The social, structural, and environmental drivers of the opioid overdose crisis

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People, Place & Health Collective
Associate Professor
Brown University School of Public Health
Every day, almost 200 Americans die of a drug overdose.

Mortality from drug overdose has never been higher.

Deaths involving heroin and prescription opioids are stable

FIGURE 1. Age-adjusted rates* of drug overdose deaths† involving prescription opioids,§ heroin,¶ cocaine,** psychostimulants with abuse potential,†† and synthetic opioids other than methadone§§,¶¶ — United States, 2013–2019

Source: [https://www.cdc.gov/mmwr/volumes/70/wr/mm7006a4.htm?s_cid=mm7006a4_w](https://www.cdc.gov/mmwr/volumes/70/wr/mm7006a4.htm?s_cid=mm7006a4_w)
Drug overdose deaths have been increasing exponentially for over three decades.

\[
\text{Mortality rate in year } y = 10^{-0.038 + 0.032 \times (y-1978)}
\]

\[R^2 = 0.99\]

Source: Jalal et al., Science, 2017
Fig. 1 | **Age-standardized prevalence of OUD per 100,000 people.** Age-standardized prevalence of opioid use disorder (OUD) per 100,000 people, based on data from the 2016 Global Burden of Disease study.

*Source: Strang et al., *Nature Reviews Disease Primers*, 2020*
Today’s Objectives

1. Identify the social, structural, and environmental determinants of the opioid overdose crisis in the United States;

2. Appraise the effectiveness of various strategies to reduce overdose deaths;

3. Discuss the relative effectiveness of these strategies in the era of COVID-19.
Deaths of despair?

- Increased alcohol & drug use
- Pain, disability, social isolation & depression
- Economic instability
- Financial insecurity

Fig. 1. All-cause mortality, ages 45–54 for US White non-Hispanics (USW), US Hispanics (USH), and six comparison countries: France (FRA), Germany (GER), the United Kingdom (UK), Canada (CAN), Australia (AUS), and Sweden (SWE).
Source: Adapted from Marks J. 1990. The Paradox of Prohibition. In: Controlled Availability: Wisdom or Disaster.
Deaths of corporate malfeasance
In 2016, the USA and Canada had the first and third highest rate of opioid consumption in the world.

Even after peaking in 2012, the US continues to have a much higher opioid prescribing rate than any other country.

Source: Degenhardt et al., *Lancet*, 2019

*Figure 1: Opioid analgesic consumption*
Industry Payments to Physicians for Opioid Products, 2013–2015

Scott E. Hadland, MD, MPH, MS, Maxwell S. Krieger, BS, and Brandon D. L. Marshall, PhD

Objectives. To identify payments that involved opioid products from the pharmaceutical industry to physicians.

Methods. We used the Open Payments program database from the Centers for Medicare and Medicaid Services to identify payments involving an opioid to physicians between August 2013 and December 2015. We used medians, interquartile ranges, and ranges as a result of heavily skewed distributions to examine payments according to opioid product, abuse-deterrent formulation, nature of payment, state, and physician specialty.

Results. During the study, 375,266 nonresearch opioid-related payments were made to 68,177 physicians, totaling $46,158,388. The top 1% of physicians received 82.5% of total payments in dollars. Abuse-deterrent formulations constituted 20.3% of total payments, and buprenorphine marketed for addiction treatment constituted 9.9%. Most payments were for speaking fees or honoraria (63.2% of all dollars), whereas food and beverage payments were the most frequent (93.9% of all payments). Physicians specializing in anesthesiology received the most in total annual payments (median = $50; interquartile range = $16–$151).


METHODS

We extracted all payments between August 1, 2013 (when mandated reporting began), and December 31, 2015, that listed a US Food and Drug Administration (FDA)–approved opioid product. We included buprenorphine but examined buprenorphine and buprenorphine/naloxone marketed for addiction treatment separately from the buprenorphine transdermal patch marketed for pain control. We excluded remifentanil (which is marketed exclusively for anesthesia) and 2 fentanyl products (1 marketed exclusively for anesthesia, and 1 marketed exclusively for palliative care and pain and symptom management).
<table>
<thead>
<tr>
<th>Nature of Payment</th>
<th>Total Payment Amount, $ (%)</th>
<th>Median Payment, $ (IQR)</th>
<th>No. of Payments (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaking fees or honoraria</td>
<td>29 190 854 (63.2)</td>
<td>2 010 (1 000–3 750)</td>
<td>9 161 (2.4)</td>
</tr>
<tr>
<td>Food and beverages</td>
<td>7 872 581 (17.1)</td>
<td>14 (11–18)</td>
<td>352 298 (93.9)</td>
</tr>
<tr>
<td>Consulting fees</td>
<td>5 886 461 (12.8)</td>
<td>1 000 (500–2 500)</td>
<td>2 145 (0.6)</td>
</tr>
<tr>
<td>Travel and lodging</td>
<td>2 904 940 (6.3)</td>
<td>537 (100–1 131)</td>
<td>4 048 (1.1)</td>
</tr>
<tr>
<td>Education</td>
<td>222 869 (0.5)</td>
<td>14 (5–25)</td>
<td>7 422 (2.0)</td>
</tr>
<tr>
<td>Other a</td>
<td>80 683 (0.2)</td>
<td>100 (14–500)</td>
<td>192 (0.1)</td>
</tr>
</tbody>
</table>

Note. IQR = interquartile ranges.
aIncludes gifts, entertainment, and space rental or facility fees.
Effect of marketing on opioid prescribing

- We linked 2014 OpenPayments data with 2015 opioid prescribing information from all physicians who prescribed under Medicare Part D.

- A total of 25,767 (7%) of physicians prescribing under Part D received 105,368 payments totaling $9,071,976 in 2014.

- After adjusting for 2014 claims and overall changes in prescribing patterns, physicians who received ≥1 payment in 2014 had a 9.3% higher rate of opioid prescribing in 2015 (95% CI: 8.7% - 9.9%).

Source: Hadland et al. JAMA Internal Medicine, 2018
Even ‘Low-value’ interactions between pharmaceutical manufacturers and providers are associated with increased rates of opioid prescribing.

Source: Hadland et al., *JAMA Internal Medicine*, 2018.
Association of Pharmaceutical Industry Marketing of Opioid Products With Mortality From Opioid-Related Overdoses

Scott E. Hadland, MD, MPH, MS; Ariadne Rivera-Aguirre, MPP; Brandon D. L. Marshall, PhD; Magdalena Cerdá, DrPH, MPH
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Model A (95% CI)</th>
<th>Model B (95% CI)</th>
<th>Model C (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing value, $ per 1000 population per year</td>
<td>1.09 (1.05-1.12)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>No. of payments, per 1000 population per year</td>
<td>NA</td>
<td>1.18 (1.14-1.21)</td>
<td>NA</td>
</tr>
<tr>
<td>No. of physicians receiving payments, per 1000 population per year</td>
<td>NA</td>
<td>NA</td>
<td>1.12 (1.08-1.16)</td>
</tr>
<tr>
<td>Age group, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-34 y</td>
<td>1.05 (1.03-1.07)</td>
<td>1.04 (1.02-1.06)</td>
<td>1.05 (1.03-1.06)</td>
</tr>
<tr>
<td>35-64 y</td>
<td>1.10 (1.07-1.12)</td>
<td>1.09 (1.07-1.12)</td>
<td>1.09 (1.07-1.12)</td>
</tr>
<tr>
<td>≥65 y</td>
<td>1.01 (0.99-1.02)</td>
<td>1.01 (0.99-1.02)</td>
<td>1.01 (1.00-1.03)</td>
</tr>
<tr>
<td>Male, %</td>
<td>0.93 (0.91-0.95)</td>
<td>0.94 (0.92-0.96)</td>
<td>0.94 (0.92-0.96)</td>
</tr>
<tr>
<td>White, %</td>
<td>1.01 (1.01-1.02)</td>
<td>1.01 (1.01-1.02)</td>
<td>1.01 (1.01-1.02)</td>
</tr>
<tr>
<td>High school or lower education, %</td>
<td>1.00 (1.00-1.01)</td>
<td>1.00 (1.00-1.01)</td>
<td>1.00 (1.00-1.01)</td>
</tr>
<tr>
<td>Unemployment, %</td>
<td>1.03 (1.01-1.04)</td>
<td>1.03 (1.02-1.05)</td>
<td>1.03 (1.01-1.04)</td>
</tr>
<tr>
<td>Poverty, %</td>
<td>1.03 (1.01-1.04)</td>
<td>1.03 (1.01-1.04)</td>
<td>1.03 (1.01-1.04)</td>
</tr>
<tr>
<td>Median household income ($1000)</td>
<td>1.00 (1.00-1.01)</td>
<td>1.00 (1.00-1.01)</td>
<td>1.00 (1.00-1.01)</td>
</tr>
<tr>
<td>Gini index&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.01 (1.00-1.02)</td>
<td>1.00 (1.00-1.02)</td>
<td>1.01 (1.00-1.02)</td>
</tr>
<tr>
<td>Metropolitan area</td>
<td>1.21 (1.11-1.31)</td>
<td>1.13 (1.04-1.22)</td>
<td>1.20 (1.10-1.30)</td>
</tr>
</tbody>
</table>

Source: Hadland et al. JAMA Network Open, 2019
Increased overdose mortality during the first week of the month: Revisiting the “check effect” through a spatial lens

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3 Department of Emergency Medicine, Boston University Medical Center, Boston, Massachusetts, USA
4 Center for Health Data and Analysis, Rhode Island Department of Health, Providence, RI, USA

Table 1
Increases in overdose fatalities in Rhode Island (2014–2016) in the beginning of a month relative to the end of a month, stratified by decedent age and sex and substances deemed to be involved in death.

<table>
<thead>
<tr>
<th></th>
<th>Total Overdoses</th>
<th>Overdoses:First 7 Days</th>
<th>Overdoses:Last 7 Days</th>
<th>Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>840</td>
<td>225</td>
<td>193</td>
<td>1.17 (1.04–1.38)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 to 24 years old</td>
<td>67</td>
<td>17</td>
<td>17</td>
<td>1.00 (0.85, 1.15)</td>
</tr>
<tr>
<td>25 to 34 years old</td>
<td>228</td>
<td>42</td>
<td>58</td>
<td>0.72 (0.65, 0.80)</td>
</tr>
<tr>
<td>35 to 44 years old</td>
<td>162</td>
<td>50</td>
<td>42</td>
<td>1.19 (1.09, 1.29)</td>
</tr>
<tr>
<td>45 to 54 years old</td>
<td>222</td>
<td>59</td>
<td>50</td>
<td>1.42 (1.33, 1.52)</td>
</tr>
<tr>
<td>55 years and older</td>
<td>159</td>
<td>47</td>
<td>33</td>
<td>1.42 (0.94, 1.30)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>604</td>
<td>155</td>
<td>149</td>
<td>1.04 (0.99, 1.09)</td>
</tr>
<tr>
<td>Female</td>
<td>234</td>
<td>60</td>
<td>51</td>
<td>1.18 (1.10, 1.25)</td>
</tr>
</tbody>
</table>
Table 3
Multivariable logistic regression analyses of factors associated with a census block group being included within a cluster of excess overdoses occurring during the first week of the month, Rhode Island (2014–2016).

<table>
<thead>
<tr>
<th>Neighborhood Characteristic</th>
<th>Adjusted Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% 18 to 24 years old</td>
<td>0.65 (0.36, 1.18)</td>
</tr>
<tr>
<td>% Male</td>
<td>1.28 (0.78, 2.08)</td>
</tr>
<tr>
<td>% Black (Non-Hispanic)</td>
<td>1.42 (1.02, 1.98)</td>
</tr>
<tr>
<td>% Poverty</td>
<td>1.51 (1.14, 1.99)</td>
</tr>
<tr>
<td>% Labor Force Participation</td>
<td>1.18 (0.82, 1.71)</td>
</tr>
<tr>
<td>% High School Completion</td>
<td>0.76 (0.55, 1.04)</td>
</tr>
<tr>
<td>% Health Insurance</td>
<td>0.96 (0.62, 1.49)</td>
</tr>
<tr>
<td>% Disability</td>
<td>1.53 (0.97, 2.41)</td>
</tr>
<tr>
<td>% Public Assistance Receipt</td>
<td>0.72 (0.36, 1.42)</td>
</tr>
<tr>
<td>% Supplemental Security Income (SSI)</td>
<td>1.04 (0.67, 1.62)</td>
</tr>
<tr>
<td>Receipt</td>
<td></td>
</tr>
<tr>
<td>% Housing Cost Burdened</td>
<td>1.42 (1.05, 1.91)</td>
</tr>
</tbody>
</table>

Note: All odds ratios are expressed per 10-unit increase in each of the continuous covariates.
Does the weather influence risk of opioid overdose?

Cold weather might:

1. Have a direct biological impact on respiratory function
2. Increase one’s likelihood of using drugs alone
3. Interrupt drug trafficking and drug selling patterns
Conducted a case-crossover analysis of 3,275 opioid overdose deaths in CT and RI between 2014 and 2017

Matched each case to a control day in the same year, month, and day of the week

Compared mean ambient temperature on the day of death, as well as average temp. up to 14 days before death

Used conditional logistic regression, adjusting for relative humidity and federal holidays
Odds of opioid overdose death was about 30% higher after periods of particularly cold weather (\(<0^\circ\text{C}, \text{or} <32^\circ\text{F}\))

Source: Goedel et al. Epidemiology, 2019
Strategies to reduce overdose death
A simple mathematical model for overdose deaths

\[ D = N \beta \mu \]

where:

- \( D \) = number of overdose deaths per year
- \( N \) = number of people at risk of overdose per year
- \( \beta \) = risk of overdose per person at risk per year
- \( \mu \) = risk of death per overdose per year
A simple mathematical model for overdose deaths

\[ D = N \beta \mu \]

Some principles:

- Each term is equally important
- Design interventions to impact >1 term
- Avoid interventions that decrease one term but increase another
How to decrease overdose deaths

\[ D = N \beta \mu \]

- Prevention, Treatment, and Recovery
- Harm Reduction
- Naloxone and Rescue
There are major gaps in the OUD care continuum:

- Screening/diagnosis
- Initiation of treatment

Source: Yedinak et al., PLoS Medicine, 2019
Drug checking programs

- Drug checking services are offered at supervised consumption facilities in Canada
- Rapid test strips detect fentanyl and analogs in urine or drug samples dissolved in water
- Fentanyl test strips are being distributed by harm reduction organizations throughout the US
- As of 2017, lack of research on uptake and acceptability of rapid fentanyl test strips, particularly among young people
Results from the first visit

- Mean age was 27
- 56% identified as male, 41% as female, and 4% as trans, non-binary, genderqueer, or something else
- 56% identified as white, 15% black, 28% other/mixed race + 24% Latinx
- Half had ever injected, over 1/3 reported a prior overdose, and 2/3 had ever witnessed an overdose
- 95% of participants planned to use take-home test strips
Results from the follow-up visit

81 (87%) participants returned for a second visit

77% reported using at least one strip

50% who used one strip received a positive result
Behavioral change after receiving a positive test

After receiving a positive result:
- 45% used smaller amounts
- 42% went slower when using
- 39% used with someone else around
- 36% did a tester shot
- 10% threw their drugs out

Among participants who received a positive result:
- 68% reported a positive change in overdose risk reduction practices, compared to baseline ($p < 0.001$)

But it’s (fentanyl) going to show up in the test, so it is kind of worth it. That’s what I’m saying is, you could save your life by using this. Or you could not use it and do what you’re going to do and be dead...I thought it came out positive, so I got rid of the fentanyl (Respondent 17, white male, age 20, urine testing group).

Source: Goldman et al., Harm Reduction Journal, 2019
But it’s (fentanyl) going to show up in the test, so it is kind of worth it. That’s what I’m saying is, you could save your life by using this. Or you could not use it and do what you’re going to do and be dead...I thought it came out positive, so I got rid of the fentanyl (Respondent 14, white, age 20, urine testing group).

Everything was useful. Those tests opened my eyes, and it has saved my life, and I can gladly say I haven’t taken any more because I was going to take two bags. If I had took those two bags, I think I wasn’t even going to be here right now (Respondent 39, male of non-disclosed race, age 28, residue testing group).
Everything was useful. Those tests opened my eyes, and it has saved my life, and I can gladly say I haven’t taken any more because I was going to be here right now. I would say we were definitely a lot more cautious about what we were doing, like definitely a lot more ready for something to, you know, go wrong… I definitely, like, would pace myself a lot slower with the drugs. And you know, it was like I said, it’s kind of sad to say but we were almost expecting an overdose or such. And so, if that did happen, you know like at least somebody could be like, oh and jump on it and act fast (Respondent 22, white male, age 22, urine testing group).
Senate Passes Bill Legalizing Fentanyl Test Strips

The Senate passed legislation on Tuesday allowing the possession and distribution of test strips to help prevent overdose deaths.

Fentanyl test Strips handed out for Overdose Awareness Day

Public Health advocates are promoting the use of fentanyl test strips to help prevent overdose deaths.
The COVID-19 pandemic is worsening the overdose crisis
Overdose & COVID-19: Manifold Hypotheses

1. Changes in the illegal drug supply as supply chains have been disrupted by travel restrictions and border measures

2. Less access to supports and services for people who use drugs, such as syringe service programs & supervised consumption sites (in Canada)

3. Discontinuation of therapies and return to use among persons in treatment

4. Multiple COVID-19 related stressors, including unemployment, financial losses, eviction, isolation, and depression leading to increased use of substances and recurrence of use

5. Increase in the number of people using drugs in private & alone
In Kentucky, there has been a 17% increase in EMS runs for suspected opioid overdose since COVID-19 and a 71% increase in runs with refusal to transport.

There has been a 50% increase suspected opioid overdose runs with deaths at the scene.

Source: Slavova et al., *Drug and Alcohol Dependence*, 2020
Overdose Death Trends, by month (2013-2020)

Source: RIDOH (https://health.ri.gov/data/drugoverdoses/)
Brown/Ecosystem Updated Analyses: New Findings

**STUDY PERIOD:** Jan-Aug 2019 vs. Jan-Aug 2020

**POPULATION**

- Nearly all increase among **men** (among 58 excess deaths, 55 are men)
- Significant increases among **men with depression + men with anxiety**
- Significant increases among people **age 50-59 with anxiety**

**ENVIRONMENT**

- The **majority** of overdose decedents in 2020 died at home (45% vs 53%)
- Modest proportional increase across **all contributing causes of death except heroin**

Source: https://preventoverdoseri.org/presentation-archive/
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  - Scott Hadland, Assistant Professor of Pediatrics, Boston University
  - Jody Rich, Professor of Medicine, Brown University
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Thank you!

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Title of Program: VCBH Monthly Lecture Series FY2021

Title of Talk: Social, Structural, and Environmental Drivers of the Opioid Overdose Crisis

Speaker/Moderator: Brandon Marshall, PhD

Planning Committee Members: Stephen H. Higgins, PhD, Phillip Ades, MD, Diann Gaalema, PhD

Date: February 17, 2021

Workshop #: 21-265-06

Learning Objectives

Claiming Instructions

Vermont Center on Behavior and Health Monthly Lecture Series FY 2021-Social, Structural, and Environmental Drivers of the Opioid Overdose Crisis 02/17/2021

Use the following link to access the claiming app, or scan the QR code below.


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Is there anything to disclose? ☐ Yes  ☑ No

Please list the Potential Conflict of Interest (if applicable): ****

All Potential Conflicts of Interest have been resolved prior to the start of this program.

☑ Yes  ☐ No  (If no, credit will not be awarded for this activity.)

(CMIE staff members do not have any interests to disclose)

All recommendations involving clinical medicine made during this talk were based on evidence that is accepted within the profession of medicine as adequate justification for their indications and contraindications in the care of patients.

☑ Yes

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