies explicitly as part of their efforts to tackle the drug overdose crisis. On the supply side, one might have expected greater efforts to regulate the supply of prescription opioids and the predatory marketing. In this regard, by 2015, states have had a better record, with 31 states adopting policies to educate prescribers about prescription drug misuse, 22 to educate pharmacists, 26 establishing guidelines for safe opioid prescribing, and 23 providing requirements for prescriber use of prescription monitoring programs by 2015 (Wickramatilake et al. 2017).

But the major causes of the phenomenal rise in drug deaths since 2010 seem to have been quite different from those of the pre-2010 period and this change may have major implications for policy. Between 2010 and 2017, overdose death rates from natural and semi-synthetic opioids such as Oxycontin increased only modestly, going up by less than 15%, while deaths from heroin increased four times, from 3,000 to 15,000, and deaths from synthetic opioids (like fentanyl) increased nine-fold, from 3,000 to 28,000 (Glickman and Weiner, 2019). The 43,000 deaths in 2017 due to heroin and fentanyl-like opioids constituted about 57% of the drug overdose deaths that year.

The reason why this change is significant for policy makers is that, if prescription drugs are no longer a major cause of the drug overdose epidemic, policies aimed at curbing the supply of prescription opioids may actually lead to increased deaths among the group of people already at risk for overdoses. In the absence of available prescription opioids, these people may feel forced to substitute more dangerous, and illegal, drugs (like heroin and fentanyl). Glickman and Weiner (2019), for example, distinguish between policies that "focus on reducing the *demand* for opioids—for example, by improving access to medication-assisted treatment" and policies that are aimed at "reducing the *supply* of opioids—for example, by increased monitoring and regulation of opioid prescribing." They argue that, given the drugs (heroin and fentanyl-like products) that seem to be driving the drug overdose epidemic today, putting more emphasis on the former policies makes sense.

However, this shift in focus assumes that prescription opioids are no longer a major driver of the epidemic. This is the issue we address in this paper. We examine the correlation between the opioid prescription rate and the drug overdose rate among the 50 states over the period 2006 to 2017. Based on our reading of the recent history of the drug overdose epidemic, we hypothesize that the correlation between prescriptions and drug deaths will have risen before about 2010 and may have declined thereafter.

Methods

Data about opioid prescription rates, both at the national and state levels, are from the Centers of Disease Control (CDC) in 2018. These data are available from 2006 to 2017. They are based upon information drawn from a sample of about 50,000 pharmacies every year, information about prescriptions for buprenorphine, codeine, fentanyl, hydrocodone, hydromorphone, methadone, morphine, oxycodone, oxymorphone, propoxyphene, tapentadol, and tramadol. They do not include products used for colds or coughs.

Data about drug overdose deaths, again at national and state levels, are from the Kaiser Family Foundation (KFF) in 2019. For purposes of comparison with the opioid prescription data, we use data from 2006 to 2017. KFF (2018) in turn received the data from the National Vital Statistics System.

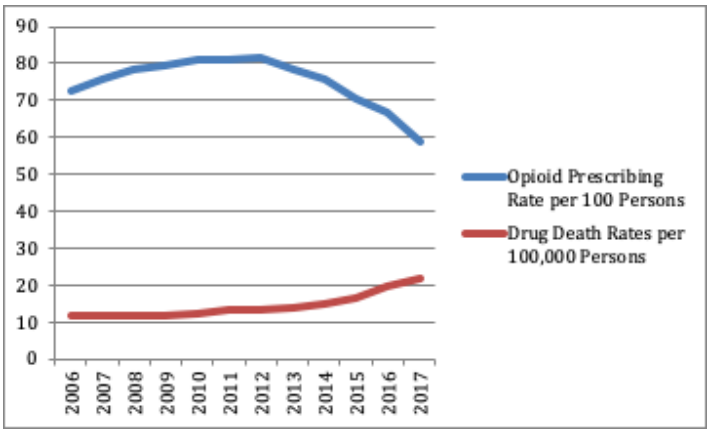
Our initial analysis simply depicts the relationship between the overall opioid prescription rate and the drug overdose rate by year for the U. S. as a whole. However, our key concern is with the relationship between the two rates among the 50 states for each year between 2006 and 2017. We use the Statistical Package for the Social Sciences (SPSS) to calculate those correlations. Finally, we examine whether there might be lag periods that would improve the predictive capacity of opioid prescription rates for drug overdose deaths among the states.

Results

In Figure 1 we examine the relationship between opioid prescription rate per 100 and the drug overdose rate per 100,000 for the U.S. between 2006 and 2017. This figure shows that between 2006 and 2010, the relationship was generally positive: as the prescription rate increased so did the drug overdose rate. This result is consistent with findings from many other sources (e.g., Kolodney et al. 2019; Lopez 2019; Paulozzi et al. 2011; Volkow et al. 2014), most of which view prescription opioids as driving the overdose epidemic until at least 2010.

What Figure 1 also shows, though, is that soon after 2010 there was actually a negative relationship between the opioid prescription rate and the drug overdose rate, at least at the national level. This "coming apart" has been seen to be associated with two new developments. On the one hand, many states introduced policies, as we mentioned above, to make opioid prescriptions less likely to lead to addiction. In doing so, they likely engendered the decline in prescriptions depicted in the figure. On the other hand, those already addicted to opioids gained access to illegal opioids, like heroin and fentanyl. Such illegal drugs, because of their potency, were even more likely to lead to death (e.g., Economist 2017a; Economist 2017; Glickman and Weiner 2019). (See Figure 1.)

Figure 1. National Opioid Prescription Rates per 100 Persons and Drug Overdose Death Rate per 100,000 Persons for the Years 2006-2017



But just because the opioid prescription rate and the drug overdose rate at the national level have come apart does not mean that the correlation no longer exists at the state level. And it is at the state level that important drug policy is made. It is still possible, for instance, that those states that have the highest opioid prescription rates have the highest drug overdose rates and that the prescription rates remain a major cause of variation in drug death rates. After all, there remains huge variation in the prescription rates, with Alabama pharmacists (with a prescription rate of 107.3 per 100 persons) filling almost three times more prescriptions per person than those in Hawaii (37 per 100) (CDC 2018).

There also remains huge variation in the drug overdose death rates by state. However, there has also been considerable change in the rank ordering of states in terms of drug overdose death rates between 2006 and 2017. This change occurred more among states with the highest death rates than those with the lowest. Table 1 shows the five states with the highest and the five states with the lowest drug overdose death rates in both 2006 and 2017. One notable feature of the Table 1 is how little the composition of the states with the lowest

rates changed over the 11-year period. This would be especially true if North Dakota's rate in 2006 had not been unavailable in 2006. (Its rate, 4.8 per 100,000, was the lowest in the country in 2007.) Another remarkable feature of Table 1 is how relatively little the rates for the states with the lowest rates increased between 2006 and 2017. Iowa's rate of 11.5 drug deaths per 100,000, for instance, did not change at all between 2006 and 2017. A third significant feature of this table is how relatively much the rates for the states with the highest rates increased during the period. West Virginia's rate of 20.4 per 100,000 in 2006 almost tripled to 57.8 per 100,000 in 2017. A fourth notable feature is how the geographic concentration of the states with the highest rates changed between 2006 and 2017. In 2006 three of the five states (New Mexico, Utah and Nevada) lay west of the Mississippi River. But by 2017, none did, and the four with the highest rates (West Virginia, Ohio, Kentucky and Pennsylvania) formed a contiguous corridor of drug overdose deaths up the middle of the region east of the Mississippi. Many observers (e.g., Economist 2017b; Botelho et al. 2017) believe the eastward movement of the drug scourge has resulted from the location of the two major heroin markets in the United States. One, lying east of the Mississippi, predominantly receives a white heroin from Columbia. White heroin is sufficiently like the crushed pain pills that addicts grew used to during the first decade of the century that it made the switch from those pills to heroin a relatively easy one—and in turn made the switch over to fentanyl an easy one as well. A brown heroin market, pushed by Mexican suppliers, largely prevailed in states west of the Mississippi and "probably deterred many painkiller addicts from trying the drug (i.e., heroin), and has kept synthetic opioids at bay" (Economist 2017b). (See Table 1.)

In any case, the tremendous variation by state in both opioid prescription rates and the drug death rates means it was still possible that the two could have remained highly correlated after 2010. In fact, however, the correlation between prescription rates and drug death rates for the 50 states declined greatly since 2010. Figure 2 shows that the correlation (Pearson's r) plummeted dramatically from a high of +.65 in 2010 to +.11 in 2017 and did so essentially monotonically. (See Figure 2.) Moreover, Figure 3, which graphs the R-squared values (multiplied by 100) for each of these correlations, depicts the dramatic reduction in the amount of variance in the

Table 1. States with the Highest and Lowest Drug Overdose Deaths Rates in 2006 and 2017

(Rates are Per 100,000 Residents)

States with **Highest Rates** in 2006	States with **Highest Rates** in 2017
New Mexico 21.8	West Virginia 57.8
West Virginia 20.4	Ohio 46.3
Utah 19.1	Pennsylvania 44.3
Nevada 18.1	Kentucky 37.2
Kentucky 17.4	New Hampshire 37.0
States with Lowest Rates in 2006	**States with Lowest Rates in 2017**
South Dakota 5.1	Nebraska 8.1
Nebraska 5.4	South Dakota 8.5
Minnesota 5.9	North Dakota 9.2
Hawaii 6.4	Iowa 11.5
Iowa 11.5	Montana 11.7

Source: Kaiser Family Foundation Data (2019)

drug death rates across states that can be predicted (or explained) by opioid prescription rates: from 42% in 2010 to 1% in 2017. (See Figure 3.)

Figure 2. Correlations of Opioid Prescription Rates and Drug Death Rates by State for the Years 2006-2017

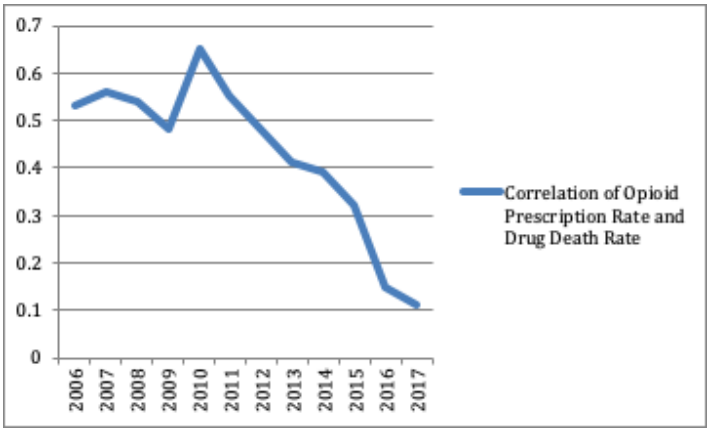
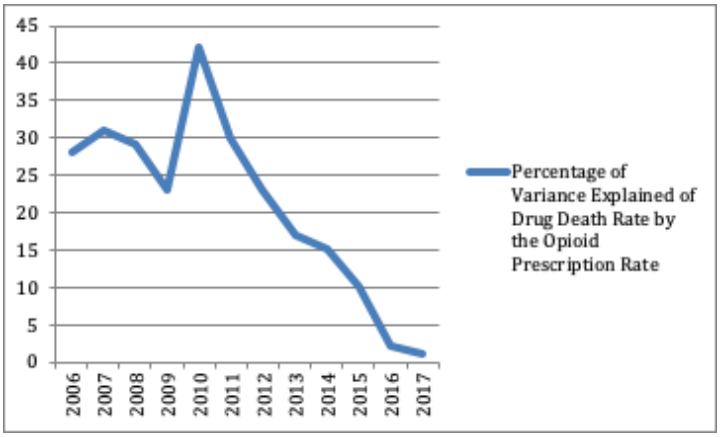
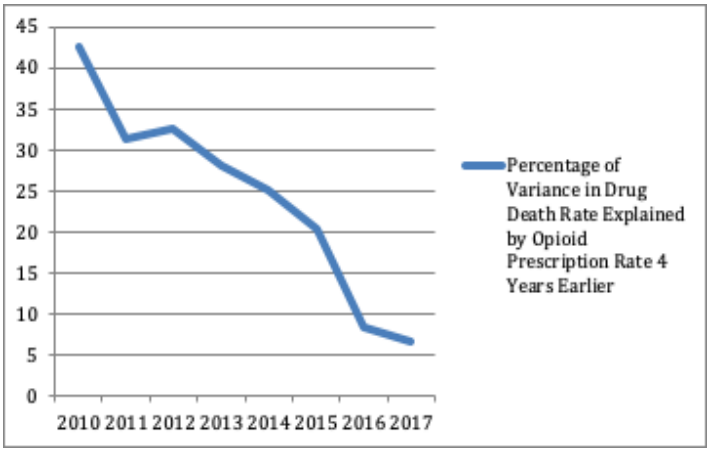


Figure 3. Percentage of Variance in the Drug Overdose Death Rate by State, Explained by the Opioid Prescription for the Years 2006-2017



We note that by correlating the drug overdose death rate with the opioid prescription rate in any given year we have not necessarily captured the appropriate lag period between the two variables. Further analysis indicates that correlations were substantially increased when a lag of anywhere between two to four years was employed, but that the lag period that maximized the correlation between the drug overdose rate and the opioid prescription rate depended on the particular year. Figure 4, however, captures the amount of variance explained when a four-year lag was used—the lag that maximized the correlation for the greatest number of the years under study. Even using the four-year lag, though, it is clear that the amount of variance explained by the opioid prescription rate has dropped substantially since 2010—from about 42.4% in 2010 to about 6.5% in 2017. We do not have data at this point for 2018 or 2019, but we think it is very likely that even with the lag the variance explained by the opioid prescription rate would hover just above zero percent. (See Figure 4.)

Figure 4. Percentage of Variance in Drug Death Rate Explained by Opioid Prescription Rate 4 years Earlier



CONCLUSION

The major contribution of this paper is the finding that very little of the current variation in recent drug overdose death rates among U. S. states can be attributed to variation in states' opioid prescription rates. This is a marked change from the beginning of the decade when more than 40% of that variation could be explained by the prescription rates alone. This result might have been expected, given the dramatic change in the kinds of the drugs that are most implicated in opioid-related deaths between 2010 and 2017—a change from prescription opioids to illicit heroin and fentanyl-like drugs (e.g., Botelho et al. 2017; Glickman and Weiner 2019; Scholl et al. 2019). But the decline in the variance explained in state drug overdose rates by state opioid prescription rates was not a necessary implication of the increase in the significance of heroin and fentanyl. Despite a general decline in the opioid prescription rate in the U.S. since 2010, it was still possible that this rate could be highly correlated with the drug death rate among the states. But we find that it is not.

Care is needed when deriving policy implications from any single empirical study. But we feel the suggestion made by Glickman and Weiner (2019)—that at least some

states may want to moderate policies that would curb the supply of prescription opioids and upgrade efforts to improve access to medication-assisted treatments—makes sense for at least three reasons. First, the supply of prescription opioids is not strongly associated any longer with the drug overdose rate—the finding of this paper. Second, curbing the supply of prescription opioids may actually compel those addicted to prescription opioids--whether obtained legally or not—to turn to more dangerous alternatives like heroin and fentanyl. Third, the evidence that policies aimed at reducing the supply of prescription opioids actually reduce drug deaths is at best equivocal, and some of it suggests that such policies have led to the substitution of heroin for prescription opioids among those already addicted to those opioids (e.g., Paulozzi et al. 2014; Alpert et al. 2018; Pitt et al. 2018).

We are not entirely comfortable with the part of Glickman and Weiner's argument that would have all states disinvest in stemming the supply of prescription opioids to their people. Especially in states, like Nebraska, South Dakota and North Dakota, where drug death rates remain low, reducing the supply of opioid pain relievers that are not absolutely necessary should reduce the number of people who develop new opioid addictions. However, evidence from our analysis (and that of others) makes us feel relatively confident that greater investment in stemming this supply in states where addiction rates are high would be misplaced. Given that the number of people who already die from drug use disorders is so high in states like Ohio, Kentucky, West Virginia, Pennsylvania and rural New England, we feel that policies aimed at the treatment and functional recovery of addicts deserve additional support. Volkow et al. (2014) write of three kinds of medication-assisted therapies (MATs) for patients with opioid addictions: methadone, buprenphine and naitraxone. They also speak of the substantial underuse of all three of these medications as of 2012, when a National Survey on Drug Use and Health estimated that only about two of every five Americans declaring an opioid dependency received a MAT for his or her opioid addiction. It is likely that such a survey underestimated the number of people with addictions and therefore overestimated the percentage that was receiving treatment.

One limitation of our study is the absence of any controls for the relationship between opioid prescription rates and drug overdose rates. Bivariate analyses can be suggestive but cannot be considered definitive. Unfortunately, data about some of the most plausible suppressor variables—such as the heroin and fentanyl use rates by state—are simply unavailable at this point in time. It may be that future drug use surveys will give us some handle on plausible suppressor variables. However, at this point such variables remain elusive.

References

Alpert, A., D. Powell, and R. Liccardo Pacula. 2018. "Supply-Side Drug Policy on the Presence of Substitutes." *American Economic Journal: Economic Policy*. 10(4): 1-35.

Botelho M., J. Lemos, J. Souza and R. Clark. 2017. "The Drug Overdose Epidemic: Deaths of Despair or Deaths of Addiction?" *Sociology Between the Gaps: Forgotten and Neglected Topics.* https://digitalcommons.providence.edu/cgi/viewcontent.cgi?article=1030&context=sbg. Retrieved May 25, 2019.

Case, A. and A. Deaton. 2017. Mortality and Morbidity in the 21st Century. Brookings Papers on Economic Activity. https://www.brookings.edu/wpcontent/uploads/2017/03/6_casedeaton.pdf. Retrieved June14, 2017.

Case, A. and A. Deaton. 2015a. "Rising Morbidity and Mortality in Midlife Among White Non-Hispanic Americans in the 21st Century." PNAS, December 8, 112(49): 15078-83.

Case, A. and A. Deaton. 2015b. "Suicide, Age, and Wellbeing: An Empirical Investigation." NBER Working Paper 21279, Cambridge, MA (June).

Centers for Disease Control and Prevention (CDC). 2018. U.S. Opioid Prescribing Rates. https://www.cdc.gov/drugoverdose/maps/rxrate-maps.html. Retrieved May 25, 2019.

Cherlin, A. 2009. ***The Marriage-Go-Round: The State of Marriage and the Family in America Today***. New York. Vintage.

Economist. 2017a. "Opioids and Lawsuits: Ohio High." June 10th - June 16th. Vol. 423 (9044): 30-31.

Economist. 2017b. "A Selective Scourge: Inside the Opioid Epidemic." May 11th. http://www.economist.com/news/united-states/21721960-deathsdrugs-say-more-about-markets-about-white-despairinside-opioid. Retrieved June 17, 2017.

Giatitelli, A. 2018. "More People Died from Drug Overdoses in 2017 than Guns, Murders or Car Accidents." *Washington Examiner.* https://www.washingtonexaminer.com/news/more-people-died-from-drug-overdoses-in-2017-than-guns-murders-or-car-accidents. Retrieved May 13, 2019.

Glickman, A. and J. Weiner. 2019. Why Deaths Continue to Rise in the Opioid Epidemic. *Leonard Davis Institute of Health Economics*. https://ldi.upenn.edu/healthpolicysense/why-deaths-continue-rise-opioid-epidemic. Retrieved May 25, 2019.

Hadland, S., A. Rivera-Aguirre, D. L. Brandon, and M. C. Marshall. 2019. "Association of Pharmaceutical Industry Marketing of Opioid Products with Mortality from Opioid-Related Overdoses." *JAMA Network Open*, 2 (1): e186007. DOI:10.1001/jamanetworkopen.2018.6007

Henry J. Kaiser Foundation. 2019. Opioid Overdose Death Rates and All Drug Overdose Death Rates per 100,000 Population (Age-Adjusted). https://www.kff.org/other/state-indicator/opioid-overdose-death-rates/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D. Retrieved May 25, 2019.

Kenschaft, L., R. Clark, and D. Ciambrone. 2016. ***Gender Inequality in Our Changing World***. New York: Routledge.

Lopez, G. 2019. "We Now Have More Proof that Drug Companies Helped Cause the Opioid Epidemic." 2019. *Vox*. https://www.vox.com/future-perfect/2019/1/25/18188542/opioid-epidemic-marketing-overdose-death-purdue. Retrieved May 25, 2019.

Okie, S. 2010. "A Flood of Opioids, a Rising Tide of Deaths." *New England Journal of Medicine* 363(21):1981-5.

Paulozzi, L., E. Kilbourne, and H. Desai. 2011. "Prescription Drug Monitoring Programs and Death Rates from Drug Overdose." *Pain Medicine.* 12(5): 747-754.

Pitt, A., K. Humphreys, and M. Brandeau. 2018. "Modeling Health Benefits and Harms of Public Policy Responses to the US Opioid Epidemic." *American Journal of Public Health*. 108(10): 1394-1400.

Quinones, S. 2015. ***Dream Land. A True Tale of America's Opiate Epidemic.*** New York: Bloomsbury Press.

Stiglitz, J. E. 2015. When Inequality Kills, Project Syndicate, Dec 7. https://www.projectsyndicate.org/ commentary/lower-life-expectancy-white-americans-byjoseph-e--stiglitz-2015-12?barrier=accessreg.

Volkov, N., T. Frieden, P. Hyde, and S. Cha. 2014. "Medication-Assisted Therapies—Tackling the Opioid-Overdose Epidemic." *New England Journal of Medicine.* https://www.ncbi.nlm.nih.gov/pubmed/24758595. Retrieved May 25, 2019.

Wickramatilake, S. J. Zur, N. Mulvaney-Day, M. Campopiano vo Klimo, E. Selmi, and H. Harwood. 2017. "How States are Tackling the Opioid Crisis." *Public Health Reports* 132(3): 171-179.

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