



Mortality and Longevity

# Economic Impact of Non-Medical Opioid Use in the United States



October 2019



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Annual Estimates and Projections for 2015 through 2019

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## Executive Summary

According to the Centers for Disease Control and Prevention (CDC), nearly 400,000 people in the United States died from drug overdoses involving prescription or illicit opioids from 1999 to 2017.<sup>1</sup> In addition to the substantial human toll of the opioid crisis, many sectors of the economy have been adversely impacted. An understanding of the scale and distribution of these impacts is necessary in order to inform responses and resource allocation decisions as the health care industry works to understand and address what some have termed “the biggest public health epidemic of a generation.”<sup>2</sup>

We estimate that the total economic burden of the opioid crisis in the United States from 2015 through 2018 was at least \$631 billion. This estimate includes costs associated with additional health care services for those impacted by opioid use disorder (OUD), premature mortality, criminal justice activities, child and family assistance programs, education programs and lost productivity. Importantly, this estimate does not include impacts for which there is a lack of adequate data, yet that are still meaningful and may be significant, as described throughout this report. For example, a few such impacts include reductions in household (non-paid) productivity, reductions in productive output while at work (presenteeism), and reductions in quality of life for those impacted directly or indirectly by OUD.

The estimated costs consist of the following:

- Nearly one-third (\$205 billion) of the estimated economic burden of the opioid crisis is attributable to excess health care spending for individuals with OUD, infants born with neonatal abstinence syndrome (NAS) or neonatal opioid withdrawal syndrome (NOWS), and for family members of those with diagnosed OUD.
- Mortality costs accounted for 40% (\$253 billion) of the estimated economic impact, predominantly driven by lost lifetime earnings for those who died prematurely due to drug overdoses involving opioids.
- Costs associated with criminal justice activities, including police protection and legal adjudication activities, lost property due to crime, and correctional facility expenditures, totaled \$39 billion, roughly 6% of the total cost from 2015 to 2018.
- Costs associated with government-funded child and family assistance programs and education programs contributed another \$39 billion over the four-year period.
- Lost productivity costs comprised the remaining 15% of total costs from 2015 through 2018, totaling \$96 billion. Lost productivity costs are associated with absenteeism, reduced labor force participation, incarceration for opioid-related crimes, and employer costs for disability and workers’ compensation benefits to employees with OUD.

It is important to recognize who bears these economic burdens. In total, we estimate \$186 billion (29%) of the total economic burden of the opioid crisis was borne by federal, state and local governments, while the remainder was borne by the private sector and individuals.

Using the latest available data, we also projected costs for 2019 based on three scenarios reflecting how the opioid crisis may develop. Our midpoint cost estimate for 2019 is \$188 billion, with our low and high cost estimates ranging from \$172 billion to \$214 billion. These cost estimates reflect a range of potential outcomes for key assumptions such as the prevalence of OUD and the number of opioid overdose deaths in 2019 and are intended to represent a reasonable range of scenarios, rather than the minimum or maximum of possible outcomes.

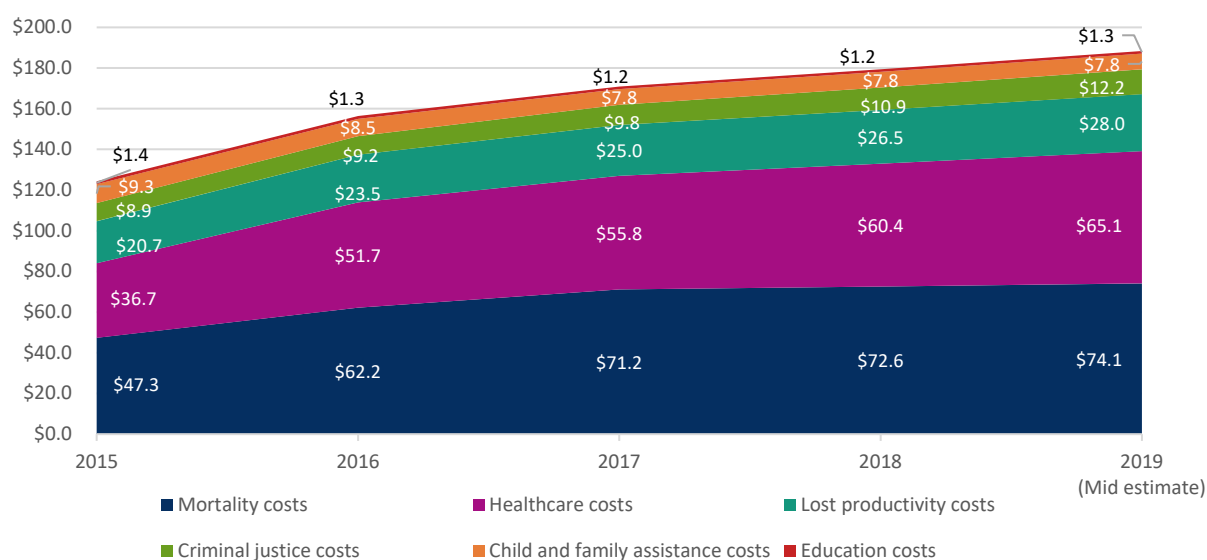
Our cost estimates for 2015 through 2018, each projected scenario for 2019 and grand total estimates including the 2019 midpoint scenario are summarized in Figure 1 (all costs in billions of dollars).

**Figure 1**  
TOTAL COST ESTIMATES BY CATEGORY, 2015–2019 (BILLIONS)

COST CATEGORY	2015	2016	2017	2018	TOTAL 2015–2018	2019 MID EST. (LOW-HIGH)	GRAND TOTAL 2015–2019 MID EST.
Health care Costs	\$36.7	\$51.7	\$55.8	\$60.4	\$204.6	\$65.1 (\$60.4–\$76.6)	\$269.7
Mortality Costs	\$47.3	\$62.2	\$71.2	\$72.6	\$253.3	\$74.1 (\$65.6–\$83.6)	\$327.4
Criminal Justice Costs	\$8.9	\$9.2	\$9.8	\$10.9	\$38.8	\$12.2 (\$11.2–\$12.8)	\$50.9
Child and Family Assistance Costs	\$9.3	\$8.5	\$7.8	\$7.8	\$33.4	\$7.8 (\$7.3–\$8.7)	\$41.1
Education Costs	\$1.4	\$1.3	\$1.2	\$1.2	\$5.2	\$1.3 (\$1.2–\$1.4)	\$6.5
Lost Productivity Costs	\$20.7	\$23.5	\$25.0	\$26.5	\$95.7	\$28.0 (\$26.0–\$31.3)	\$123.7
Grand Total	\$124.3	\$156.4	\$170.9	\$179.4	\$631.0	\$188.4 (\$171.6–\$214.4)	\$819.3

Figure 2 shows how total costs and each component have trended from 2015 through the 2019 midpoint estimate.

**Figure 2**  
TRENDS IN TOTAL COSTS BY CATEGORY, 2015–2019 (BILLIONS)



The increases in many of the cost estimates in Figures 1 and 2 are largely driven by increasing numbers of opioid overdose deaths and increasing prevalence of OUD. We see the most significant increases in health care, mortality and lost productivity costs from 2015 to 2016, which coincides with a significant year-over-year increase in both the number of opioid overdose deaths and the prevalence of OUD. Opioid deaths increased significantly in 2016 as the use of fentanyl, which is far more potent than prescription opioids or heroin, became more common. In 2016, illicit opioids (such as heroin and fentanyl) passed prescription opioids as the most common drugs involved in overdose deaths for the first time in the United States. Further, our estimates for the prevalence of OUD increased significantly, from an estimated 2.7 million individuals in 2015 to 3.5 million individuals in 2016 (though some of this increase could be driven by increased identification of individuals already experiencing OUD because the crisis began to generate more awareness within the public and the medical community or by sampling differences in our data sources). Note that, while we estimate that the total economic cost of the opioid crisis increased each year from 2015 to 2018, the rate of increase also slowed each year, though it is too early to tell whether we are approaching a turning point in the crisis.

## Introduction

According to the CDC, nearly 20 million American adults experienced “high-impact” chronic pain in 2016.<sup>3</sup> Those experiencing severe pain are more likely to suffer a range of adverse health effects, including depression, exhaustion, anxiety and more difficulty functioning in general, including keeping up with employment and other responsibilities. Severe pain is also associated with more frequent use of health care services and higher mortality.<sup>4</sup>

The response of the U.S. health care system to the problem of pain has varied over time, and early recognition of the problem of under-treatment in the 1990s was followed by a rapid increase in the use of opioid analgesics, with the number of opioid prescriptions nearly tripling from 76 million to 219 million per year from 1991 to 2011.<sup>5, 6</sup> As clinicians began to reassess the safety and effectiveness of prescription opioids in the early 2010s, the number of opioid prescriptions began to decline, but the epidemic entered a second phase marked by increased use of heroin and a few years later a third phase marked by the emergence of illegally manufactured fentanyl.<sup>7</sup> In 2017, the U.S. Department of Health and Human Services (HHS) declared the epidemic a public health emergency, because 130 Americans were dying every day from opioid overdoses.<sup>8</sup>

While the number of opioid prescriptions peaked in 2011, the number of drug overdose deaths has continued to climb. More than 70,000 Americans died in 2017 from drug overdoses, and opioids are the fastest-growing and the largest drug category involved.<sup>9</sup> Opioid overdose deaths are now the single largest factor slowing the growth in U.S. life expectancy and have led to stagnation or decreases in life expectancy three years in a row for the first time since 1915–1918, when the country was facing World War I and the Spanish flu pandemic.<sup>10</sup> By some estimates, the United States may be on track to see an additional 500,000 opioid overdose deaths over the next decade.<sup>11</sup>

In light of these alarming statistics and the tremendous human toll of the crisis, stakeholders across the health care system are working to build their understanding of OUD and develop effective responses to the problem.<sup>12</sup> The Mortality and Longevity Program Steering Committee (MLPSC) engaged Milliman to complete a study of the economic and financial implications of the opioid crisis, with the goals of helping actuaries and insurers better understand and project the impacts on pricing, valuation, and for other purposes, as well as helping others understand the scale and distribution of the economic impacts to support resource allocation decisions and development of responses to the crisis. Actuaries have long played an important role in understanding and measuring population-level risks, and this research will also benefit the public and policymakers as they respond to the opioid crisis.

The estimates for the economic impact of the opioid crisis presented in this report include several different quantifiable cost categories. We estimate health care costs as those associated with additional services for individuals with OUD and family members of individuals with OUD, as well as hospital treatment costs for infants born with NAS or NOWS. We estimate mortality costs based on lost lifetime earnings and medical costs at time of death for fatal drug overdoses involving opioids. Criminal justice costs are identified as those associated with criminal activity involving opioids, independent of whether the involved individuals were opioid users. Child and family assistance program costs, as well as education costs, are apportioned from federal expenditures based on assumptions for the percentage of federal spending attributable to non-medical opioid use. Finally, lost productivity costs include lost wages due to absenteeism, non-participation in the labor force and incarceration, as well as disability and workers’ compensation claims, for individuals with OUD. The glossary provides further descriptions of these terms within the context of this report.

In the sections that follow, we provide a review of the prominent literature on this topic, an overview of our findings, detailed results by cost category, descriptions of the methodology employed for each category, a discussion of our results, and limitations of our findings. Our results are presented throughout this report in the order in which we were able to provide the most significant contributions to the body of literature, starting with health care costs, where we leveraged proprietary Milliman data resources alongside other national research databases. Additional details for health care and lost productivity costs are provided in the appendices, including results by age, sex, state and health care service category.



## Literature review

A few notable studies published in the past several years have estimated the significant societal and economic costs of the opioid crisis in the United States. The most prominent and widely cited of these studies are listed below:

- The White House Council of Economic Advisers (CEA) published estimates in 2017 and found that the economic cost of the opioid crisis was \$504 billion in 2015, or 2.8% of gross domestic product (GDP).<sup>13</sup>
- Researchers from the CDC and the U.S. HHS published estimates in 2016 and found that the total economic burden of non-medical opioid use was \$78.5 billion in 2013.<sup>14</sup>
- Researchers from Analysis Group Inc. published estimates in 2011 and found that the total societal cost of prescription opioid abuse was \$55.7 billion in 2007.<sup>15</sup>
- Altarum published estimates in 2017 and found that the potential societal benefit of eliminating opioid overdoses, deaths and substance use disorders was \$95 billion in 2016.<sup>16</sup>

For the most part, these studies relied on broadly similar underlying methodologies and found that the highest contributors to the total economic impact of non-medical opioid use are costs associated with premature mortality and use of health care services. All studies mentioned above also included costs associated with criminal justice activity and lost productivity, while Rhyon also included costs of federal education spending and child and family assistance spending. The primary outlier of the established literature on this topic is the mortality cost estimate that CEA produced, which relied on a different methodology for valuing costs of early death due to opioid overdose, producing an estimate several times higher than those reported in the other studies. While most of these reports estimated the value of lost lifetime earnings due to premature mortality, the CEA instead calculated the “value of a statistical life,” which is a measure that federal agencies use in comparative analyses for policies, regulations or programs. This approach differs from other approaches conceptually in that it estimates the loss of economic *value* associated with early mortality, rather than the loss of economic *activity*.

In addition to the prominent literature identified above, several other studies have explored the impact of non-medical opioid use on health care costs. A study completed by Kirson et al. found that OUD results in nearly \$15,000 in excess costs per patient per year, landing in the middle of the range of other studies they cited, which ranged from \$10,000 to \$20,000 in additional health expenses each year.<sup>17</sup> Another study conducted by the same team found nearly \$11,000 in excess health care costs per patient when relying on a different data source for their analysis.<sup>18</sup> A study focusing on Medicare fee-for-service (FFS) beneficiaries found more than \$24,000 per year in additional health care costs.<sup>19</sup> One literature review encompassing 49 studies across both private and public payers found that patients with diagnosed OUD averaged \$20,000 to \$29,000 in annual health care costs compared to \$10,000 to \$14,000 for patients without OUD.<sup>20</sup>

This analysis combines methodologies from several of the aforementioned reports, along with new approaches and more recent data, to produce updated estimates of the economic cost of non-medical opioid use (both prescription misuse and illicit use) from 2015 through 2018, as well as cost projections for 2019. A brief comparison of the methodologies employed in the prominent studies listed above and those used in this analysis is provided in Figure 3.

**Figure 3**  
METHODOLOGY SUMMARY BY STUDY

COST CATEGORY	BIRNBAUM ET AL. (2011)	FLORENCE ET AL. (2016)	RHYAN (2017)	CEA (2017)	THIS REPORT
Health care Costs	Matched case-control study	Matched case-control study	Overdoses resulting in emergency room and hospital visits; costs based on increased risk of illicit drug-related conditions	Projected from Florence et al.	Matched case-control study
<i>Payers included</i>	<i>Privately insured, Florida Medicaid</i>	<i>All insured and uninsured populations</i>	<i>All insured and uninsured populations</i>	<i>All insured and uninsured populations</i>	<i>All insured and uninsured populations</i>
<i>Populations included</i>	<i>Individuals with OUD and some family members of those with OUD</i>	<i>Individuals with OUD</i>	<i>Individuals with OUD</i>	<i>Individuals with OUD</i>	<i>Individuals with OUD, family members of those with OUD, and infants born with NAS/NOWS</i>
Mortality Costs	Lost lifetime earnings	Lost lifetime earnings	Lost lifetime earnings	Value of statistical life	Lost lifetime earnings
Criminal Justice Costs	Apportionment of costs for police protection, legal and adjudication, correctional facility, and property lost due to crime	Same method as Birnbaum et al.	Same method as Birnbaum et al.	Projected from Florence et al.	Same method as Birnbaum et al.
Child and Family Assistance Costs	Not included	Not included	Apportionment of federal expenditures	Not included	Same method as Rhyan
Education Costs	Not included	Not included	Apportionment of federal expenditures	Not included	Same method as Rhyan
Lost Productivity Costs	Absenteeism, presenteeism, incarceration, disability	Absenteeism, reduced labor force participation, incarceration	Productivity decreases associated with substance use, incarceration	Projected from Florence et al.	Absenteeism, reduced labor force participation, incarceration, disability, workers' compensation

Our analysis applies methods in previously published studies to more recent data to update cost estimates for a few categories while also extending results for other categories to cover a wider range of individuals impacted by the opioid crisis. In particular, we present a broader conception of health care costs than the noted studies by including treatment costs of NAS/NOWS and costs for all insured and uninsured individuals with family members who have OUD. Further, we provide a greater level of cost detail by subpopulation (payer type, age, sex, state) than available in other published literature.

Additionally, we calculate higher prevalence rates of diagnosed OUD than other published studies, contributing to higher total health care costs and lost productivity costs. We derived OUD prevalence rates from detailed medical claims data, which paint a different picture of how the opioid crisis is evolving from self-reported OUD prevalence data that underlie the cost estimates of many other studies.

The nature and scale of the opioid crisis have been in considerable flux in recent years, with synthetic opioids such as fentanyl only recently becoming a dominant driver of the severity of the crisis. Provisional estimates from the CDC show opioid overdose deaths plateauing in 2018, but overdose deaths from illicit use of synthetic opioids are still on the rise, and it's not yet clear whether overdose deaths are likely to be higher or lower in 2019.<sup>21</sup> As such, timely estimates are key for understanding the economic costs of the crisis as it is currently manifesting.



## Overview of Results

Using a wide range of public and proprietary data sources, including administrative claims data, federal surveys, databases and reports, as well as prior peer-reviewed literature, we estimated the economic impact of non-medical opioid use on health care costs, costs associated with premature mortality, criminal justice costs, child and family assistance program costs, education program costs and lost productivity costs.

Conceptually, our aim was to quantify areas where non-medical opioid use was expected to generate measurable changes in economic activity. Further, we focused on downstream costs associated with the consequences of non-medical opioid use, not on upstream economic activities designed to prevent or deter such use. The estimates presented in this report are inclusive of economic impacts for which sufficient data were available to develop reasonable estimations. There are other economic impacts of non-medical opioid use worth noting that we have not quantified for this analysis due to the lack of adequate data, as described in the Discussion, Limitations and Caveats sections of this report.

Figure 4 summarizes the results of our analysis by cost category from 2015 through 2019. Due to uncertainty about how the opioid crisis may develop in 2019, we have projected mid, low and high cost estimates that encompass different scenarios for the prevalence of OUD and opioid overdose deaths in that year. The 2019 estimates represent a range of possible scenarios and are not intended to represent minima or maxima of possible outcomes.

**Figure 4**  
ECONOMIC IMPACT OF NON-MEDICAL OPIOID USE (IN MILLIONS)

COST CATEGORY	2015	2016	2017	2018	2019 MID EST.	2019 LOW EST.	2019 HIGH EST.
Health care Costs							
For individuals with OUD							
Commercial	\$12,547	\$15,761	\$16,780	\$17,867	\$19,151	\$17,795	\$22,209
Medicare	\$10,531	\$19,560	\$21,297	\$23,162	\$25,355	\$23,494	\$31,357
Medicaid	\$5,902	\$7,402	\$7,896	\$8,294	\$8,770	\$8,124	\$9,731
Other Public Insurance	\$345	\$467	\$495	\$523	\$555	\$508	\$692
Uninsured	\$5,083	\$5,638	\$6,171	\$7,095	\$7,577	\$7,023	\$8,344
<i>Subtotal</i>	<i>\$34,408</i>	<i>\$48,827</i>	<i>\$52,639</i>	<i>\$56,941</i>	<i>\$61,407</i>	<i>\$56,944</i>	<i>\$72,332</i>
For infants born with NAS or NOWS							
Commercial	\$76	\$82	\$86	\$92	\$97	\$91	\$109
Medicare	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Medicaid	\$495	\$540	\$586	\$642	\$695	\$652	\$789
Other Public Insurance	\$6	\$7	\$7	\$7	\$7	\$7	\$8
Uninsured	\$47	\$52	\$56	\$61	\$66	\$62	\$75
<i>Subtotal</i>	<i>\$624</i>	<i>\$681</i>	<i>\$734</i>	<i>\$801</i>	<i>\$865</i>	<i>\$812</i>	<i>\$981</i>
For family members of individuals with OUD							
Commercial	\$727	\$915	\$990	\$1,054	\$1,130	\$1,050	\$1,310
Medicare	\$281	\$524	\$579	\$630	\$690	\$639	\$853
Medicaid	\$342	\$430	\$466	\$489	\$517	\$479	\$574
Other Public Insurance	\$20	\$27	\$29	\$31	\$33	\$30	\$41
Uninsured	\$295	\$327	\$364	\$419	\$447	\$414	\$492
<i>Subtotal</i>	<i>\$1,665</i>	<i>\$2,223</i>	<i>\$2,428</i>	<i>\$2,623</i>	<i>\$2,816</i>	<i>\$2,612</i>	<i>\$3,270</i>
<b>Health care subtotal</b>	<b>\$36,697</b>	<b>\$51,731</b>	<b>\$55,801</b>	<b>\$60,365</b>	<b>\$65,088</b>	<b>\$60,368</b>	<b>\$76,583</b>
Mortality Costs							
Medical costs	\$173	\$225	\$259	\$264	\$270	\$238	\$304
Lost lifetime earnings	\$47,161	\$61,938	\$70,943	\$72,368	\$73,817	\$65,331	\$83,322
<b>Mortality subtotal</b>	<b>\$47,334</b>	<b>\$62,163</b>	<b>\$71,202</b>	<b>\$72,632</b>	<b>\$74,087</b>	<b>\$65,569</b>	<b>\$83,626</b>

COST CATEGORY	2015	2016	2017	2018	2019 MID EST.	2019 LOW EST.	2019 HIGH EST.
<b>Criminal Justice Costs</b>							
Police protection	\$3,013	\$3,186	\$3,590	\$4,114	\$4,761	\$4,349	\$4,920
Legal and adjudication activities	\$1,355	\$1,417	\$1,580	\$1,791	\$2,050	\$1,872	\$2,118
Property lost due to crime	\$938	\$942	\$841	\$867	\$894	\$846	\$1,004
Correctional facilities	\$3,564	\$3,610	\$3,826	\$4,133	\$4,470	\$4,118	\$4,712
<b>Criminal justice subtotal</b>	<b>\$8,870</b>	<b>\$9,155</b>	<b>\$9,837</b>	<b>\$10,905</b>	<b>\$12,175</b>	<b>\$11,185</b>	<b>\$12,754</b>
<b>Child and Family Assistance Costs</b>							
Child welfare	\$1,313	\$1,269	\$1,231	\$1,299	\$1,371	\$1,297	\$1,539
Food and nutritional assistance	\$3,640	\$3,214	\$2,805	\$2,683	\$2,567	\$2,429	\$2,882
Income assistance	\$708	\$646	\$587	\$582	\$578	\$547	\$649
Housing/homeless assistance	\$3,627	\$3,417	\$3,143	\$3,189	\$3,236	\$3,062	\$3,633
<b>Child and family assistance subtotal</b>	<b>\$9,288</b>	<b>\$8,546</b>	<b>\$7,766</b>	<b>\$7,753</b>	<b>\$7,752</b>	<b>\$7,335</b>	<b>\$8,703</b>
<b>Education Costs</b>	<b>\$1,426</b>	<b>\$1,335</b>	<b>\$1,231</b>	<b>\$1,244</b>	<b>\$1,257</b>	<b>\$1,190</b>	<b>\$1,412</b>
<b>Lost Productivity Costs</b>							
Reduced labor force participation and absenteeism	\$16,719	\$19,356	\$20,717	\$21,852	\$23,094	\$21,414	\$25,995
Incarceration	\$3,280	\$3,264	\$3,433	\$3,655	\$3,909	\$3,600	\$4,120
Short-term disability	\$312	\$372	\$393	\$417	\$443	\$412	\$514
Long-term disability	\$28	\$34	\$36	\$38	\$40	\$38	\$47
Workers' Compensation	\$362	\$442	\$470	\$500	\$535	\$497	\$621
<b>Lost productivity subtotal</b>	<b>\$20,701</b>	<b>\$23,468</b>	<b>\$25,049</b>	<b>\$26,462</b>	<b>\$28,022</b>	<b>\$25,961</b>	<b>\$31,296</b>
<b>Grand Total</b>	<b>\$124,317</b>	<b>\$156,398</b>	<b>\$170,886</b>	<b>\$179,360</b>	<b>\$188,381</b>	<b>\$171,608</b>	<b>\$214,375</b>

The largest cost category in each year was mortality, predominantly driven by lost lifetime earnings for those who died prematurely due to drug overdoses involving opioids. Mortality costs increased more than 30% from 2015 to 2016 and nearly 15% from 2016 to 2017 but may be starting to level off, consistent with provisional estimates of drug overdose deaths from the CDC that show the number of opioid overdose deaths remaining flat from 2017 to 2018.<sup>22</sup>

Health care was the next largest cost category, predominantly driven by the additional health care costs incurred by patients who have been diagnosed with OUD. Health care costs increased by more than 40% from 2015 to 2016 but have grown by roughly 8% per year thereafter. The significant increase from 2015 to 2016 was largely driven by a significant increase in our estimates for the prevalence of OUD over the same time period. The increase in the observed prevalence of OUD (and associated health care costs) was particularly large for the Medicare population. More than half (55%) of health care costs were incurred by patients with public insurance—including Medicare, Medicaid and other public insurance programs—and nearly one-third (33%) of health care costs were incurred by patients with commercial insurance, while the remainder (12%) was incurred by those without insurance coverage.

Lost productivity accounted for over 15% of total costs, driven predominantly by reduced labor force participation and increased absenteeism for those with OUD. Lost productivity costs increased by more than 13% from 2015 to 2016 but have increased by 6% to 7% per year thereafter.

Criminal justice, child and family assistance, and education costs collectively accounted for the remaining 12% of total costs. Criminal justice costs have increased each year consistent with the increasing presence of illicit opioids such as heroin and fentanyl in the opioid drug environment. Child and family assistance costs, as well as education costs, have fallen each year, which is a function of total federal budgets for these types of programs remaining largely static and opioids falling as a percentage of all non-medical substance use cases (due to increasing use of marijuana, cocaine, hallucinogens, inhalants and methamphetamine).

We further summarized cost estimates for government and non-government stakeholders, as shown in Figure 5. Government costs include health care costs for public payers, criminal justice costs (excluding property lost due to crime), child and family assistance costs and education costs. Costs for the private sector and individuals include health care costs for those with commercial insurance or who are uninsured, mortality costs, property lost due to crime and lost productivity.<sup>23</sup>

**Figure 5**

ECONOMIC IMPACT OF NON-MEDICAL OPIOID USE, BY STAKEHOLDER, 2015–2019 (MILLIONS)

STAKEHOLDER	2015	2016	2017	2018	2019 MID EST.	2019 LOW EST.	2019 HIGH EST.
Federal, state and local governments	\$36,568	\$47,049	\$49,348	\$52,812	\$56,911	\$52,797	\$65,909
Private sector and individuals	\$87,749	\$109,349	\$121,538	\$126,548	\$131,470	\$118,811	\$148,465

Government spending represented approximately 30% of total costs each year over this time period, with the majority of costs falling to the private sector and individuals.

## Detailed Results

The sections below describe our results and methodology in more detail for each cost category presented in Figure 4 above, including detailed estimates of the economic impact of non-medical opioid use in the United States from 2015 to 2018, as well as projected ranges for 2019.

### Health Care Costs

Using a matched case-control study design with administrative health care claims data, we have estimated the additional health care costs for patients with diagnosed OUD, as well as for family members of individuals with OUD who also incur more health care costs compared to individuals without non-medical opioid use in the family. Further, there has been a dramatic increase in the number of newborns with NAS or NWS since the start of the opioid crisis, and we have developed estimates for the costs associated with their hospital care based on National Vital Statistics reports and prior published literature. Overall, we found that the additional health care costs of patients with OUD and their families contribute a significant portion to the total economic impact of non-medical opioid use in the United States.

These estimates rely on the prevalence of diagnosed opioid abuse, dependence or poisoning in medical claims data, and it is likely that additional costs exist for those with non-medical opioid use that has not been diagnosed in a health care setting. We note that our results are largely consistent with other prominent literature on the additional health care costs for patients with OUD, as described in the earlier Literature Review section of this report.

### Patients with Diagnosed OUD

Studies have shown that patients with diagnosed OUD have more complex health care needs than those without, as well as lower reported physical and mental qualities of life.<sup>24, 25, 26</sup> Patients with OUD exhibit additional health care costs, not only from the direct treatment of OUD but also from increased utilization of all types of health care services (including both physical health and behavioral health services in inpatient, outpatient and professional settings).

We estimated the additional health care costs for patients with OUD by completing a matched case-control study using administrative claims data from three large national research databases. Using data from 2014 through 2017, we identified individuals with a diagnosis of opioid abuse, poisoning or dependence and matched them to controls without such diagnoses of the same age, sex, state, payer, eligibility category (for public payers) and with similar risk factors over a 12-month baseline period. We then compared the costs of patients with OUD and their matched controls without OUD in the year following the opioid-related diagnosis and extrapolated results to national population estimates by age, sex and state. Detailed information regarding the data and matching approach used in this analysis can be found in the Methodology section of this report below.

Our estimates rely on detailed claims data for commercial, Medicare and Medicaid covered patients. Due to lack of comparably detailed data for the other populations (those with other public insurance and the uninsured), we made the following simplifying assumptions:

- That the age-sex specific prevalence rates for OUD and the additional health care costs per patient with OUD for those without insurance are comparable to those on Medicaid.<sup>27</sup> National extrapolations were adjusted by age, sex and area to account for differences in the demographic and geographic distributions of the two populations. This approach assumes that similar socioeconomic circumstances between those on Medicaid and the uninsured might lead to similar prevalence rates of OUD and that the amount of additional health care resources used by OUD patients without insurance is comparable to the resources used by those with Medicaid, regardless of the ability of the patient to pay for those services. This approach further assumes that any health care costs that the uninsured were not able to pay for still generated an economic cost in the form of reduced payment for services rendered by health care providers.

- That the age-sex specific prevalence rates for OUD and the additional health care costs per patient with OUD for those with other public insurance are comparable to those with commercial insurance.<sup>28</sup> National extrapolations were adjusted by age, sex and area to account for differences in the demographic and geographic distributions of the two populations. This approach assumes that similar socioeconomic circumstances between those with other public insurance and with commercial insurance might lead to similar prevalence rates of OUD and that the amount of additional health care resources used by OUD patients with other public insurance is comparable to the resources used by those with commercial insurance.

The estimates for the other public and uninsured populations are necessarily rough and are subject to considerable uncertainty. These estimates are intended only to provide a sense for the general magnitude of potential costs for these populations.

Figure 6 summarizes national estimates of additional health care costs by payer (for example, commercial, Medicare and Medicaid) for patients with OUD from 2015 through 2018.<sup>29</sup> Additional tables displaying a comparison of baseline characteristics and results of statistical testing, as well as results by age, sex, state and detailed health care service category, are provided in the appendices.

**Figure 6**

#### ADDITIONAL HEALTH CARE COSTS FOR PATIENTS WITH OUD BY PAYER, 2015–2018

PAYER	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT	TOTAL (MILLIONS)
<b>Calendar Year 2015</b>				
Commercial	3.49	608,701	\$20,612	\$12,547
Medicare	14.64	652,912	\$16,129	\$10,531
Medicaid	12.24	732,082	\$8,062	\$5,902
Other Public	3.28	15,326	\$22,480	\$345
Uninsured	22.67	668,519	\$7,604	\$5,083
<b>Total</b>	<b>8.56</b>	<b>2,677,540</b>	<b>\$12,851</b>	<b>\$34,408</b>
<b>Calendar Year 2016</b>				
Commercial	4.20	738,350	\$21,346	\$15,761
Medicare	25.11	1,149,118	\$17,021	\$19,560
Medicaid	14.11	865,771	\$8,549	\$7,402
Other Public	4.27	19,858	\$23,522	\$467
Uninsured	25.93	701,252	\$8,040	\$5,638
<b>Total</b>	<b>11.05</b>	<b>3,474,348</b>	<b>\$14,054</b>	<b>\$48,827</b>
<b>Calendar Year 2017</b>				
Commercial	4.36	770,751	\$21,771	\$16,780
Medicare	26.08	1,227,442	\$17,351	\$21,297
Medicaid	14.66	892,445	\$8,847	\$7,896
Other Public	4.47	20,491	\$24,176	\$495
Uninsured	26.93	747,406	\$8,257	\$6,171
<b>Total</b>	<b>11.54</b>	<b>3,658,534</b>	<b>\$14,388</b>	<b>\$52,639</b>
<b>Calendar Year 2018</b>				
Commercial	4.52	805,372	\$22,185	\$17,867
Medicare	27.09	1,309,945	\$17,681	\$23,162
Medicaid	15.23	919,941	\$9,016	\$8,294
Other Public	4.67	21,217	\$24,636	\$523
Uninsured	27.97	779,032	\$9,108	\$7,095
<b>Total</b>	<b>12.02</b>	<b>3,835,507</b>	<b>\$14,846</b>	<b>\$56,941</b>

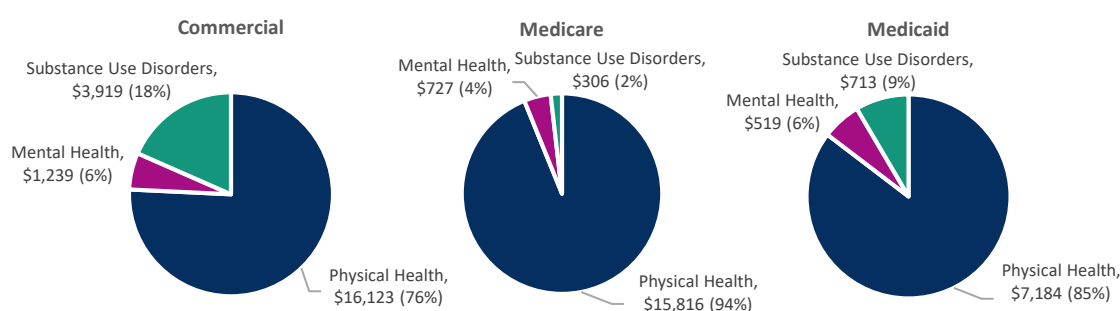
Averaged across all payers, patients with OUD incurred almost \$13,000 to \$15,000 more in health care costs each year than similar patients not diagnosed with OUD. Among the three major payers, commercially insured patients with OUD show the highest additional costs, followed by Medicare and Medicaid beneficiaries, with the costs for Medicaid beneficiaries coming in at half or less of the additional costs for those covered by commercial insurance or Medicare. OUD prevalence derived from medical claims data increased in all populations between 2015 and 2018, with the largest increases occurring between 2015 and 2016. Within the Medicare population, the prevalence of OUD was substantially higher for those under 65 (generally qualifying for Medicare benefits through disability) than for those 65 and older.

The prevalence of OUD increased dramatically for Medicare in particular (more than 70%) from 2015 to 2016. This increase was widespread, with 14 states showing doubled prevalence rates in the Medicare population over this timeframe. In line with this increase, OUD prevalence rates for commercially insured and Medicaid patients also increased significantly for individuals aged 65 and older from 2015 to 2016. Some of the increase in prevalence may be associated with heightened coding of opioid dependence in medical encounters in response to the opioid crisis. The older population may be particularly impacted by potential heightened coding, where long-term prescription opioid use is more prevalent.<sup>30</sup> Detailed OUD prevalence results by age, sex and state can be found in the appendices.

Due to increasing prevalence of diagnosed OUD, additional health care costs for diagnosed patients of all payers increased from 2015 through 2018, totaling \$192.8 billion over the four-year period. The additional costs for patients with OUD relative to those without occur across a variety of health care service types. Figure 7 shows the distribution of additional health care costs for commercially insured, Medicare and Medicaid patients with OUD compared to their matched controls (see the Methodology section below for details) by service category, averaged across patients diagnosed with OUD in either 2015 or 2016.<sup>31</sup>

**Figure 7**

HEALTH CARE COST DIFFERENCES BETWEEN PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY PAYER AND SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)<sup>32</sup>



The substantial majority of additional health care costs for each payer were for physical health care services. This is in line with previous reports that have found that most of the excess costs for patients with behavioral and chronic medical comorbidities result from increased medical treatment, rather than directly from higher utilization of behavioral health services.<sup>33</sup> The next largest category of additional costs for commercially insured and Medicaid patients was substance use disorder treatment services. Spending on mental health and substance use disorders was particularly small in the Medicare population.

Figure 8 provides further detail on the cost differences between patients with OUD and their matched controls by health care service category for the commercially insured population. Comparable tables with more detailed service categories, as well as results for the Medicare and Medicaid populations, can be found in the appendices.

**Figure 8**

HEALTHCARE COST DIFFERENCES BETWEEN COMMERCIALLY INSURED PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	AVERAGE COST PER PATIENT			ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PATIENTS WITH OUD	MATCHED CONTROLS	RELATIVE COST*	PER PATIENT	PERCENTAGE OF TOTAL
<b>Total</b>	<b>\$29,557</b>	<b>\$8,276</b>	<b>3.6</b>	<b>\$21,281</b>	<b>100.0%</b>
<b>Physical Health</b>	<b>\$20,537</b>	<b>\$5,850</b>	<b>3.5</b>	<b>\$14,687</b>	<b>69.0%</b>
Inpatient Facility	\$8,470	\$1,594	5.3	\$6,875	32.3%
Outpatient Facility	\$6,287	\$2,489	2.5	\$3,799	17.9%
Emergency Care	\$1,428	\$266	5.4	\$1,162	5.5%
Professional	\$4,351	\$1,500	2.9	\$2,851	13.4%
<b>Behavioral Health</b>	<b>\$4,604</b>	<b>\$173</b>	<b>26.6</b>	<b>\$4,430</b>	<b>20.8%</b>
<b>Mental Health</b>	<b>\$988</b>	<b>\$141</b>	<b>7.0</b>	<b>\$847</b>	<b>4.0%</b>
Inpatient Facility	\$635	\$45	14.0	\$590	2.8%
Outpatient Facility	\$159	\$16	9.7	\$142	0.7%
Professional	\$194	\$79	2.4	\$114	0.5%
<b>Substance Use Disorders</b>	<b>\$3,616</b>	<b>\$32</b>	<b>112.0</b>	<b>\$3,584</b>	<b>16.8%</b>
Inpatient Facility	\$1,746	\$20	87.0	\$1,726	8.1%
Outpatient Facility	\$1,722	\$10	164.3	\$1,712	8.0%
Professional	\$147	\$2	85.5	\$146	0.7%
<b>Prescription Drugs</b>	<b>\$4,417</b>	<b>\$2,253</b>	<b>2.0</b>	<b>\$2,163</b>	<b>10.2%</b>
Medication-assisted Treatment	\$339	\$3	103.5	\$335	1.6%
Other Opioids	\$774	\$82	9.4	\$691	3.2%
Behavioral Health	\$594	\$201	2.9	\$392	1.8%
Physical Health	\$2,710	\$1,966	1.4	\$744	3.5%

\*Relative costs represent the ratio of the cost per patient between OUD patients and controls.

In relative terms, the increases in costs were the largest for substance use disorder treatment services, with the costs for many types of services being more than 100 times as high for patients with OUD compared to their matched controls. The relative increase in costs for mental health services was double the increase for physical health services (7.0 times vs. 3.5 times), though in absolute terms physical health care costs accounted for the majority of excess costs (as indicated in Figure 7).

Figure 9 provides a comparison of the relative costs and the distribution of additional costs by service category between commercially insured, Medicare and Medicaid patients with OUD compared to their matched controls.



**Figure 9**

COMPARISON OF DIFFERENCES IN RELATIVE COSTS BETWEEN COHORTS, BY SERVICE CATEGORY  
(AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	COSTS FOR OUD PATIENTS RELATIVE TO MATCHED CONTROLS			PERCENTAGE OF TOTAL ADDITIONAL COST (%)		
	COMMERCIAL	MEDICARE	MEDICAID	COMMERCIAL	MEDICARE	MEDICAID
<b>Total</b>	<b>3.6</b>	<b>2.3</b>	<b>2.5</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Physical Health</b>	<b>3.5</b>	<b>2.6</b>	<b>2.8</b>	<b>69.0</b>	<b>84.1</b>	<b>79.9</b>
<i>Inpatient Facility</i>	5.3	4.1	4.4	32.3	58.8	51.6
<i>Outpatient Facility</i>	2.5	1.5	1.8	17.9	7.7	8.6
<i>Emergency Care</i>	5.4	3.3	3.6	5.5	4.8	7.2
<i>Professional</i>	2.9	1.8	1.9	13.4	12.8	12.5
<b>Behavioral Health</b>	<b>26.6</b>	<b>5.0</b>	<b>6.6</b>	<b>20.8</b>	<b>3.8</b>	<b>9.9</b>
<b>Mental Health</b>	<b>7.0</b>	<b>3.8</b>	<b>3.9</b>	<b>4.0</b>	<b>2.5</b>	<b>4.4</b>
<i>Inpatient Facility</i>	14.0	5.2	6.5	2.8	2.3	3.5
<i>Outpatient Facility</i>	9.7	1.5	2.7	0.7	0.1	0.3
<i>Professional</i>	2.4	1.8	1.8	0.5	0.2	0.6
<b>Substance Use Disorders</b>	<b>112.0</b>	<b>30.4</b>	<b>26.1</b>	<b>16.8</b>	<b>1.3</b>	<b>5.5</b>
<i>Inpatient Facility</i>	87.0	33.1	25.2	8.1	1.2	3.0
<i>Outpatient Facility</i>	164.3	14.1	20.3	8.0	0.1	0.8
<i>Professional</i>	85.5	16.7	33.0	0.7	0.0	1.7
<b>Prescription Drugs</b>	<b>2.0</b>	<b>1.5</b>	<b>1.5</b>	<b>10.2</b>	<b>12.1</b>	<b>10.1</b>
<i>Medication-assisted Treatment</i>	103.5	23.9	84.2	1.6	0.5	3.0
<i>Other Opioids</i>	9.4	6.3	3.6	3.2	4.9	2.0
<i>Behavioral Health</i>	2.9	1.6	1.6	1.8	1.8	1.8
<i>Physical Health</i>	1.4	1.2	1.2	3.5	4.9	3.4

In total, health care costs were 3.6 times, 2.3 times and 2.5 times higher, respectively, for commercially insured, Medicare and Medicaid patients diagnosed with OUD compared to similar patients without OUD. As may be expected, relative costs for substance use services and medication-assisted treatment drugs were particularly high for patients diagnosed with OUD, especially in the commercially insured population.

We projected additional health care costs in 2019 under three scenarios that represent potential outcomes for the prevalence of diagnosed OUD based on recent trends. As a midpoint estimate, we assumed that the most recent year-over-year trends in OUD prevalence (from 2016 to 2017), where the annual increase in prevalence has somewhat slowed down compared to prior years, will continue after 2017. As a high estimate, we assumed that the longer-term trend in OUD prevalence (from 2015 to 2017) will continue. As a low estimate, we assumed that OUD prevalence will return to 2017 levels in 2019. Figure 10 shows the resulting additional health care cost estimates under each scenario.

**Figure 10**

### PROJECTED ADDITIONAL HEALTH CARE COSTS FOR PATIENTS WITH OUD BY PAYER, 2019

PAYER	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT	TOTAL (MILLIONS)
<b>Calendar Year 2019 (projected)—Mid estimate</b>				
Commercial	4.69	841,549	\$22,756	\$19,151
Medicare	28.15	1,397,993	\$18,137	\$25,355
Medicaid	15.82	948,284	\$9,248	\$8,770
Other Public	4.88	21,969	\$25,271	\$555
Uninsured	29.05	810,996	\$9,342	\$7,577
<b>Total</b>	<b>12.51</b>	<b>4,020,791</b>	<b>\$15,272</b>	<b>\$61,407</b>
<b>Calendar Year 2019 (projected)—Low estimate</b>				
Commercial	4.36	781,979	\$22,756	\$17,795
Medicare	26.08	1,295,372	\$18,137	\$23,494
Medicaid	14.66	878,475	\$9,248	\$8,124
Other Public	4.47	20,117	\$25,271	\$508
Uninsured	26.93	751,717	\$9,342	\$7,023
<b>Total</b>	<b>11.60</b>	<b>3,727,661</b>	<b>\$15,276</b>	<b>\$56,944</b>
<b>Calendar Year 2019 (projected)—High estimate</b>				
Commercial	5.44	975,942	\$22,756	\$22,209
Medicare	34.81	1,728,904	\$18,137	\$31,357
Medicaid	17.55	1,052,201	\$9,248	\$9,731
Other Public	6.08	27,397	\$25,271	\$692
Uninsured	31.99	893,092	\$9,342	\$8,344
<b>Total</b>	<b>14.56</b>	<b>4,677,537</b>	<b>\$15,464</b>	<b>\$72,332</b>

We estimate that the additional health care costs for patients with OUD could total \$56.9 billion to \$72.3 billion in 2019. These estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how the prevalence of diagnosed OUD may develop.

### Family Members of Individuals with Diagnosed OUD

The impact of non-medical opioid use also extends beyond the patient to family members of individuals with diagnosed OUD. Using the same methods as conducted for the analysis of patients with OUD, we performed a matched case-control study to identify health care cost differences between individuals with and without any family members who have been diagnosed with OUD.

Due to data constraints, this matched case-control analysis was only possible for the commercially insured population. We developed total cost estimates for the other populations using assumptions developed from the commercial population. We assumed that the ratio of additional costs for family members of patients with OUD relative to additional costs for individual patients with OUD would be the same across all payers as it is for the commercially insured population. These estimates are necessarily coarse and are meant only to give a sense of the potential magnitude of additional health care costs for these populations. Infants were not captured in this analysis, but health care costs for infants impacted by maternal opioid use are captured under the Neonatal Abstinence Syndrome/Neonatal Opioid Withdrawal Syndrome section below.

Figure 11 shows national extrapolations for the number of individuals without diagnosed OUD who have a family member with a diagnosis, as well as their additional health care costs.

**Figure 11**

ADDITIONAL HEALTH CARE COSTS FOR PATIENTS WITH A FAMILY MEMBER DIAGNOSED WITH OUD BY PAYER, 2015–2018

PAYER	INDIVIDUALS WITH A FAMILY MEMBER DIAGNOSED WITH OUD	PER INDIVIDUAL	ADDITIONAL COSTS TOTAL (MILLIONS)
<b>Calendar Year 2015</b>			
Commercial	962,039	\$756	\$727
Medicare	475,249	\$591	\$281
Medicaid	1,157,041	\$296	\$342
Other Public	24,222	\$824	\$20
Uninsured	1,056,581	\$279	\$295
<b>Total</b>	<b>3,675,131</b>	<b>\$453</b>	<b>\$1,665</b>
<b>Calendar Year 2016</b>			
Commercial	1,165,659	\$785	\$915
Medicare	836,433	\$626	\$524
Medicaid	1,366,823	\$314	\$430
Other Public	31,351	\$865	\$27
Uninsured	1,107,091	\$296	\$327
<b>Total</b>	<b>4,507,357</b>	<b>\$493</b>	<b>\$2,223</b>
<b>Calendar Year 2017</b>			
Commercial	1,216,454	\$814	\$990
Medicare	893,444	\$648	\$579
Medicaid	1,408,520	\$331	\$466
Other Public	32,340	\$903	\$29
Uninsured	1,179,609	\$309	\$364
<b>Total</b>	<b>4,730,368</b>	<b>\$513</b>	<b>\$2,428</b>
<b>Calendar Year 2018</b>			
Commercial	1,271,096	\$829	\$1,054
Medicare	953,497	\$661	\$630
Medicaid	1,451,916	\$337	\$489
Other Public	33,487	\$921	\$31
Uninsured	1,229,524	\$340	\$419
<b>Total</b>	<b>4,939,521</b>	<b>\$531</b>	<b>\$2,622</b>

Across all payers, we estimate that health care costs for individuals with a family member with OUD were around \$500 higher each year than for similar individuals without. Including costs for both patients and their families, health care costs for patients impacted by OUD totaled \$201.8 billion in the United States from 2015 through 2018.

In relative terms, the largest increase in costs for this population was for substance use disorder treatment services, which suggests that other, non-opioid related substance use disorders may be more common in households where a family member has OUD relative to those without. Detailed cost and utilization metrics for this population are provided in the appendices.

Using the same projections for the prevalence of OUD in 2019 as described previously, we estimated the additional costs for family members of individuals with OUD in 2019. These scenarios are displayed in Figure 12.

**Figure 12**

# PROJECTED ADDITIONAL HEALTH CARE COSTS FOR PATIENTS WITH A FAMILY MEMBER DIAGNOSED WITH OUD BY PAYER, 2019

PAYER	INDIVIDUALS WITH A FAMILY MEMBER	ADDITIONAL COSTS	
	DIAGNOSED WITH OUD	PER INDIVIDUAL	TOTAL (MILLIONS)
<b>Calendar Year 2019 (projected)—Mid estimate</b>			
Commercial	1,328,193	\$850	\$1,130
Medicare	1,017,587	\$678	\$690
Medicaid	1,496,649	\$346	\$517
Other Public	34,674	\$944	\$33
Uninsured	1,279,971	\$349	\$447
<b>Total</b>	<b>5,157,074</b>	<b>\$546</b>	<b>\$2,816</b>
<b>Calendar Year 2019 (projected)—Low estimate</b>			
Commercial	1,234,175	\$850	\$1,050
Medicare	942,890	\$678	\$639
Medicaid	1,386,473	\$346	\$479
Other Public	31,750	\$944	\$30
Uninsured	1,186,414	\$349	\$414
<b>Total</b>	<b>4,781,702</b>	<b>\$546</b>	<b>\$2,612</b>
<b>Calendar Year 2019 (projected)—High estimate</b>			
Commercial	1,540,301	\$850	\$1,310
Medicare	1,258,454	\$678	\$853
Medicaid	1,660,659	\$346	\$574
Other Public	43,240	\$944	\$41
Uninsured	1,409,542	\$349	\$492
<b>Total</b>	<b>5,912,197</b>	<b>\$553</b>	<b>\$3,270</b>

We estimate that additional health care costs for family members of patients with OUD may contribute another \$2.6 billion to \$3.3 billion to the total cost of non-medical opioid use in 2019. These estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how the prevalence of diagnosed OUD may develop.

## Neonatal Abstinence Syndrome/Neonatal Opioid Withdrawal Syndrome

In addition to increasing prevalence of diagnosed OUD in the general population, maternal OUD and NAS or NOWS are on the rise as well. According to the National Institute on Drug Abuse, an infant is born with NAS/NOWS once every 15 minutes in the United States.<sup>34</sup> Further, treatment for NAS/NOWS adds significant health care costs for newborns.

Extrapolating published annual estimates of NAS/NOWS birth rates and hospital costs to national estimates of annual births provided in National Vital Statistics reports by payer, we estimated national treatment costs of NAS/NOWS from 2015 through 2018.<sup>35, 36</sup> These estimates primarily rely on incidence rates and treatment costs for patients with Medicaid or private insurance coverage, which make up more than 90% of births in the country. For other publicly insured patients, we assumed that incidence rates of NAS/NOWS and treatment costs per newborn are similar to that of the commercial population; and for uninsured patients, we assumed that these estimates are similar to that of the Medicaid population. The estimates for these populations are necessarily coarse and are meant to provide a general sense of the potential magnitude of costs. The assumptions for these populations are similar to those applied elsewhere in the health care cost analysis. Figure 13 displays national cost estimates for treatment of NAS/NOWS by payer.

**Figure 13**

### COSTS FOR TREATMENT OF INFANTS BORN WITH NAS/NOWS, 2015–2018

YEAR	TOTAL BIRTHS	INCIDENCE OF NAS/NOWS		TREATMENT COSTS FOR INFANTS BORN WITH NAS/NOWS	
		PER 1,000 BIRTHS	TOTAL	PER NEWBORN	TOTAL (MILLIONS)
Calendar Year 2015					
Commercial	1,947,074	1.99	3,879	\$19,678	\$76
Medicaid	1,705,177	14.34	24,449	\$20,227	\$495
Other Public	163,660	1.99	326	\$19,678	\$6
Uninsured	162,587	14.34	2,331	\$20,227	\$47
Total	3,978,497	7.79	30,985	\$20,152	\$624
Calendar Year 2016					
Commercial	1,949,262	2.14	4,176	\$19,709	\$82
Medicaid	1,680,943	15.50	26,057	\$20,716	\$540
Other Public	153,889	2.14	330	\$19,709	\$7
Uninsured	161,781	15.50	2,508	\$20,716	\$52
Total	3,945,875	8.38	33,071	\$20,580	\$681
Calendar Year 2017					
Commercial	1,893,051	2.29	4,341	\$19,739	\$86
Medicaid	1,657,865	16.66	27,628	\$21,205	\$586
Other Public	146,509	2.29	336	\$19,739	\$7
Uninsured	158,076	16.66	2,634	\$21,205	\$56
Total	3,855,500	9.06	34,939	\$21,008	\$734
Calendar Year 2018					
Commercial	1,894,024	2.44	4,628	\$19,770	\$92
Medicaid	1,658,718	17.83	29,572	\$21,694	\$642
Other Public	141,545	2.44	346	\$19,770	\$7
Uninsured	158,157	17.83	2,820	\$21,694	\$61
Total	3,852,444	9.70	37,365	\$21,437	\$801

Treatment costs for NAS/NOWS were roughly \$20,000 per newborn from 2015 through 2018. Incidence of NAS/NOWS is particularly high in the Medicaid population, with rates over seven times higher than the commercial population. In the past four years, treatment for NAS/NOWS contributed \$2.8 billion to additional health care costs of non-medical opioid use in the United States.

We projected three scenarios for 2019 costs using different assumptions for NAS/NOWS incidence rates based on recent trends. As a midpoint estimate, we applied the long-term trend in incidence rates from 2004 through 2014 (the time span available in published literature) for each year beginning in 2015. As a high estimate, we assumed that more recent trends in incidence spanning from 2010 to 2014, which show a notable uptick from longer-term trends, continue in the future. As a low estimate, we assumed that the long-term trend in incidence from 2004 through 2014 continues through 2018 and then holds flat in 2019. The resulting cost estimates for each scenario are provided separately by payer in Figure 14.

**Figure 14**

# PROJECTED COSTS FOR TREATMENT OF NAS/NOWS BY PAYER, 2019

YEAR	TOTAL BIRTHS	INCIDENCE OF NAS/NOWS		TREATMENT COSTS FOR NEWBORNS WITH NAS/NOWS	
		PER 1,000 BIRTHS	TOTAL	PER NEWBORN	TOTAL (MILLIONS)
Calendar Year 2019 (projected)—Mid estimate					
Commercial	1,882,682	2.59	4,883	\$19,800	\$97
Medicaid	1,648,785	18.99	31,313	\$22,183	\$695
Other Public	136,318	2.59	354	\$19,800	\$7
Uninsured	157,210	18.99	2,986	\$22,183	\$66
Total	3,824,994	10.34	39,535	\$21,867	\$865
Calendar Year 2019 (projected)—Low estimate					
Commercial	1,882,682	2.44	4,600	\$19,800	\$91
Medicaid	1,648,785	17.83	29,395	\$22,183	\$652
Other Public	136,318	2.44	333	\$19,800	\$7
Uninsured	157,210	17.83	2,803	\$22,183	\$62
Total	3,824,994	9.71	37,130	\$21,869	\$812
Calendar Year 2019 (projected)—High estimate					
Commercial	1,882,682	2.93	5,512	\$19,800	\$109
Medicaid	1,648,785	21.57	35,571	\$22,183	\$789
Other Public	136,318	2.93	399	\$19,800	\$8
Uninsured	157,210	21.57	3,392	\$22,183	\$75
Total	3,824,994	11.73	44,874	\$21,868	\$981

If trends continue, treatment costs for NAS/NOWS may contribute an additional \$0.8 billion to \$1.0 billion to health care costs in 2019. These estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how the incidence of NAS/NOWS may develop.

## Mortality Costs

Mortality costs related to non-medical opioid use result from medical costs at the time of death as well as lost lifetime earnings associated with early mortality due to opioid overdose. Medical costs from fatalities may include costs such as those associated with a hospital stay, emergency room visit, payments to a medical examiner or emergency medical transportation at the time of death. Lost lifetime earnings represent the net present value of expected annual earnings over the individual's years of potential life lost, as well as the discounted value of lost household work. Our estimates for mortality costs are a function of the number of opioid overdose deaths in each year, as well as the average medical costs and lost lifetime earnings per death.

Figure 15 presents mortality costs due to opioid overdose from 2015 to 2018 by age group. The number of opioid overdose deaths represent national counts as reported by the CDC.<sup>37, 38, 39</sup> Average values for medical costs and lost lifetime earnings per death caused by poisoning are produced by the CDC's Web-based Injury Statistics Query and Reporting System (WISQARS™) tool<sup>40</sup> and are based on 2010 dollars, which we have indexed to the specified year using the Federal Reserve Economic Data GDP Implicit Price Deflator.<sup>41</sup> This approach for calculating mortality costs due to opioid overdose deaths is consistent with other prominent literature on the topic and is explained in more detail in the Methodology section of this report.<sup>42</sup>

**Figure 15**

### MORTALITY COSTS DUE TO OPIOID OVERDOSE BY AGE GROUP, 2015–2018

AGE GROUP	OPIOID OVERDOSE DEATHS	AVG. MEDICAL COSTS PER DEATH	AVG. LOST LIFETIME EARNINGS PER DEATH	TOTAL MEDICAL COSTS (MILLIONS)	TOTAL LOST LIFETIME EARNINGS (MILLIONS)	TOTAL MORTALITY COSTS (MILLIONS)
<b>Calendar Year 2015</b>						
0–14	83	\$8,448	\$1,482,124	\$1	\$123	\$124
15–24	3,082	\$5,290	\$1,975,036	\$16	\$6,087	\$6,103
25–34	8,568	\$5,102	\$1,955,254	\$44	\$16,753	\$16,797
35–44	7,484	\$4,983	\$1,591,022	\$37	\$11,907	\$11,944
45–54	7,595	\$4,710	\$1,129,080	\$36	\$8,575	\$8,611
54–65	5,089	\$5,114	\$676,854	\$26	\$3,445	\$3,471
65+	1,188	\$11,296	\$228,437	\$13	\$271	\$284
<b>Total</b>	<b>33,089</b>			<b>\$173</b>	<b>\$47,161</b>	<b>\$47,334</b>
<b>Calendar Year 2016</b>						
0–14	83	\$8,575	\$1,504,329	\$1	\$125	\$126
15–24	4,027	\$5,370	\$2,004,626	\$22	\$8,073	\$8,095
25–34	11,552	\$5,178	\$1,984,547	\$60	\$22,925	\$22,985
35–44	9,747	\$5,058	\$1,614,859	\$49	\$15,740	\$15,789
45–54	9,074	\$4,781	\$1,145,996	\$43	\$10,399	\$10,442
54–65	6,321	\$5,190	\$686,994	\$33	\$4,342	\$4,375
65+	1,441	\$11,465	\$231,860	\$17	\$334	\$351
<b>Total</b>	<b>42,245</b>			<b>\$225</b>	<b>\$61,938</b>	<b>\$62,163</b>
<b>Calendar Year 2017</b>						
0–14	79	\$8,753	\$1,535,596	\$1	\$121	\$122
15–24	4,094	\$5,481	\$2,046,290	\$22	\$8,378	\$8,400
25–34	13,181	\$5,286	\$2,025,795	\$70	\$26,702	\$26,772
35–44	11,149	\$5,163	\$1,648,422	\$58	\$18,378	\$18,436
45–54	10,207	\$4,880	\$1,169,815	\$50	\$11,940	\$11,990
54–65	7,153	\$5,298	\$701,273	\$38	\$5,016	\$5,054
65+	1,724	\$11,704	\$236,679	\$20	\$408	\$428
<b>Total</b>	<b>47,587</b>			<b>\$259</b>	<b>\$70,943</b>	<b>\$71,202</b>



AGE GROUP	OPIOID OVERDOSE DEATHS	AVG. MEDICAL COSTS PER DEATH	AVG. LOST LIFETIME EARNINGS PER DEATH	TOTAL MEDICAL COSTS (MILLIONS)	TOTAL LOST LIFETIME EARNINGS (MILLIONS)	TOTAL MORTALITY COSTS (MILLIONS)
<b>Calendar Year 2018</b>						
0–14	95	\$8,939	\$1,568,232	\$1	\$149	\$150
15–24	4,337	\$5,598	\$2,089,781	\$24	\$9,064	\$9,088
25–34	12,893	\$5,398	\$2,068,850	\$70	\$26,673	\$26,743
35–44	10,988	\$5,272	\$1,683,457	\$58	\$18,497	\$18,555
45–54	10,405	\$4,984	\$1,194,677	\$52	\$12,431	\$12,483
54–65	7,187	\$5,411	\$716,177	\$39	\$5,147	\$5,186
65+	1,685	\$11,952	\$241,709	\$20	\$407	\$427
<b>Total</b>	<b>47,590</b>			<b>\$264</b>	<b>\$72,368</b>	<b>\$72,632</b>

Mortality costs due to opioid overdose from 2015 to 2018 totaled \$253.3 billion in the United States. From 2015 to 2018, total mortality costs due to opioid overdose rose by more than \$25 billion, an increase of over 50% relative to 2015 cost levels. This substantial increase in mortality costs is predominantly driven by a rising number of opioid overdose deaths, which increased by 44% from 2015 to 2018. The number of opioid overdose deaths grew by nearly 30% from 2015 to 2016, though the rate of increase decreased substantially from 2016 to 2017. Provisional estimates from the CDC show opioid overdose deaths leveling off between 2017 and 2018, though it may be too early to tell whether those trends are a statistical anomaly or reflect an inflection point in the progression of this crisis.

While provisional estimates suggest that opioid overdose deaths may have reached their peak in 2018, it is uncertain whether deaths may continue to decline or longer-term trends in opioid overdose deaths hold. We have projected a range of mortality costs for 2019 under three scenarios: 1) the number of deaths remains flat, consistent with the most recent trends from 2017 and 2018 (mid estimate); 2) the number of deaths begins to decrease consistent with the year-over-year pace of improvement in trends from 2015 to 2018 (low estimate); and 3) deaths continue to increase consistent with longer-term annualized trends from 2015 to 2018 (high estimate). These scenarios are presented in Figure 16.

**Figure 16**

**PROJECTED MORTALITY COSTS DUE TO OPIOID OVERDOSE DEATHS BY AGE GROUP, 2019**

AGE GROUP	OPIOID OVERDOSE DEATHS	AVG. MEDICAL COSTS PER DEATH	AVG. LOST LIFETIME EARNINGS PER DEATH	TOTAL MEDICAL COSTS (MILLIONS)	TOTAL LOST LIFETIME EARNINGS (MILLIONS)	TOTAL MORTALITY COSTS (MILLIONS)
<b>Calendar Year 2019 (projected)—Mid estimate</b>						
0–14	95	\$9,118	\$1,599,597	\$1	\$152	\$153
15–24	4,337	\$5,710	\$2,131,576	\$25	\$9,245	\$9,270
25–34	12,893	\$5,506	\$2,110,227	\$71	\$27,207	\$27,278
35–44	10,988	\$5,378	\$1,717,126	\$59	\$18,867	\$18,926
45–54	10,405	\$5,083	\$1,218,571	\$53	\$12,680	\$12,733
54–65	7,187	\$5,519	\$730,501	\$40	\$5,250	\$5,290
65+	1,685	\$12,191	\$246,543	\$21	\$416	\$437
<b>Total</b>	<b>47,590</b>			<b>\$270</b>	<b>\$73,817</b>	<b>\$74,087</b>
<b>Calendar Year 2019 (projected)—Low estimate</b>						
0–14	84	\$9,118	\$1,599,597	\$1	\$134	\$135
15–24	3,839	\$5,710	\$2,131,576	\$22	\$8,183	\$8,205
25–34	11,411	\$5,506	\$2,110,227	\$63	\$24,079	\$24,142
35–44	9,725	\$5,378	\$1,717,126	\$52	\$16,698	\$16,750
45–54	9,209	\$5,083	\$1,218,571	\$47	\$11,222	\$11,269
54–65	6,361	\$5,519	\$730,501	\$35	\$4,647	\$4,682
65+	1,492	\$12,191	\$246,543	\$18	\$368	\$386
<b>Total</b>	<b>42,120</b>			<b>\$238</b>	<b>\$65,331</b>	<b>\$65,569</b>

AGE GROUP	OPIOID OVERDOSE DEATHS	AVG. MEDICAL COSTS PER DEATH	AVG. LOST LIFETIME EARNINGS PER DEATH	TOTAL MEDICAL COSTS (MILLIONS)	TOTAL LOST LIFETIME EARNINGS (MILLIONS)	TOTAL MORTALITY COSTS (MILLIONS)
Calendar Year 2019 (projected)—High estimate						
0–14	107	\$9,118	\$1,599,597	\$1	\$171	\$172
15–24	4,896	\$5,710	\$2,131,576	\$28	\$10,436	\$10,464
25–34	14,553	\$5,506	\$2,110,227	\$80	\$30,710	\$30,790
35–44	12,403	\$5,378	\$1,717,126	\$67	\$21,297	\$21,364
45–54	11,745	\$5,083	\$1,218,571	\$60	\$14,313	\$14,373
54–65	8,112	\$5,519	\$730,501	\$45	\$5,926	\$5,971
65+	1,902	\$12,191	\$246,543	\$23	\$469	\$492
<b>Total</b>	<b>53,719</b>			<b>\$304</b>	<b>\$83,322</b>	<b>\$83,626</b>

Projected 2019 mortality costs due to opioid overdose range from \$65.6 billion to \$83.6 billion. If the number of opioid overdose deaths remains flat at 2017 and 2018 levels (our mid scenario), mortality costs in 2019 could potentially add \$74.1 billion to the economic impact of non-medical opioid use in the United States. If the number of opioid overdose deaths begins to decline at a pace consistent with recent improvements in the trends (our low scenario, which represents a decrease of 11.5% compared to 2018), mortality costs could decrease to roughly 2016 levels. On the other hand, if the number of overdose deaths were to continue increasing consistent with the longer-term annualized trends from 2015 to 2018 (our high scenario), projected mortality costs could increase by approximately 15% compared to 2018 levels. These estimates are not meant to represent maxima or minima on the range of possible outcomes. There is significant uncertainty around how the overdose death rate may change over time, and these results only reflect a few of the many possible outcomes.

## Criminal Justice Costs

Criminal justice costs associated with non-medical opioid use result from criminal activities, law enforcement encounters, legal proceedings and incarcerations that involve opioids. In other studies estimating the economic impact of non-medical opioid use, criminal justice costs have been calculated using an apportionment method to estimate costs associated with police protection, legal and adjudication activities, property lost due to crime and correctional facilities.<sup>43, 44</sup> In this approach, total expenditures for each cost category are first apportioned by the amount attributable to all illicit substance use and then are further apportioned by the percentage of all illicit substance use attributable to non-medical opioid use. We have followed a similar approach to develop updated figures for 2015 through 2018 criminal justice cost estimates.

Figure 17 presents criminal justice costs due to non-medical opioid use from 2015 to 2018, separately by cost category. The total expenditures presented below represent national figures published by the Bureau of Justice Statistics and FBI Uniform Crime reports.<sup>45, 46, 47</sup> Costs attributable to non-medical opioid use were carved out of these total expenditures using opioid cost apportionment estimates, described in further detail in the Methodology section of this report.

**Figure 17**

### CRIMINAL JUSTICE COSTS DUE TO NON-MEDICAL OPIOID USE, 2015–2018

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	OPIOID COST APPORTIONMENT (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2015</b>			
Police Protection	\$136,701	2.2	\$3,013
Legal and Adjudication Activities	\$61,468	2.2	\$1,355
Property Lost Due to Crime	\$14,300	6.6	\$938
Correctional Facilities	\$87,895	4.1	\$3,564
<i>Federal</i>	\$7,542	4.9	\$367
<i>State</i>	\$52,540	4.0	\$2,084
<i>Local</i>	\$27,813	4.0	\$1,113
<b>Total</b>	<b>\$300,364</b>		<b>\$8,870</b>
<b>Calendar Year 2016</b>			
Police Protection	\$139,542	2.3	\$3,186
Legal and Adjudication Activities	\$62,069	2.3	\$1,417
Property Lost Due to Crime	\$15,600	6.0	\$942
Correctional Facilities	\$89,988	4.0	\$3,610
<i>Federal</i>	\$7,659	5.1	\$390
<i>State</i>	\$54,200	3.8	\$2,074
<i>Local</i>	\$28,129	4.1	\$1,146
<b>Total</b>	<b>\$307,199</b>		<b>\$9,155</b>
<b>Calendar Year 2017</b>			
Police Protection	\$142,443	2.5	\$3,590
Legal and Adjudication Activities	\$62,676	2.5	\$1,580
Property Lost Due to Crime	\$15,300	5.5	\$841
Correctional Facilities	\$92,140	4.2	\$3,826
<i>Federal</i>	\$7,778	5.8	\$454
<i>State</i>	\$55,913	3.8	\$2,133
<i>Local</i>	\$28,449	4.4	\$1,239
<b>Total</b>	<b>\$312,559</b>		<b>\$9,837</b>

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	OPIOID COST APPORTIONMENT (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2018</b>			
Police Protection	\$145,403	2.8	\$4,114
Legal and Adjudication Activities	\$63,289	2.8	\$1,791
Property Lost Due to Crime	\$15,826	5.5	\$867
Correctional Facilities	\$94,351	4.4	\$4,133
<i>Federal</i>	<i>\$7,898</i>	<i>6.4</i>	<i>\$503</i>
<i>State</i>	<i>\$57,680</i>	<i>3.9</i>	<i>\$2,277</i>
<i>Local</i>	<i>\$28,773</i>	<i>4.7</i>	<i>\$1,353</i>
<b>Total</b>	<b>\$318,869</b>		<b>\$10,905</b>

We estimate that criminal justice costs due to non-medical opioid use totaled \$38.8 billion in the United States from 2015 through 2018. Total expenditures on criminal justice activities have increased about 2% annually since 2015. Over this same timeframe, non-medical opioid use as a portion of all illicit substance use has decreased; however, opioids as a percentage of all substances secured in law enforcement operations have increased, driven by increasing trends in the use of illicit fentanyl and heroin. For this reason, estimated opioid apportionment corresponding to drug law violations increased while opioid apportionment for all other types of crimes attributable to substance use decreased.

As with other costs presented in this analysis, we developed a range of estimates for 2019 criminal justice costs due to non-medical opioid use. In each scenario, we assume that recent historical trends for total criminal justice expenditures will continue but vary our estimates of cost attributable to non-medical use by developing three scenarios for how non-medical opioid use as a portion of illicit drug use and illicit substance procurement in law enforcement may trend in the future. These opioid apportionment scenarios were developed by evaluating how short-term and longer-term non-medical opioid use rates have evolved over the past few years and are described in further detail in the Methodology section of this report.

Figure 18 shows mid, low and high estimates for 2019 criminal justice costs due to non-medical opioid use.

**Figure 18**

#### PROJECTED CRIMINAL JUSTICE COSTS DUE TO NON-MEDICAL OPIOID USE, 2019

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	OPIOID COST APPORTIONMENT (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2019 (projected)—Mid estimate</b>			
Police Protection	\$148,425	3.2	\$4,761
Legal and Adjudication Activities	\$63,907	3.2	\$2,050
Property Lost Due to Crime	\$16,370	5.5	\$894
Correctional Facilities	\$96,624	4.6	\$4,470
<i>Federal</i>	<i>\$8,021</i>	<i>6.9</i>	<i>\$556</i>
<i>State</i>	<i>\$59,503</i>	<i>4.1</i>	<i>\$2,434</i>
<i>Local</i>	<i>\$29,100</i>	<i>5.1</i>	<i>\$1,480</i>
<b>Total</b>	<b>\$325,326</b>		<b>\$12,175</b>
<b>Calendar Year 2019 (projected)—Low estimate</b>			
Police Protection	\$148,425	2.9	\$4,349
Legal and Adjudication Activities	\$63,907	2.9	\$1,872
Property Lost Due to Crime	\$16,370	5.2	\$846
Correctional Facilities	\$96,624	4.3	\$4,118
<i>Federal</i>	<i>\$8,021</i>	<i>6.3</i>	<i>\$505</i>
<i>State</i>	<i>\$59,503</i>	<i>3.8</i>	<i>\$2,255</i>
<i>Local</i>	<i>\$29,100</i>	<i>4.7</i>	<i>\$1,358</i>
<b>Total</b>	<b>\$325,326</b>		<b>\$11,185</b>

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	OPIOID COST APPORTIONMENT (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2019 (projected)—High estimate</b>			
Police Protection	\$148,425	3.3	\$4,920
Legal and Adjudication Activities	\$63,907	3.3	\$2,118
Property Lost Due to Crime	\$16,370	6.1	\$1,004
Correctional Facilities	\$96,624	4.9	\$4,712
<i>Federal</i>	<i>\$8,021</i>	<i>7.1</i>	<i>\$567</i>
<i>State</i>	<i>\$59,503</i>	<i>4.4</i>	<i>\$2,600</i>
<i>Local</i>	<i>\$29,100</i>	<i>5.3</i>	<i>\$1,545</i>
<b>Total</b>	<b>\$325,326</b>		<b>\$12,754</b>

We project that criminal justice costs due to non-medical opioid use could increase to \$11.2 billion to \$12.8 billion in 2019. A key driver of the projected increase in costs is the growth in illicit opioid use in the United States, which is expected to continue at least in the near-term despite the downward trend in overall non-medical opioid use. As with our other projections for 2019, these estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how non-medical opioid use may develop as a proportion of all illicit substance use.

## Child and Family Assistance Costs

Child and family assistance costs for non-medical opioid use result from increased government expenditures on programs that support children and families impacted by non-medical substance use. Consistent with other prominent literature on the economic impact of non-medical opioid use, we have developed our estimates for these cost categories by identifying total spending for each category, and apportioning some of that spending to non-medical opioid use.<sup>48, 49</sup>

A study conducted by the National Center on Addiction and Substance Abuse at Columbia University (NCASA) found that a sizable portion of federal welfare spending is related to substance abuse.<sup>50</sup> The largest area of federal spending on substance abuse and addiction aside from health care programs is in child and family assistance programs. NCASA found that 15.6% of federal spending on these programs—including child welfare, food and nutritional assistance, income assistance, housing assistance, child and family assistance, and employment assistance—is linked to substance abuse and addiction.

We used a similar apportionment method for estimating criminal justice costs to estimate child and family assistance program costs attributable to non-medical opioid use. We first apportioned the amounts attributable to substance use as reported by NCASA and then by the portion of illicit substance use attributable to non-medical opioid use. The total expenditures below represent federal spending estimates from various sources, listed in the Methodology section. Figure 19 displays child and family assistance costs due to non-medical opioid use from 2015 to 2018, separately for each program category defined in the NCASA study.

**Figure 19**

### CHILD AND FAMILY ASSISTANCE COSTS DUE TO NON-MEDICAL OPIOID USE, 2015–2018

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF DRUG USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2015</b>				
Child Welfare	\$8,360	74.2	21.2	\$1,313
Food and Nutritional Assistance	\$73,187	23.5	21.2	\$3,640
Housing Assistance	\$47,800	35.8	21.2	\$3,627
Income Assistance	\$86,437	3.9	21.2	\$708
<i>Temporary Assistance for Needy Families</i>	<i>\$31,471</i>			
<i>Supplemental Security Income</i>	<i>\$54,966</i>			
<b>Total</b>	<b>\$215,784</b>			<b>\$9,288</b>
<b>Calendar Year 2016</b>				
Child Welfare	\$8,776	74.2	19.5	\$1,269
Food and Nutritional Assistance	\$70,222	23.5	19.5	\$3,214
Housing Assistance	\$48,925	35.8	19.5	\$3,417
Income Assistance	\$85,728	3.9	19.5	\$646
<i>Temporary Assistance for Needy Families</i>	<i>\$30,929</i>			
<i>Supplemental Security Income</i>	<i>\$54,799</i>			
<b>Total</b>	<b>\$213,651</b>			<b>\$8,546</b>
<b>Calendar Year 2017</b>				
Child Welfare	\$9,358	74.2	17.7	\$1,231
Food and Nutritional Assistance	\$67,344	23.5	17.7	\$2,805
Housing Assistance	\$49,475	35.8	17.7	\$3,143

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF DRUG USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
Income Assistance	\$85,560	3.9	17.7	\$587
<i>Temporary Assistance for Needy Families</i>	\$31,044			
<i>Supplemental Security Income</i>	\$54,516			
<b>Total</b>	<b>\$211,737</b>			<b>\$7,766</b>
<b>Calendar Year 2018</b>				
Child Welfare	\$9,901	74.2	17.7	\$1,299
Food and Nutritional Assistance	\$64,600	23.5	17.7	\$2,683
Housing Assistance	\$50,334	35.8	17.7	\$3,189
Income Assistance	\$85,125	3.9	17.7	\$582
<i>Temporary Assistance for Needy Families</i>	\$30,832			
<i>Supplemental Security Income</i>	\$54,293			
<b>Total</b>	<b>\$209,960</b>			<b>\$7,753</b>

We estimate that the total costs for child and family assistance attributable to non-medical opioid use from 2015 to 2018 was \$33.4 billion. Over this time period, federal spending on child and family assistance programs decreased, as has non-medical opioid use as a portion of all illicit drug use in the United States.

We developed a range of projections for 2019 by examining recent and longer-term trends in non-medical opioid use. In each scenario, we assume that recent historical trends for total child and family assistance spending will continue but developed a range of potential costs due to non-medical opioid use by varying the opioid apportionment estimates. These assumptions are consistent with the projections for non-medical opioid use as a proportion of all illicit substance use used in other cost categories, as described in the Methodology section of this report. Figure 20 gives a range of projected 2019 child and family assistance costs due to non-medical opioid use.

**Figure 20**

PROJECTED CHILD AND FAMILY ASSISTANCE COSTS DUE TO NON-MEDICAL OPIOID USE, 2019

COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF DRUG USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2019 (projected)—Mid estimate</b>				
Child Welfare	\$10,476	74.2	17.6	\$1,371
Food and Nutritional Assistance	\$61,968	23.5	17.6	\$2,567
Housing Assistance	\$51,209	35.8	17.6	\$3,236
Income Assistance	\$84,692	3.9	17.6	\$ 578
<i>Temporary Assistance for Needy Families</i>	\$30,622			
<i>Supplemental Security Income</i>	\$54,070			
<b>Total</b>	<b>\$208,345</b>			<b>\$7,752</b>



COST CATEGORY	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF DRUG USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
<b>Calendar Year 2019 (projected)—Low estimate</b>				
Child Welfare	\$10,476	74.2	16.7	\$1,297
Food and Nutritional Assistance	\$61,968	23.5	16.7	\$2,429
Housing Assistance	\$51,209	35.8	16.7	\$3,062
Income Assistance	\$84,692	3.9	16.7	\$ 547
<i>Temporary Assistance for Needy Families</i>	\$30,622			
<i>Supplemental Security Income</i>	\$54,070			
<b>Total</b>	<b>\$208,345</b>			<b>\$7,335</b>
<b>Calendar Year 2019 (projected)—High estimate</b>				
Child Welfare	\$10,476	74.2	19.8	\$1,539
Food and Nutritional Assistance	\$61,968	23.5	19.8	\$2,882
Housing Assistance	\$51,209	35.8	19.8	\$3,633
Income Assistance	\$84,692	3.9	19.8	\$ 649
<i>Temporary Assistance for Needy Families</i>	\$30,622			
<i>Supplemental Security Income</i>	\$54,070			
<b>Total</b>	<b>\$208,345</b>			<b>\$8,703</b>

We estimate that child and family assistance costs due to non-medical opioid use could be \$7.3 billion to \$8.7 billion in 2019. Using longer-term trends of non-medical opioid use as a portion of total illicit substance use, we project a mid-range estimate of \$7.8 billion, similar to the estimated 2018 costs. As with our other projections for 2019, these estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how non-medical opioid use may develop as a proportion of all illicit substance use.

## Education Costs

Education costs from non-medical opioid use result from increased federal expenditures on education programs in response to non-medical opioid use. Approximately 90% of education funding in the United States comes from state or local funding sources, while the remaining 10% comes from federal funding sources. Day-to-day operations of public education institutions are generally funded at the state and local level, while federal expenditures generally revolve around special programs such as those that support low-income or special needs students. For our education cost estimates, we have assumed that state and local funding is independent of non-medical opioid use but that a portion of federal funding can be attributed to non-medical opioid use.

In addition to the impact on child and welfare program spending, the NCASA study also found that about 12.2% of federal expenditures on education are attributable to substance abuse and addiction.<sup>51</sup> These costs are primarily associated with grants for elementary and secondary education programs. NCASA noted that the costs of substance abuse and addiction associated with higher education are likely notable but are more difficult to estimate.

Using the same opioid apportionment estimates as applied to child and family assistance costs, we estimated the amount of education spending attributable to non-medical opioid use. The total expenditures below represent federal spending on elementary and secondary education, as reported by the National Center for Education Statistics (NCES).<sup>52, 53, 54</sup> These costs are displayed for 2015 through 2018 in Figure 21.

**Figure 21**

### FEDERAL EDUCATION COSTS DUE TO NON-MEDICAL OPIOID USE, 2015–2018

YEAR	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF SUBSTANCE USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
2015	\$55,247	12.2	21.2	\$1,426
2016	\$56,169	12.2	19.5	\$1,335
2017	\$56,925	12.2	17.7	\$1,231
2018	\$57,690	12.2	17.7	\$1,244

We estimate that federal education expenditures attributable to non-medical opioid use totaled \$5.2 billion from 2015 through 2018. Although federal education spending increased roughly 1.5% each year, decreasing non-medical opioid use as a portion of all illicit substance use resulted in decreasing estimates for the costs attributable to opioid use from 2015 through 2018.

Using the same trend scenarios for opioid apportionment as in the child and family assistance section, we projected costs in 2019 under three different scenarios for how non-medical opioid use as a proportion of all illicit substance use may develop. Figure 22 shows a range of projections for 2019 education costs attributable to non-medical opioid use.

**Figure 22**

### PROJECTED FEDERAL EDUCATION COSTS DUE TO NON-MEDICAL OPIOID USE, 2019

YEAR	TOTAL EXPENDITURES (MILLIONS)	PERCENTAGE APPORTIONED TO SUBSTANCE USE (%)	PERCENTAGE OF DRUG USE ATTRIBUTABLE TO OPIOIDS (%)	COST ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
2019 (mid)	\$58,466	12.2	17.6	\$1,257
2019 (low)	\$58,466	12.2	16.7	\$1,190
2019 (high)	\$58,466	12.2	19.8	\$1,412

We estimate that federal education spending attributable to non-medical opioid use could be \$1.2 billion to \$1.4 billion in 2019. As with our other projections for 2019, these estimates are not meant to represent minima or maxima for possible outcomes but are reflective of a few potential scenarios for how non-medical opioid use may develop as a proportion of all illicit substance use.

## Lost Productivity Costs

Lost productivity costs from non-medical opioid use result from reductions in participation in economically productive activity for workers with non-medical opioid use or for those incarcerated due to opioid-related crimes. We also considered costs to employers for short- and long-term disability and workers' compensation payments related to OUD.

### Lost Productivity Due to Non-Medical Opioid Use

This component of lost productivity places a value on time lost due to absenteeism and a decrease in the labor force participation rate. Absenteeism costs arise when people must take time away from gainful employment due to non-medical opioid use. Labor force participation declines when people drop out of the labor force altogether due to non-medical opioid use.

We first estimated the number of individuals diagnosed with OUD, by age and sex, for the commercial, Medicaid and aged Medicare insured populations, by extrapolating prevalence rates from large medical claims data sets (described in the Methodology section).<sup>55</sup> For uninsured and other publicly insured populations, we assumed the same prevalence rates as calculated for the Medicaid and commercially insured populations, respectively, as described previously. The prevalence rates used for this analysis are consistent with those used in the health care cost portion of this analysis, except that Medicare disability beneficiaries were excluded as those individuals are generally precluded from typical employment opportunities due to their health status and Medicare eligibility requirements.

We then multiplied the nationwide cases of OUD by inflation-adjusted per-person annual productivity values published by the U.S. National Library of Medicine, followed by the proportion of productivity lost due to drug use as reported by the National Drug Intelligence Center.<sup>56, 57</sup> Figure 23 displays 2015 through 2018 estimated lost productivity costs due to non-medical opioid use. Detailed results by age and sex are provided in the appendices.

**Figure 23**

#### LOST PRODUCTIVITY COSTS DUE TO NON-MEDICAL OPIOID USE, 2015–2018

YEAR	INDIVIDUALS WITH OUD	TOTAL ANNUAL PRODUCTIVITY (MILLIONS)	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
2015	2,267,693	\$96,685	\$16,719
2016	2,761,680	\$111,862	\$19,356
2017	2,937,889	\$119,739	\$20,717
2018	3,066,771	\$126,297	\$21,852

We estimate that, from 2015 through 2018, the cost of lost productivity due to non-medical opioid use totaled \$78.6 billion in the United States. This estimate includes commercially insured, Medicaid, aged Medicare, other publicly insured and uninsured populations. Due to lack of available data, we made several assumptions about the other publicly insured and uninsured populations to present total estimates of lost productivity costs in this analysis. To the extent that the prevalence of OUD in these populations is different from what we have assumed, total cost estimates may be affected.

These estimates may be slightly understated to the extent that individuals may underreport loss of productivity due to drug use. Further, prevalence of non-medical opioid use was estimated based on a diagnosis of opioid abuse, dependence or poisoning in medical claims data, and it is likely that additional costs exist for those with non-medical opioid use that have not been diagnosed in a health care setting.

As with the other cost categories, we have developed three projections for 2019 costs. These estimates vary based on three scenarios of future prevalence rate trends. The Methodology section discusses these scenarios in more detail. Figure 24 displays these estimates, with additional detail by age and sex available in the appendices.

**Figure 24**

### PROJECTED LOST PRODUCTIVITY COSTS DUE TO NON-MEDICAL OPIOID USE, 2019

YEAR	INDIVIDUALS WITH OUD	TOTAL ANNUAL PRODUCTIVITY (MILLIONS)	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
2019 (mid)	3,200,744	\$133,478	\$23,094
2019 (low)	2,967,799	\$123,769	\$21,414
2019 (high)	3,664,700	\$150,244	\$25,995

These estimates for 2019 range from \$21.4 billion to \$26.0 billion. These estimates are not meant to represent minima or maxima of possible outcomes but rather are a few scenarios that could play out based on prevailing trends for the prevalence of OUD in the United States.

### Lost Productivity Due to Opioid-Related Incarcerations

To estimate lost productivity due to incarceration, we used the opioid-related incarcerations calculated in the Criminal Justice Costs section at the federal, state and local levels for 2015 through 2018. We then multiplied by a per-person annual production value, indexed to the appropriate year.<sup>58</sup>

Costs for lost productivity due to incarcerations stayed relatively flat from 2015 through 2018. Total incarcerations attributable to opioid-related crimes dipped in 2016, before increasing again in 2017 and 2018. The per-person annual production value moves with inflation, so it increased slightly each year. Figure 25 displays 2015 through 2018 estimated lost productivity costs due to opioid-related incarcerations.

**Figure 25**

### LOST PRODUCTIVITY DUE TO OPIOID-RELATED INCARCERATIONS, 2015–2018

YEAR	NUMBER OF INMATES INCARCERATED FOR OPIOID-RELATED CRIMES			PER-PERSON ANNUAL PRODUCTION VALUE	PRODUCTIVITY LOST TO OPIOID-RELATED INCARCERATIONS (MILLIONS)
	FEDERAL	STATE	LOCAL		
2015	9,055	52,206	28,945	\$36,357	\$3,280
2016	8,780	49,666	29,996	\$36,901	\$3,264
2017	9,728	49,157	32,262	\$37,668	\$3,433
2018	10,054	50,312	35,251	\$38,223	\$3,655

In total, we estimate that \$13.6 billion of productivity was lost due to incarcerations for opioid-related crimes. We assumed that 100% of annual productivity is lost for incarcerated persons. In other words, we assumed that all of a person's potential productivity is lost in the year in which that person was incarcerated, without accounting for the length of the incarceration.

As with criminal justice costs, we included costs for incarcerations attributable to non-medical opioid use based on assumptions for the portion of crimes that are drug-induced and the portion of illicit substance use that is comprised of non-medical opioid use. It is possible that a person is incarcerated for more than one reason or that the person may have been incarcerated regardless of substance use.

We also assumed that the average market compensation value for the general population applies to the incarcerated population as well. This assumption does not reflect the ways in which the two populations may differ socioeconomically; however, it is possible that socioeconomic differences prior to incarceration are also related to the factors that led to non-medical opioid use. Due to the intertwined nature of non-medical opioid use and socioeconomic disadvantages, we have not attempted to adjust the market compensation values for pre-incarceration differences in socioeconomics for this analysis. This approach is consistent with how costs related to incarcerations have been estimated in other literature.

Consistent with other sections, we developed projections for 2019 lost productivity costs due to incarceration. The three scenarios for the number of inmates incarcerated for opioid-related crimes in this section match those used in the criminal justice section. These assumptions are displayed in Figure 26.

**Figure 26**

**PROJECTED LOST PRODUCTIVITY DUE TO OPIOID-RELATED INCARCERATIONS, 2019**

YEAR	NUMBER OF INMATES INCARCERATED FOR OPIOID-RELATED CRIMES			PER-PERSON ANNUAL PRODUCTION VALUE IN UNITED STATES	INCARCERATION COSTS ATTRIBUTABLE TO NON-MEDICAL OPIOID USE (MILLIONS)
	FEDERAL	STATE	LOCAL		
2019 (mid)	10,379	51,589	38,589	\$38,876	\$3,909
2019 (low)	9,422	47,784	35,401	\$38,876	\$3,600
2019 (high)	10,568	55,108	40,292	\$38,876	\$4,120

The mid and high projections assume an increase in opioid-related incarcerations, while the low scenario projects a decrease. We project from \$3.9 billion to \$4.1 billion in lost productivity costs due to opioid-related incarcerations in 2019. These projections are not meant to represent minima and maxima of potential outcomes but rather a range of scenarios that might occur given current trends in non-medical opioid use.

**Lost Productivity: Costs Borne by Employers**

This component of lost productivity captures the costs borne by employers for short- and long-term disability and workers' compensation claims. Short- and long-term disability insurance programs provide partial wage replacement for employees unable to work due to qualifying injuries or illnesses.

For this analysis, we estimated the additional costs related to short- and long-term disability, as well as workers' compensation, incurred by employees with OUD using a matched case-control study on a subset of our study population used for the health care cost analyses. We identified a subset of our study population that was eligible for such benefits and for whom data were available using IBM's MarketScan Health and Productivity database. We then compared the average costs for employees with OUD and their matched controls, separately for each benefit type.

We extrapolated to national totals using U.S. Census Bureau data for the number of employees nationwide, as well as the same age-sex specific prevalence rates for OUD as observed in the commercially insured population in our other analyses, to estimate the total number of employees with OUD. We then estimated the total number of employees with OUD who were likely eligible for each type of benefit coverage based on prior published literature regarding the proportion of U.S. employees eligible for short- and long-term disability, as well as workers' compensation. Total costs for each benefit type were estimated as the product of the additional costs per benefit-eligible employee with OUD and the number of benefit-eligible employees with OUD.

Figure 27 provides our estimates for the additional disability and workers' compensation costs for employees with OUD from 2015 through 2018.

**Figure 27**

**EMPLOYER COSTS RELATED TO OUD, 2015–2018**

YEAR	PREVALENCE OF OUD		% OF EMPLOYEES WITH BENEFIT	BENEFIT-ELIGIBLE EMPLOYEES WITH OUD	ADDITIONAL COSTS FOR EMPLOYEES WITH OUD	
	PER 1,000 EMPLOYEES	TOTAL			PER EMPLOYEE <sup>59</sup>	TOTAL (MILLIONS)
SHORT-TERM DISABILITY						
2015	4.55	672,191	39	262,155	\$1,190	\$312
2016	5.27	789,773	39	308,012	\$1,208	\$372
2017	5.38	818,154	39	319,080	\$1,233	\$393
2018	5.58	854,484	39	333,249	\$1,251	\$417

YEAR	PREVALENCE OF OUD		% OF EMPLOYEES WITH BENEFIT	BENEFIT-ELIGIBLE EMPLOYEES WITH OUD	ADDITIONAL COSTS FOR EMPLOYEES WITH OUD	
	PER 1,000 EMPLOYEES	TOTAL			PER EMPLOYEE <sup>59</sup>	TOTAL (MILLIONS)
LONG-TERM DISABILITY						
2015	4.55	672,191	33	221,823	\$128	\$28
2016	5.27	789,773	33	260,625	\$130	\$34
2017	5.38	818,154	33	269,991	\$133	\$36
2018	5.58	854,484	33	281,980	\$135	\$38
WORKER'S COMPENSATION						
2015	4.55	672,191	94	631,860	\$573	\$362
2016	5.27	789,773	94	742,387	\$595	\$442
2017	5.38	818,154	94	769,064	\$610	\$470
2018	5.58	854,484	94	803,215	\$622	\$500

We estimate that additional disability and workers' compensation costs for employees with OUD totaled more than \$3.4 billion from 2015 to 2018, with workers' compensation accounting for the largest share of costs and short-term disability following closely behind.

We also developed projections for 2019 based on three scenarios for how OUD prevalence may develop. The mid scenario assumes that prevalence rates will continue at their most recent year-over-year trend (2016–2017) into 2019. Our lower estimate assumes that prevalence rates will return to their 2017 levels (a decrease from 2018 to 2019), and the higher estimate assumes that they will continue at the long-term trend rate. More details on these calculations can be found in the Methodology section. Figure 28 displays our cost projections for these three scenarios.

**Figure 28**

ALL EMPLOYER COSTS RELATED TO OUD, 2019 (PROJECTED)

SCENARIO	PREVALENCE OF OUD		% OF EMPLOYEES WITH BENEFIT	BENEFIT-ELIGIBLE EMPLOYEES WITH OUD	ADDITIONAL COSTS FOR EMPLOYEES WITH OUD	
	PER 1,000 EMPLOYEES	TOTAL			PER EMPLOYEE	TOTAL (MILLIONS)
SHORT-TERM DISABILITY						
2019 (mid)	5.79	892,428	39	348,047	\$1,272	\$443
2019 (low)	5.38	829,256	39	323,410	\$1,272	\$412
2019 (high)	6.71	1,034,946	39	403,629	\$1,272	\$514
LONG-TERM DISABILITY						
2019 (mid)	5.79	892,428	33	294,501	\$137	\$40
2019 (low)	5.38	829,256	33	273,655	\$137	\$38
2019 (high)	6.71	1,034,946	33	341,532	\$137	\$47
WORKER'S COMPENSATION						
2019 (mid)	5.79	892,428	94	838,883	\$638	\$535
2019 (low)	5.38	829,256	94	779,501	\$638	\$497
2019 (high)	6.71	1,034,946	94	972,849	\$638	\$621

We estimate that additional disability and workers' compensation costs for employees with OUD may range from \$0.9 billion to \$1.2 billion in 2019. In the low scenario, prevalence rates return to 2017 levels, but costs are still higher than in 2017 due to the increasing number of people with employment, as well as costs increasing with medical trend. Both the mid and high scenarios reflect increasing prevalence of OUD in addition to cost and population increases. These estimates do not represent minima and maxima for possible outcomes but rather are reflective of a few scenarios that could develop based on trends in the prevalence of OUD.

## Methodology

### Health Care Costs

#### Study Design

We developed the health care cost estimates in this report using a matched case-control study, similar to the approach outlined in Florence et al. We identified cases (patients with OUD) and matched them with controls (patients without OUD) on baseline characteristics and then compared health care costs between the two cohorts to estimate the additional health care costs for patients with OUD relative to similar patients without.

Estimates for health care costs rely primarily on three large health care claims data sets, with data spanning from 2014 to 2017:

- IBM Watson Health’s MarketScan Commercial Claims and Encounters Database® (for individuals with commercial insurance)
- Milliman’s Consolidated Health Cost Guidelines™ Sources Database (for individuals with commercial insurance, Medicaid managed care and Medicare Advantage)
- Centers for Medicare and Medicaid Services (CMS) 5% Sample Standard Analytical Files (for individuals covered by fee-for-service Medicare)

With these three databases, we had claims data covering those with commercial insurance coverage (primarily large group employer-sponsored insurance with some individual market experience), Medicaid managed-care enrollees, and enrollees in both fee-for-service Medicare and Medicare Advantage. These claims data sets include medical and pharmacy claims data for all populations except for fee-for-service Medicare. We made an adjustment to estimate missing fee-for-service Part D claims accordingly, described in the section below.

We identified patients with OUD as those with a diagnosis code related to OUD.<sup>60</sup> Patients with OUD were eligible for inclusion in the study if they had at least one full year of insurance eligibility prior to the earliest date of diagnosis. To avoid introducing attrition bias, we did not have a minimum eligibility requirement after diagnosis, and many cases were eligible for less than a full year post-index due to a range of factors potentially including mortality, job loss (and associated loss of insurance coverage), change in insurance coverage eligibility or other factors. Restricting the analysis to cases that remained continuously insured through a full year would likely select for cases with less complicated use disorders and would bias the resulting cost estimates. See the appendices for the average follow-up duration available for each cohort.

We identified patients as potential controls if they had no diagnoses for OUD across the entirety of their claims experience that was available for study (2014–2017). Control patients were eligible for inclusion in the study if they had at least a full year of insurance eligibility that could be aligned with the baseline period for a matching case.

We identified all eligible controls that could potentially match each case by identifying controls with the same age, sex, state, health insurance payer and eligibility type (for public payers), as well as insurance eligibility for matching baseline and post-index time periods. We then selected a single matched control for each case by choosing the control with the smallest difference in health status relative to the case (as measured by risk scores<sup>61</sup>). When more than one control had the same difference in health status, we chose a single matched control at random.

We completed a similar analysis for individuals with family members diagnosed with OUD. For this analysis, we identified cases as individuals without OUD but with a person on the same insurance contract who had been diagnosed with OUD. We identified potential controls as those without OUD who also did not have anybody on the same insurance contract who had been diagnosed with OUD. We used the date of the family member’s OUD diagnosis as the index date and matched with controls in the same fashion as described above for patients. Due to



only having valid identifiers for family members in our commercial claims data sets, we could only perform the matched case-control analysis on commercially insured families. We made assumptions to estimate family costs for other types of insurance coverage, described below.

Overall, we found 182,355 matched pairs for patients diagnosed with OUD and 193,646 matched pairs for individuals with family members diagnosed with OUD. The risk score differences between cases and matched controls were negligible. See the appendices for a detailed tabulation of the baseline characteristics of matched cases and controls.

The date of initial OUD diagnosis for the case served as the index date, the preceding year served as the baseline period, and the following year served as the post-index time period. We then measured the additional health care costs for patients with OUD relative to their matched controls by comparing health care costs for the two cohorts in the post-index time period (up to a year following the date of initial diagnosis for OUD for the case).

### Family Health Care Cost Assumptions

As noted above, we could only perform a matched case-control study on commercially insured families, due to limitations for identifying families in non-commercially insured claims data. To project estimates for family health care costs of other payer types, we applied the following relativities to patient level results, calculated from the commercial population: the ratio of family members impacted by OUD relative to patients with OUD and the ratio of additional cost per family member of an individual with OUD relative to the additional cost per patient with OUD. We then arrived at total cost estimates by payer by multiplying the implied number of family members of patients with OUD by the implied excess costs per family member.

### National Extrapolations

We extrapolated the additional health care costs informed by the case-control study to national population estimates by year, age, sex, state, and payer type. We relied on 2015 through 2017 population counts from U.S. Census Bureau data to develop national population distributions by variable, and then balanced to nationwide totals published by the Kaiser Family Foundation (KFF).<sup>62, 63</sup> KFF reports Medicaid-Medicare dual eligible patients in total Medicaid population counts; however, our underlying Medicaid claims data include managed care plans primarily covering the Patient Protection and Affordable Care Act (ACA) expansion population. Dual eligible patients are included in our Medicare claims data, so we shifted the portion of dual eligible patients in KFF national Medicaid counts to the Medicare population.

For 2018 and 2019, we assumed the same population distributions by age, sex, state and payer as in 2017. We trended total national population estimates separately for commercial, Medicare, Medicaid, other public insurance and uninsured enrollment using the annualized two-year trend rates from 2015 to 2017.

The data underlying this analysis includes commercially insured, Medicaid and Medicare patients. We made a variety of assumptions to extrapolate results for uninsured and other publicly insured patients. Due to a lack of detailed claims data available for these populations, the results for uninsured and other publicly insured patients are subject to a significant uncertainty. The additional health care costs for these populations are intended to represent reasonable magnitudes of potential health care costs and should not be relied upon in detail.

We assumed that OUD prevalence rates and additional health care costs for the uninsured population align with those for the Medicaid population by age and sex. These prevalence rates were then applied to the appropriate age-sex distribution for the uninsured population as reported by the U.S. Census Bureau and balanced to national totals as reported by KFF. Similarly, we assumed that incidence rates and treatment costs of NAS/NOWS for uninsured patients follow those of the Medicaid population, and we balanced to total estimates of uninsured births informed by National Vital Statistics reports. The basis for this simplified assumption is that the socioeconomic factors for the uninsured population are likely to be most similar to those of Medicaid enrollees and, further, that people of similar socioeconomic status will have similar prevalence rates and additional health care costs associated with OUD.

The other public insurance cohort is primarily composed of enrollees covered by military or VA insurance. We assumed that OUD prevalence rates and additional costs for this population by age and sex align with those of commercial enrollees. We adjusted these prevalence rates to the appropriate age-sex distribution for military insurance and balanced to national totals as reported by KFF. We also assumed that incidence rates and treatment costs of NAS/NOWS for other publicly insured patients follow those of the commercial population and assumed all births that are not uninsured or covered by private or Medicaid insurance fall in this category.

### Medicare Fee-for-Service Part D Adjustment

We relied on the 5% Standard Analytical Files produced by CMS for Medicare FFS data in this analysis. These data are for medical claims only, including inpatient, outpatient, skilled nursing facility, home health, hospice and durable medical equipment claims. Due to a lack of available data for Medicare FFS pharmacy claims, we assumed that the relativity of prescription drug costs to total costs in the Medicare FFS population would be similar to that of the Medicare Advantage population. We scaled drug spending up by category to match the distribution of drug costs as a portion of total health care costs over 2015 and 2016 in the Medicare Advantage case and control populations.

### Service Categories

We grouped claims into a variety of inpatient, outpatient, professional and emergency categories for physical and behavioral health care services. Service categories were determined using Milliman's proprietary Health Cost Guidelines™ Grouper (HCG Grouper) software.<sup>64</sup> The software uses a variety of claim-level detail, including revenue codes, Current Procedural Terminology codes, diagnosis-related group codes, place of service codes, and diagnosis codes, in order to produce service category classifications.

We relied on therapeutic class (as defined by the IBM Micromedex® RED BOOK® database) and other criteria to identify behavioral prescription drugs. The logic used to classify drug categories within the pharmacy data is listed below.

**Medication-Assisted Treatment (MAT):** Any drug with a generic name including naltrexone, methadone or buprenorphine, excluding methylnaltrexone bromide.

**Other Opioids:** Any drug in the list of National Drug Codes (NDCs) for opioids published by the CDC, excluding any drugs classified as MAT.<sup>65</sup>

**Behavioral:** Any drugs with the following therapeutic classes or generic names, not identified as a medication-assisted treatment drug or other opioid:

- Therapeutic classes of Anticonvulsant, Benzodiazepine; Anticonvulsants, Misc.; Antimanic Agents, NEC; Anxiolytic/Sedative/Hypnot NEC; ASH, Benzodiazepines; CNS Agents, Misc.; Psychother, Antidepressants; Psychother, Tranq/Antipsychotic; and Stimulant, Amphetamine Type.
- Generic names including Buspirone Hydrochloride, Clonazepam, Reminyl (only for patients aged 65-plus), and Valproic Acid.

**Physical:** Any prescription drug not categorized above.

### Cost and Prevalence Projections

For each commercial, Medicare and Medicaid population, we averaged differences in health care costs between the case and control groups across 2015 and 2016, because cost differences were similar in both years and combining the two allowed for greater statistical credibility. We then indexed average costs by service category to the midpoint of each calendar year using relativities in the Bureau of Labor Statistics' Medical Care consumer price index (CPI) by year.<sup>66</sup>

We relied on OUD prevalence rates for commercial, Medicare and Medicaid patients from 2015 through 2017 as derived from our claims data analysis. We present detailed health care cost and utilization metrics for these three populations and years throughout this report and in the appendices, because these results are supported by detailed claims data. For other years and payer types, we present total cost estimates developed by applying trends and assumptions to aggregate 2015 through 2017 results.

The main driver of our 2018 and 2019 projections is the prevalence of OUD by payer. Reports from National Survey on Drug Use and Health (NSDUH) indicate that rates of self-reported OUD have been falling in recent years, going from 0.89% in 2015 to 0.80% in 2016 and 0.78% in 2017.<sup>67, 68</sup> Our claims data, however, have shown increasing rates of diagnosed prevalence from 2015 through 2017 for all three payers.

There are a few reasons why these two sources could have figures moving in opposite directions. For one, doctors may be increasing their coding of OUD in the midst of the opioid epidemic as the need for recognition and treatment of use disorders is increasingly emphasized. Long-term opioid users who may not have been previously coded as having a use disorder may now be coded as such. Additionally, we are seeing a decrease in self-reported painkiller use, while the use of illicit opioids such as heroin and fentanyl continues to climb.<sup>69</sup> Due to social desirability biases, respondents using illicit substances may be less likely to self-report drug use, so NSDUH data may be capturing some of the decline in painkiller use without capturing the uptick in non-medical illicit use.

For 2018, we assumed the year-over-year trend from 2016 to 2017 from our claims data would continue. Figure 29 shows these trends by payer.

**Figure 29**  
PREVALENCE TRENDS USED FROM 2017 TO 2018

COMMERCIAL	MEDICARE	MEDICAID	OTHER PUBLIC	UNINSURED
3.7%	3.9%	6.2%	4.5%	3.9%

We applied these trends for one additional year to arrive at the 2019 midpoint projections presented in this analysis. The 2019 low scenario assumes that prevalence rates return to 2017 levels in 2019. This would represent a peak in 2018, followed by a decline in 2019. The 2019 high scenario assumes that the longer-term trend in OUD prevalence from 2015 to 2017 continues through 2019. Due to the particularly large increase in OUD prevalence in the Medicare population from 2015 to 2016, we applied only one year of the 2015 to 2017 trend to project 2019 prevalence for Medicare patients. For all other populations, we applied two years of trend from 2017 prevalence rates. The annual low, mid and high trend rates used in this analysis are shown in Figure 30.

**Figure 30**  
ANNUAL PREVALENCE TRENDS USED FROM 2017 TO 2019

	RETURN TO 2017	2016–2017 TREND CONTINUES	LONG-TERM TREND CONTINUES
	Low	Mid	High
Commercial	0.0%	3.7%	11.7%
Medicare	0.0%	3.9%	33.5%
Medicaid	0.0%	3.9%	9.4%
Other public	0.0%	4.5%	16.7%
Uninsured	0.0%	3.9%	9.0%

## Mortality Costs

Mortality cost calculations rely on the number of deaths due to opioid overdose, average medical costs per death, and average lost lifetime earnings per death.

### Opioid Overdose Deaths

The CDC publishes counts of opioid overdose deaths by year and a variety of other variables, including age group, sex and state. We relied on the CDC's Morbidity and Mortality Weekly Report data for estimates of opioid overdose deaths from 2015 to 2017.<sup>70, 71</sup> At the time of this report, the CDC also published provisional estimates for opioid overdose deaths in total for 2018. We split them out by age group using proportions of opioid overdose deaths from 2015 to 2017, which were stable over that time period.<sup>72, 73</sup>

The CDC gathers mortality information from the National Vital Statistics System. To the extent that deaths due to opioid overdose are understated in CDC data, our resulting estimates for mortality costs due to non-medical opioid use may be understated as well.

We projected a range of estimates for mortality costs in 2019 using three scenarios for opioid overdose deaths: 1) assuming that the most recent mortality rates will continue and that opioid overdose deaths will remain flat from 2017–2018 levels in 2019; 2) assuming that the pace of improvement in recent years will continue and that the number of opioid overdose deaths will fall 11.5% in 2019; and 3) assuming that the longer-term annual trends in the number of opioid overdose deaths from 2015 to 2018 will continue and deaths will increase by 12.9% in 2019.

### Average Costs per Death

We relied on the CDC's WISQARS cost module to estimate average medical costs and lost lifetime earnings per fatality in this analysis. WISQARS is an online tool that provides cost of fatal injury data by age, gender and injury intent.<sup>74</sup> Consistent with other literature evaluating mortality costs due to opioid overdose, we used cost estimates for those who died from poisonings for all intents.<sup>75</sup> This approach differs from that used by the CEA in its 2017 report, which estimated mortality costs using value of statistical life, producing a mortality cost estimate several times higher than what other studies have reported.<sup>76</sup> Value of statistical life measures the economic value of fatality risk reduction and is commonly used in economic analysis for federal policies. Our analysis aims to estimate the loss of economic activity due to non-medical opioid use and instead focuses on estimates for lost lifetime earnings.

Fatal medical cost data within the WISQARS cost module represent estimated unit lifetime medical costs based on cause of injury, place of death and age of the decedent.<sup>77</sup> These costs may include payments for a coroner or medical examiner; emergency transportation; emergency department visit; or stays in a hospital, nursing home or hospice incident to the fatality. For those who died at home or any other non-medical location, coroner or medical examiner costs are the sole medical costs assigned to the fatality. For other places of death, additional costs such as transportation and facility costs are included.

Lost lifetime earnings per fatality within the WISQARS cost module represent the net present value of expected annual earnings over the decedent's remaining potential working life, based on age and sex of the decedent.<sup>78</sup> Earnings at future ages were inflated at a 1% annual growth rate and discounted to present value at a 3% rate. Lost lifetime earnings also include estimates of the value of lost household work, valued at the earnings of laborers who perform these types of services.

Cost estimates in the WISQARS cost module are valued at 2010 U.S. prices. We indexed 2010 average cost estimates to years 2015 through 2019 for this analysis using the Gross Domestic Product Implicit Price Deflator produced by the Federal Reserve Bank of St. Louis.<sup>79</sup> The GDP price deflator measures changes in prices of goods and services in the U.S. economy by year and quarter. By indexing 2010 costs to future years, we account for price changes due to inflation over time.

## Criminal Justice Costs

Criminal justice costs due to non-medical opioid use were estimated following the apportionment approach outlined in Birnbaum et al., which calculated costs for several categories: police protection, legal and adjudication activities, property lost due to crime, and correctional facilities.<sup>80</sup>

The Bureau of Justice Statistics releases Justice Expenditure and Employment Extracts each year, providing cost estimates for police protection, legal and adjudication activities, and correctional facilities by type of government funding (federal, state or local). We relied on the latest data available for this analysis, which provided preliminary cost estimates for fiscal year 2015.<sup>81</sup> We applied annualized cost trends by category from 2013 to 2015 to trend fiscal year 2015 data to calendar year 2015 through 2019 cost estimates.

The Federal Bureau of Investigation (FBI) releases “Crime in the U.S.” reports each year, which provide cost estimates for losses due to property crime. We relied on these reports for 2015 through 2017 cost estimates and applied the annualized trend rate from 2015 to 2017 to develop estimates for 2018 and 2019 costs.<sup>82, 83, 84</sup>

Opioid cost apportionment estimates were applied to each cost category to develop estimates of criminal justice costs due to non-medical opioid use. These cost apportionment estimates were developed separately for police protection and legal and adjudication activities, correctional facilities and property lost due to crime, following the approach outlined by Birnbaum et al., as further described below.

### Opioid Cost Apportionment: Police Protection and Legal and Adjudication Activities

Police protection and legal and adjudication costs were apportioned to non-medical opioid use using the percentage of arrests in the United States estimated to be related to opioids. Arrest data in the United States are available through the FBI’s “Crime in the U.S.” reports by year and offense charged.<sup>85</sup> We relied on estimates of total arrests due to drug law violations, property offenses and violent offenses in 2015 and 2017 for this analysis. Arrest data were not released for 2016, so we relied on averages from 2015 and 2017 to estimate the number of arrests for that year. We applied annualized trend rates of arrests from 2015 through 2017 separately by type of offense to estimate the number of arrests due to drug law violations, property offenses and violent offenses in 2018 and 2019.

To carve out the number of arrests estimated to be related to opioids, we first applied factors to apportion the number of arrests for each type of offense to those estimated to be drug-induced. For drug law violations, all offenses were considered to be drug-induced. We relied on estimates from a 2011 study conducted by the National Drug Intelligence Center (NDIC) for percentages of total arrests that are considered to be drug-induced for property crimes (31%) and violent crimes (12%).<sup>86</sup> We applied the same assumptions for percentages of arrests that are drug-induced for each year in this analysis.

We further apportioned the arrests considered to be drug-induced by developing assumptions for non-medical opioid use as a percentage of overall illicit drug use by year. These assumptions were based on drug seizure data for drug law violations and on illicit substance use data for other categories.

For drug law violations, we applied the ratio of opioids identified as a percentage of substances secured in law enforcement operations from annual reports released by the National Forensic Laboratory Information System (NFLIS) in 2015 through 2017.<sup>87, 88, 89</sup> Unlike the decreasing trends we observe for non-medical opioid use as a portion of illicit substance use, opioids as a percentage of substances secured in law enforcement operations are on the rise, driven by growing use of illicit fentanyl and heroin. As a proxy for opioids secured in law enforcement in 2018, we trended the number of 2017 opioid drug reports from NFLIS by the change in overdose deaths due to non-prescription opioids from 2017 to 2018 as reported by the CDC. We then divided this number by an estimate of total drug reports (by trending non-opioid reports at the annualized rate from 2015 through 2017 according to NFLIS) in order to estimate opioid apportionment for drug law violations for 2018.

For property and violent crimes, we developed estimates of non-medical opioid use as a percentage of all illicit substance use using NSDUH detailed tables from 2015 through 2017.<sup>90, 91</sup> These data provide counts of individuals

who report illicit drug use by substance, including opioid misuse, in a given year. We calculated the number of people who report opioid misuse as a portion of all illicit drug users and as a portion of all illicit drug use cases (counting each individual once for each substance category of reported using). We considered these two assumptions to be upper and lower bounds for how much additional resource use may be associated with poly substance use. The estimate as a portion of all illicit drug use cases assumes that a person's resource consumption is proportional to the number of drugs that person uses (i.e., if an individual uses two substances instead of one, resource consumption would double), while the estimate as a portion of all illicit drug users assumes a person is not more resource-intensive if that person is a poly user (i.e., an individual's resource consumption is the same for one or more substances). We used the midpoint of these two methods, assuming that poly substance users are more resource-intensive than single-substance users but not for the full additive effect of each additional substance that they use. We applied the annualized trend of individuals with OUD as a percentage of total substance use disorders from 2015 through 2017 from NSDUH data to estimate opioid apportionment for arrests due to property and crime offenses for 2018.

We arrived at estimates for the number of opioid-related arrests for each type of offense by multiplying the total number of arrests in each year by the proportion assumed to be drug-induced and the proportion of all illicit drug use attributable to non-medical opioid use. We then aggregated the number of opioid-related arrests for all crime categories as a percentage of total arrests to arrive at the opioid cost apportionment assumption applied to total police protection and legal and adjudication costs for each year.

Figure 31 displays the development of the opioid cost apportionment assumptions used for police protection and legal and adjudication costs from 2015 through 2018. The composite opioid cost apportionment figures highlighted in blue are the final assumptions applied to total expenditures by year.

**Figure 31**

OPIOID APPORTIONMENT FOR POLICE PROTECTION AND LEGAL AND ADJUDICATION COSTS, 2015–2018

CRIME CATEGORY	TOTAL ARRESTS	DRUG-INDUCED PROPORTION (%)	DRUG-INDUCED PROPORTION ATTRIBUTABLE TO OPIOIDS (%)	OPIOID-RELATED ARRESTS	OPIOID COST APPORTIONMENT (%)
<b>Calendar Year 2015</b>					
Drug law violations	928,122	100	8.5	78,951	8.5
Property	942,330	31	21.2	61,824	6.6
Violent	305,977	12	21.2	7,771	2.5
Other	4,562,934	0	0.0	0	0.0
<b>Total</b>	<b>6,739,363</b>			<b>148,546</b>	<b>2.2</b>
<b>Calendar Year 2016</b>					
Drug law violations	1,002,881	100	9.4	94,241	9.4
Property	890,052	31	19.5	53,749	6.0
Violent	319,791	12	19.5	7,475	2.3
Other	4,596,423	0	0.0	0	0.0
<b>Total</b>	<b>6,809,146</b>			<b>155,465</b>	<b>2.3</b>
<b>Calendar Year 2017</b>					
Drug law violations	1,077,640	100	11.2	120,271	11.2
Property	837,773	31	17.7	46,027	5.5
Violent	333,604	12	17.7	7,095	2.1
Other	4,629,912	0	0.0	0	0.0
<b>Total</b>	<b>6,878,929</b>			<b>173,392</b>	<b>2.5</b>
<b>Calendar Year 2018</b>					
Drug law violations	1,161,203	100	12.6	145,976	12.6
Property	789,929	31	17.7	43,281	5.5
Violent	348,339	12	17.7	7,388	2.1
Other	4,650,321	0	0.0	0	0.0
<b>Total</b>	<b>6,949,792</b>			<b>196,645</b>	<b>2.8</b>

Given less certainty around cost estimates beyond 2018, we developed three opioid apportionment estimates for 2019. These estimates were developed by applying different trend scenarios for the drug-induced portion of arrests attributable to opioids.

For drug law violations, we developed scenarios for the portion of opioids secured in law enforcement operations using trends of non-prescription opioid overdose deaths over the past few years according to CDC data. As noted above, trends in illicit opioid use (such as fentanyl and heroin) have been driving the increase in opioids as a portion of illicit substances in drug crimes over the past few years. For each scenario, we assumed that the number of non-opioid substances secured in law enforcement operations decreased at the annualized rate from 2015 through 2017 according to NFLIS data. The mid-range scenario applies the 2017 to 2018 trend of non-prescription opioid overdose deaths to the 2018 estimate for the number of opioids secured in law enforcement operations (13.9%). The high estimate assumes that the annualized overdose trend from 2015 through 2018 (21.0%) will continue for 2019. The low estimate assumes that the rate of change in non-prescription opioid overdose deaths from 2015 through 2018 (1.5%) will continue for 2019.

For property and violent offenses, we developed trend scenarios based on the prevalence of OUD as a percentage of total substance use disorders from 2015 through 2017 NSDUH data. The mid-range assumption applies the trend from 2016 to 2017 (–0.3%), which projects that the prevalence of OUDs will plateau in the future. The high estimate assumes that the rate of change in OUDs as a percentage of substance use disorders from 2015 through 2017 (5.7%) will continue for 2019. The low estimate assumes that the annualized trends from 2015 to 2017 (–3.0%), as was used to develop the 2018 apportionment estimate, will continue for 2019.

The resulting opioid apportionment assumptions for each 2019 scenario are shown in Figure 32.

**Figure 32**

OPIOID APPORTIONMENT SCENARIOS FOR POLICE PROTECTION AND LEGAL AND ADJUDICATION COSTS, 2019

CRIME CATEGORY	TOTAL ARRESTS	DRUG-INDUCED PROPORTION (%)	DRUG-INDUCED PROPORTION ATTRIBUTABLE TO OPIOIDS (%)	OPIOID-RELATED ARRESTS	OPIOID COST APPORTIONMENT (%)
<b>Calendar Year 2019–Mid Estimate</b>					
Drug law violations	1,251,245	100	14.1	176,822	14.1
Property	744,817	31	17.6	40,699	5.5
Violent	363,725	12	17.6	7,694	2.1
Other	4,661,598	0	0.0	0	0.0
<b>Total</b>	<b>7,021,385</b>			<b>225,214</b>	<b>3.2</b>
<b>Calendar Year 2019–Low Estimate</b>					
Drug law violations	1,251,245	100	12.8	159,919	12.8
Property	744,817	31	16.7	38,514	5.2
Violent	363,725	12	16.7	7,280	2.0
Other	4,661,598	0	0.0	0	0.0
<b>Total</b>	<b>7,021,385</b>			<b>205,713</b>	<b>2.9</b>
<b>Calendar Year 2019–High Estimate</b>					
Drug law violations	1,251,245	100	14.3	178,393	14.3
Property	744,817	31	19.8	45,694	6.1
Violent	363,725	12	19.8	8,638	2.4
Other	4,661,598	0	0.0	0	0.0
<b>Total</b>	<b>7,021,385</b>			<b>232,726</b>	<b>3.3</b>

## Opioid Cost Apportionment: Correctional Facilities

Correctional facility costs were apportioned to non-medical opioid use using the percentage of incarcerations in the United States estimated to be related to opioids. Following the approach outlined by Birnbaum et al., we developed cost estimates and apportionment assumptions separately for federal, state and local correctional facilities. We used incarceration data under federal and state correctional authorities published by the Bureau of Justice Statistics' National Prisoner Statistics Program by offense for years 2015 through 2017.<sup>92, 93, 94</sup> Additionally, we used jail inmate data for local facilities for years 2015 through 2017 from the Bureau's Annual Survey of Jails.<sup>95</sup> As for police protection and legal and adjudication activities, we relied on estimates of total incarcerations due to drug law violations, property offenses and violent offenses for this analysis. The latest available jail inmate data are not broken out by type of offense; thus, we assigned about a quarter of total local incarcerations each to violent, property and drug offenses every year based on a profile of jail inmates study conducted in 2002.<sup>96</sup>

We relied on the same data used for police protection and legal and adjudication activities to apportion incarcerations to those considered to be drug-induced, with the only difference being that we used estimates separately by type of correctional facility. In addition to aggregate drug-induced attribution factors (which were used for police protection and legal and adjudication activities), the 2011 NDIC study described above also produced separate factors for jails, state prisons and federal prisons, which we applied to each incarceration estimate. We applied the same assumptions for percentage of incarcerations considered to be drug-induced for each year in this analysis.

The same assumptions used to apportion drug-induced arrests to those attributable to opioid use for police protection and legal and adjudication costs were used to apportion drug-induced incarcerations for estimating opioid-related correctional facility costs.

Figure 33 displays the development of opioid cost apportionment assumptions used for correctional facility costs from 2015 through 2018.

**Figure 33**

### OPIOID APPORTIONMENT FOR CORRECTIONAL FACILITY COSTS, 2015–2018

CRIME CATEGORY	TOTAL INCARCERATIONS			DRUG-INDUCED PROPORTION (%)			DRUG- INDUCED PORTION ATTRIBUT- ABLE TO OPIOIDS (%)	OPIOID-RELATED ARRESTS			OPIOID COST APPORTIONMENT (%)		
	FEDERAL	STATE	LOCAL	FEDERAL	STATE	LOCAL		FEDERAL	STATE	LOCAL	FEDERAL	STATE	LOCAL
Calendar Year 2015													
Drug law violations	92,029	206,676	179,668	100	100	100	8.5	7,828	17,581	15,284	8.5	8.5	8.5
Property	11,155	250,118	177,486	31	32	27	21.2	732	16,939	10,142	6.6	6.8	5.7
Violent	13,758	696,380	184,760	17	12	9	21.2	495	17,686	3,519	3.6	2.5	1.9
Other	68,975	163,235	181,123	0	0	0	0	0	0	0	0.0	0.0	0.0
Total	185,917	1,316,409	723,036					9,055	52,206	28,945	4.9	4.0	4.0
Calendar Year 2016													
Drug law violations	81,900	197,200	182,953	100	100	100	9.4	7,696	18,531	17,192	9.4	9.4	9.4
Property	10,600	234,000	180,731	31	32	27	19.5	640	14,587	9,506	6.0	6.2	5.3
Violent	13,400	707,900	188,138	17	12	9	19.5	444	16,548	3,298	3.3	2.3	1.8
Other	66,654	159,059	184,434	0	0	0	0	0	0	0	0.0	0.0	0.0
Total	172,554	1,298,159	736,256					8,780	49,666	29,996	5.1	3.8	4.1



<b>Calendar Year 2017</b>													
Drug law violations	78,800	190,100	184,064	100	100	100	11.2	8,795	21,216	20,543	11.2	11.2	11.2
Property	9,800	226,100	181,829	31	32	27	17.7	538	12,823	8,701	5.5	5.7	4.8
Violent	13,100	710,900	189,281	17	12	9	17.7	395	15,119	3,019	3.0	2.1	1.6
Other	65,076	161,366	185,555	0	0	0	0	0	0	0	0.0	0.0	0.0
<b>Total</b>	<b>166,776</b>	<b>1,288,466</b>	<b>740,729</b>					<b>9,728</b>	<b>49,157</b>	<b>32,262</b>	<b>5.8</b>	<b>3.8</b>	<b>4.4</b>
<b>Calendar Year 2018</b>													
Drug law violations	72,917	182,317	186,303	100	100	100	12.6	9,166	22,919	23,420	12.6	12.6	12.6
Property	9,186	214,970	184,040	31	32	27	17.7	503	12,158	8,783	5.5	5.7	4.8
Violent	12,783	718,273	191,583	17	12	9	17.7	384	15,234	3,048	3.0	2.1	1.6
Other	63,072	159,157	187,811	0	0	0	0	0	0	0	0.0	0.0	0.0
<b>Total</b>	<b>157,958</b>	<b>1,274,718</b>	<b>749,737</b>					<b>10,054</b>	<b>50,312</b>	<b>35,521</b>	<b>6.4</b>	<b>3.9</b>	<b>4.7</b>

Additionally, we applied the same trend scenarios for the drug-induced proportion of incarcerations attributable to opioids in 2019 as described in the police protection and legal and adjudication costs above. The resulting assumptions are shown in Figure 34.

**Figure 34**  
OPIOID APPORTIONMENT SCENARIOS FOR CORRECTIONAL FACILITY COSTS, 2019

CRIME CATEGORY	TOTAL INCARCERATIONS			DRUG-INDUCED PROPORTION (%)			DRUG- INDUCED PORTION ATTRIBUT -ABLE TO OPIOIDS (%)	OPIOID- RELATED ARRESTS		OPIOID COST APPORTIONMENT (%)			
	FEDERAL	STATE	LOCAL	FEDERAL	STATE	LOCAL		FEDERAL	STATE	LOCAL	FEDERAL	STATE	LOCAL
Calendar Year 2019—Mid Estimate													
Drug law violations	67,473	174,853	188,569	100	100	100	14.1	9,535	24,710	26,648	14.1	14.1	14.1
Property	8,610	204,389	186,278	31	32	27	17.6	470	11,529	8,865	5.5	5.6	4.8
Violent	12,474	725,722	193,913	17	12	9	17.6	374	15,350	3,076	3.0	2.1	1.6
Other	61,050	156,152	190,095	0	0	0	0.0	0	0	0	0.0	0.0	0.0
Total	149,606	1,261,116	758,855					10,379	51,589	38,589	6.9	4.1	5.1
Calendar Year 2019—Low Estimate													
Drug law violations	67,473	174,853	188,569	100	100	100	12.8	8,624	22,348	24,101	12.8	12.8	12.8
Property	8,610	204,389	186,278	31	32	27	16.7	445	10,910	8,389	5.2	5.3	4.5
Violent	12,474	725,722	193,913	17	12	9	16.7	354	14,526	2,911	2.8	2.0	1.5
Other	61,050	156,152	190,095	0	0	0	0.0	0	0	0	0.0	0.0	0.0
Total	149,606	1,261,116	758,855					9,422	47,784	35,401	6.3	3.8	4.7
Calendar Year 2019—High Estimate													
Drug law violations	67,473	174,853	188,569	100	100	100	14.3	9,620	24,929	26,885	14.3	14.3	14.3
Property	8,610	204,389	186,278	31	32	27	19.8	528	12,944	9,954	6.1	6.3	5.3
Violent	12,474	725,722	193,913	17	12	9	19.8	420	17,235	3,454	3.4	2.4	1.8
Other	61,050	156,152	190,095	0	0	0	0.0	0	0	0	0.0	0.0	0.0
Total	149,606	1,261,116	758,855					10,568	55,108	40,292	7.1	4.4	5.3

## Opioid Cost Apportionment: Property Loss

The portion of property loss costs attributable to non-medical opioid use was estimated using the NDIC drug-induced attribution factor for property crime as well as NSDUH estimates of opioid misuse as a percentage of all illicit substance use. These are the same assumptions used to apportion property offenses described in the sections above.

Figure 35 shows the development of opioid cost apportionment assumptions used for property losses from 2015 through 2018, as well as the projected scenarios for 2019.

**Figure 35**

### OPIOID APPORTIONMENT FOR PROPERTY LOSSES, 2015–2019

CRIME CATEGORY	DRUG-INDUCED PROPORTION (%)	DRUG-INDUCED PROPORTION ATTRIBUTABLE TO OPIOIDS (%)	OPIOID COST APPORTIONMENT (%)
<b>Property Losses</b>			
2015	31	21.2	6.6
2016	31	19.5	6.0
2017	31	17.7	5.5
2018	31	17.7	5.5
2019–Mid Estimate	31	17.6	5.5
2019–Low Estimate	31	16.7	5.2
2019–High Estimate	31	19.8	6.1

## Child and Family Assistance Costs

According to a study conducted by NCASA, 15.6% of federal spending on child and family assistance programs in 2009 was attributable to substance abuse and addiction.<sup>97</sup> This study included costs for child welfare, food and nutritional assistance, income assistance, housing assistance, child and family assistance, and employment assistance programs.

We relied on a variety of sources for estimates of total child and family assistance program costs for calendar years 2015 through 2017:

- Federal child welfare program funding by fiscal year from the Congressional Research Service.<sup>98</sup>
- Cost estimates for the Supplemental Nutrition Assistance Program by fiscal year from the U.S. Department of Agriculture.<sup>99</sup>
- Financial data for Temporary Assistance for Needy Families by fiscal year from the Office of Family Assistance.<sup>100, 101, 102</sup>
- Supplemental Security Income payments by year from the Social Security Administration.<sup>103</sup>
- Housing assistance spending by year from the U.S. government’s Data Lab.<sup>104</sup>

To estimate total child and family assistance costs for 2018 and 2019, we applied annualized trend rates from 2015 through 2017 by program category.

We then followed an apportionment method similar to that used for criminal justice costs to estimate the portion of child and family assistance costs attributable to non-medical opioid use. First, we applied the percentage of federal spending attributable to substance abuse or addiction published by NCASA for each assistance program category listed above. Next, we applied assumptions for non-medical opioid use as a portion of total illicit substance abuse derived from NSDUH data. These are the same opioid apportionment assumptions and 2019 apportionment scenarios used for property and violent crimes as described in the Criminal Justice Costs Methodology section. Figures 19 and 20 in the earlier Detailed Results section of this report display the assumed apportionment assumptions for each year.

## Education Costs

According to the NCASA study, 12.2% of federal spending on elementary and secondary education programs in 2009 was attributable to substance abuse and addiction.<sup>105</sup> This study was unable to estimate costs for higher education expenditures due to a lack of evidence of substance abuse program implementation in these institutions; thus, education costs for higher education are not included in this analysis.

We relied on Common Core of Data reports from the NCES for estimates of total federal education expenditures from fiscal years 2013 through 2016.<sup>106, 107, 108</sup> To estimate education costs beyond 2016, we applied annualized trend rates in federal spending from 2014 through 2016.

We then followed the same apportionment method as described for child and family assistance costs to estimate the portion of education spending attributable to non-medical opioid use. First, we applied the percentage of federal education spending attributable to substance abuse or addiction published by NCASA. Next, we applied assumptions for non-medical opioid use as a portion of total illicit substance abuse derived and projected based on NSDUH data. Figures 21 and 22 in the earlier Detailed Results section of this report display the apportionment assumptions for each year.

## Lost Productivity Costs

Lost productivity costs were estimated following the approach of Florence et al., which calculated lost productivity costs due to reduced productive hours at work attributed to non-medical opioid use and lost productivity due to incarcerations related to non-medical opioid use.<sup>109</sup> We also analyzed employer costs for short- and long-term disability and workers' compensation related to OUD.

### Opioid Cost Apportionment: Lost Productivity Due to Non-Medical Opioid Use

Lost productivity due to non-medical opioid use occurs by virtue of reduced participation in economically productive activities. This can take the form of absenteeism (someone missing time from employment due to the adverse effects of drug use) or reduced labor force participation, where someone drops out of the labor force altogether due to non-medical drug use.

To estimate these costs, we used the following data and sources:

- We calculated prevalence rates of OUD by age and sex using 2015-2017 IBM Watson Health MarketScan Commercial Claims and Encounters Database,<sup>®</sup> Milliman's Consolidated Health Cost Guidelines<sup>™</sup> Sources Database, and CMS 5% Standard Analytical Files. These prevalence rates were then extrapolated to national numbers using U.S. Census Bureau data<sup>110</sup> and data from KFF.<sup>111</sup>
- We used per-person annual production values in terms of market compensation by age and sex from Grosse et al., indexed to the appropriate year using the Federal Reserve Economic Data Implicit GDP Price Deflator. We excluded the value of household production from these estimates, including activities such as family care, yard work, and cleaning, as these services are not directly compensated in the economy.
- We used lost productivity values attributable to illicit drug use, broken out by sex.<sup>112</sup>

The prevalence rates of diagnosed OUD used in this analysis are the same as those developed for the health care cost analysis described above. As for health care cost results, the estimates for uninsured and other publicly insured populations are subject to significant uncertainty. While we believe our estimates reasonably capture the general magnitude of total costs, the numbers should not be relied on in a precise fashion.

For the Medicare population, we only considered enrollees who are at least 65 years of age. Younger beneficiaries can qualify as Medicare-eligible if they are disabled (if they have received Social Security Disability benefits for 24 months) or if they have end-stage renal disease or amyotrophic lateral sclerosis.<sup>113</sup> Opioid use is disproportionately common in the non-aged Medicare population compared to the aged population, and the qualifications for eligibility may reasonably restrict these members from gainful employment.<sup>114</sup> For these reasons, Medicare members under age 65 were not included in our lost productivity analysis.

We then multiplied national estimates of OUD cases by the per-person annual market compensation from Grosse et al., indexed to the appropriate year's prices. Finally, we reached a value for productivity lost to non-medical opioid use by multiplying by the assumed proportion of lost productivity attributable to illicit drug use. We relied on the 2011 NDIC study for these estimates (17% for males and 18% for females).<sup>115</sup>

For 2018 and 2019 projections, we relied on the same trends in prevalence rates and total population estimates as described in the Health Care Costs Methodology section.

### Opioid Cost Apportionment: Lost Productivity Due to Incarcerations

Lost productivity costs due to incarceration were calculated by multiplying the number of incarcerations attributed to opioid use by an estimate of per-person annual productivity indexed to the appropriate year using the Federal Reserve Economic Data GDP Implicit Price Deflator.<sup>116, 117</sup>

We once again used incarceration data under federal and state correctional authorities published by the Bureau of Justice Statistics' National Prisoner Statistics Program by offense for years 2015 through 2017, in addition to jail inmate data for local facilities for years 2015 through 2017 from the Bureau's Annual Survey of Jails.<sup>118, 119, 120, 121</sup>

These incarcerations were apportioned to opioid use in the same way as described for correctional facility criminal justice costs. In this case, however, the endpoint is the total number of opioid-related incarcerations, rather than the percentage of costs we can apportion to them. Figure 36 shows the incarcerations attributable to non-medical opioid use. The build-up for these numbers can be found in the Criminal Justice Methodology section.

**Figure 36**

#### OPIOID-RELATED INCARCERATIONS, 2015–2019

YEAR	FEDERAL	STATE	LOCAL
2015	9,055	52,206	28,945
2016	8,780	49,666	29,996
2017	9,728	49,157	32,262
2018	10,054	50,312	35,251
2019—Mid	10,379	51,589	38,589
2019—Low	9,422	47,784	35,401
2019—High	10,568	55,108	40,292

We applied the same trend scenarios for the drug-induced proportion of incarcerations attributable to opioids in 2019 as described in the Criminal Justice Methodology section above. The resulting mid, high and low assumptions are included in Figure 36.

#### Opioid Cost Apportionment: Costs Borne by Employers

We also developed lost productivity costs borne by employers associated with workers' compensation and short- and long-term disability pay. We used the matched members from the health care cost case-control analysis along with IBM's MarketScan Health and Productivity® database from 2015 and 2016 to develop estimates of excess workers' compensation and short- and long-term disability costs for employees with OUD.

We used data from the U.S. Census Bureau to estimate the number of employed people by age and sex in each year from 2015 to 2018. We then applied prevalence rates of OUD in the commercially insured population, calculated in our health care cost analysis, to estimate the total number of employees with OUD by age and sex. This approach assumes that the characteristics of those eligible for disability and workers' compensation benefits are similar for those who are eligible for health care benefits.

We then applied assumptions for the percentage of employees in the United States with short-term disability, long-term disability, and workers' compensation coverage. Figure 37 shows these assumptions, published by the Bureau of Labor Statistics and Employers' insurance company.<sup>122, 123</sup>

**Figure 37**

#### ASSUMED PERCENTAGE OF EMPLOYEES WITH DISABILITY AND WORKERS' COMPENSATION COVERAGE

SHORT-TERM DISABILITY	LONG-TERM DISABILITY	WORKERS' COMPENSATION
39%	33%	94%

Multiplying these percentages by the number of employees with OUD, we arrived at estimates for the number of employees with OUD and eligibility for each of these types of benefits. We then multiplied these employee counts by the additional costs per employee with OUD averaged across 2015 and 2016, indexed to each calendar year.

Disability costs were indexed using the Federal Reserve Economic Data GDP Implicit Price Deflator, consistent with other sections in this report. However, a substantial portion of workers' compensation costs are used to cover

medical expenses, and medical costs increase faster than general inflation. Thus, workers' compensation claims were indexed using the Bureau of Labor Statistics' Medical Care CPI.<sup>124</sup>

Our estimates for 2019 are driven by projected changes in prevalence rates and the number of employees in the United States. We relied on the same scenarios for 2019 prevalence rates of OUD as we used in the health care cost analysis. Employee projections were developed by holding the employment rate constant from 2017 levels and multiplying by the total population assumptions developed for the health care cost section of this report. We assumed that the age-sex distribution of workers will hold constant from 2017.

## Discussion

We estimate that the opioid crisis will likely cost the United States \$803 billion to \$845 billion over a five-year period ending in 2019, with costs growing each year over that time period. Given the number of domains that we were not able to confidently quantify, it is likely that the true costs are meaningfully higher than those reported here. Stakeholders need to understand the scale and distribution of these impacts as they work to respond to this crisis and make resource allocation decisions.

The cost estimates described herein demonstrate that the opioid crisis in the United States has had (and will continue to have) significant economic ramifications across many sectors of the economy. Most immediately, individuals with OUD (as well as their immediate family members) and those that insure them (including state, federal and private payers) experience substantially higher health care costs. Individuals with OUD lose out on wages now due to decreased capacity for work and in the future due to early mortality, while their employers also see higher costs for disability and workers' compensation claims. Federal, state and local governments shoulder the burden of responding to criminal activity involving opioids, while the federal government also helps sustain children and families who are disadvantaged by OUD.

In addition to the economic consequences, these estimates shed additional light on the human toll of the opioid crisis. By our estimates, there may be as many as 4 million people in the United States with OUD this year, which represents 1 out of every 80 Americans. This reflects meaningfully higher prevalence estimates than are typically produced by other public health surveillance tools, such as the NSDUH, and suggests that estimates extrapolated from diagnoses reported by health care providers at the point of care may paint a very different picture of the scope of the crisis from self-reported drug use captured in survey responses.

Beyond the estimated 4 million individuals who may be living with OUD this year, we estimate that there may be another 5.2 million people who have immediate family members in their households with OUD. Collectively, we estimate that 9.2 million Americans either have OUD or have an immediate family member in their households living with OUD, which means that nearly 1 in 35 Americans may live in households directly impacted by OUD. For many, the effects of this crisis are felt from birth: We estimate that nearly 40,000 infants born in 2019 (or around 1 in 97 births) may have NAS due to prenatal opioid exposure. For too many, the effects of this crisis will be felt on the other end of their lives as well, with opioid overdose deaths potentially claiming another 48,000 lives in 2019.

Life between those endpoints is complicated as well, because individuals with OUD experience more complex health care needs, reduced participation in gainful employment, and higher rates of disability. Individuals with OUD also navigate a more troubled relationship with law enforcement, with as many as 225,000 arrests and 101,000 incarcerations related to opioids expected in 2019. These challenges almost certainly spill over into the lives of those who surround them as well.

We hope that the figures presented within this report will help readers appreciate the economic urgency of addressing this important public health crisis. The extent to which future costs will rise or fall will be dependent on our ability to reduce the incidence of OUD and to support those currently living with OUD working toward recovery. Important work remains to develop and disseminate effective interventions to address OUD, and stakeholders across the economy may find that engaging in that work presents an opportunity to reduce both the human and economic costs of the crisis.

## Limitations and Caveats

### Limitations

Described in this section are some important limitations of our analysis involving study design, data adjustments, assumptions and extrapolations made, as well as scope. In addition, we provide certain caveats in the use of the findings of this analysis.

#### *Study design considerations*

- **Availability of data.** The costs presented in this report are reflective of disordered use of prescription opioids, use of illicit opioids, drug overdoses involving opioids and criminal activity involving opioids. We have focused on cost categories that could reasonably be quantified with the available data. In many cases, the economic costs of non-medical opioid use could not be directly measured but were estimated based on a variety of assumptions. In other cases, costs could not be estimated at all. We have provided a separate section below that describes a number of cost domains that we did not quantify but that are nevertheless important and may be significant.
- **Prescription and illicit opioids.** The methods used in this analysis are similar to approaches outlined in other studies but also include some new approaches and more recent data. One of the primary methodologies we used for several cost categories in this report is an opioid apportionment approach, which attributes drug-related costs to non-medical opioid use based on the proportion of illicit substance use comprised of non-medical opioid use. While some data suggest that prescription opioid misuse is on the decline, illicit opioid use has continued to increase over the past few years. We have not adjusted for any differences in resource consumption that may be implied by non-medical opioid use shifting between prescription and illicit use.
- **Prevalence of OUD.** A number of cost categories rely on estimates of the prevalence of OUD in the United States. While self-reported OUD has declined in the past few years according to the NSDUH, diagnosed OUD in medical claims data has continued to increase over the same time period. A few external forces may be driving the decrease in reported OUD, including changes in guidelines for opioid prescriptions and increased offerings of treatment programs. Additionally, a few drivers may be leading to the increase in diagnosed OUD, such as a heightened focus on physicians considering and screening for risks of opioid dependence. For OUD prevalence calculations, we relied on estimates derived from medical claims data, because this provides a greater level of detail and reliability than self-reported data. Due to the many external factors at play, we have considered a range of potential scenarios for how opioid use prevalence may trend in the future.
- **Health care costs.** Our health care cost estimates were based on the costs that occurred within a year following initial diagnosis for a sample of OUD patients covered by commercial, Medicare or Medicaid managed care insurance coverage, consistent with the approach used by Florence et al. Costs for those newly diagnosed with OUD may differ from those who are not newly diagnosed. Additionally, costs may be greater prior to diagnosis, because there is likely a delay between the onset and diagnosis of OUD for most patients.
- **Mortality valuation.** We developed mortality cost estimates using average values of medical costs and lost lifetime earnings due to poisoning, as well as CDC-reported counts of deaths due to opioid overdose. We elected to use this approach (as done by Florence et al.) to more directly estimate the value of lost economic *activity* due to early mortality. This approach differs from the value of statistical life methodology outlined by the CEA, which measures the economic *value* of reduction of risk of death. Using a different valuation method for the costs associated with early mortality can result in significant differences in estimates. Additionally, we are relying on the number of opioid overdose deaths as reported by the CDC for this analysis; and if those numbers are understated, our mortality valuations would be understated as well. We are also not looking at any impacts from cessation of government benefits for those receiving them at the time of overdose death.



- **Opioid-involved crimes.** Criminal justice costs in this analysis were developed following the approach outlined by Birnbaum et al. These costs include federal, state and local expenditures on police protection, legal and adjudication activities, and correctional facilities, as well as the value of property lost due to crime. The portion of these costs attributable to non-medical opioid use relies on assumptions for the proportion of crimes that are drug-induced and the proportion of illicit substance use attributable to non-medical opioid use. Drug-induced crimes are those that are considered to be motivated by the desire to purchase drugs or those that occurred while under the influence of drugs.
- **Lost productivity.** Lost productivity costs in this analysis were valued using average estimates of lost market compensation value due to non-medical opioid use. These costs are associated with lost wages due to incarceration, as well as absenteeism from work and reduced labor force participation. Lost productivity costs due to incarceration rely on estimates of opioid-related crimes and include all incarcerated individuals in the United States. Disabled Medicare enrollees were excluded from lost productivity costs resulting from absenteeism or reduced labor force participation, because we have assumed that these enrollees are not typically engaged in gainful employment. Additionally, lost productivity costs rely on the same estimates of the prevalence of OUD as assumed in the health care cost analyses.

#### *Adjustments, assumptions and extrapolations*

- **Data adjustments.** We made several other assumptions to estimate health care costs where data were lacking, including Medicare fee-for-service pharmacy claims and costs for family members of individuals with OUD who are not commercially insured, as well as incidence rates and treatment costs of NAS or NOWS for patients without Medicaid or private insurance coverage. These assumptions are subject to higher degrees of uncertainty than other health care cost estimates where detailed data were available.
- **Estimates for other public insurance and the uninsured.** The health care claims data underlying this analysis includes patients with commercial, Medicaid managed care, Medicare FFS and Medicare Advantage coverage. Costs for other populations are more difficult to estimate. The health care cost estimates presented for the uninsured and other publicly insured populations in this report rely on a variety of assumptions and are intended to reasonably estimate costs of those populations. The estimates for uninsured and other publicly insured patients are subject to high degrees of uncertainty and should not be relied upon in detail. If different assumptions about prevalence or costs were used, the results for these populations could differ significantly, though the impact on grand totals may not be substantial.
- **Medicaid data.** The estimates of cost and prevalence for the Medicaid population are based on experience for managed care enrollees in 17 states with statistically credible sample sizes. The program eligibility mix of the managed care enrollees may not reflect the same mix of beneficiaries as in the fee-for-service programs or of Medicaid programs in other states.
- **National extrapolations.** We extrapolated our cost estimates to national totals using total population data by payer from KFF and the U.S. Census Bureau. These sources may not align with totals reported elsewhere, including those reported by CMS. In particular, Medicare population numbers reported by KFF are generally lower than those reported in other sources. Using different sources for population estimates would result in different results.
- **Future projections.** Historical costs can be estimated with more certainty than future estimates, and the 2019 scenarios developed in this analysis only represent three selected possible outcomes for total costs in that year. For projected results, we developed alternative scenarios for how the severity of the opioid crisis may develop, including changes in prevalence rates, in overdose deaths, in opioid use as a share of all non-medical drug use, and more. In these projections, we have held other factors (such as federal budget estimates, population estimates, per-person cost estimates and others) constant to highlight the role that changing prevalence and severity of OUD play in determining future costs.

### *Scope considerations*

Because we could not reasonably estimate many cost categories, we believe that the full economic impact is likely meaningfully higher than the figures reported here. The following is a list of categories for which we were unable to develop estimates.

- **Illicit opioids.** For those with OUD, we have included estimates for the costs of prescription opioids, but we were unable to estimate the costs associated with the purchase of opioids prescribed to other patients or illicit opioids.
- **Undiagnosed OUD.** Additional health care costs for patients with OUD were included in this analysis for insured and uninsured populations. The study design for health care costs in this report relies on medical and pharmacy claims data and by definition only includes health care costs for individuals who had OUD diagnosed and coded to a medical claim by a health care provider. Medical costs for treating attempted suicide by opioid overdose or consumption would only be captured in our analysis to the extent that the appropriate diagnosis codes pertaining to opioid poisoning were used on the associated claims. Additional health care costs likely exist for individuals with non-medical opioid use who have not been diagnosed with a use disorder.
- **Lifetime effects of NAS and NOWS.** Costs for NAS/NOWS are not included beyond the hospital costs involved with treating infants born with these conditions. Additional costs likely exist throughout childhood and later in life as a consequence of these conditions.
- **Victims of opioid-involved crimes.** Costs associated with victims of crimes related to non-medical opioid use are not included beyond the value of property lost due to crime. Additional costs may arise for victims of these crimes, such as health care, lost productivity or mortality costs for victims of violent crimes that were related to non-medical opioid use.
- **Pharmaceutical and physician legal costs.** Additional criminal justice costs that fall outside the scope of this analysis include those associated with pharmaceutical and physician legal action in response to the opioid crisis. Thousands of state and local governments have begun suing pharmaceutical companies to aid with costs of responding to the crisis.<sup>125</sup> For example, Purdue Pharma, the maker of OxyContin, faces more than 1,000 lawsuits, the first of which was settled with the state of Oklahoma for \$270 million.<sup>126</sup> Physicians are also experiencing legal consequences from opioid prescribing practices. The legal costs associated with pharmaceutical and physician lawsuits, many of which are still in progress, may be substantial.
- **Other child and family assistance costs.** Child and family assistance costs in this analysis only include federal program funding attributable to non-medical opioid use. This type of funding is primarily directed toward those in poverty, although increased child and family assistance costs due to non-medical opioid use are likely borne by families of all socioeconomic backgrounds. Due to lack of data, child and family assistance costs incurred outside of federally funded programs are not included.
- **Other education costs.** A portion of federal education costs in this analysis were allocated to non-medical opioid use. Federal spending on education is predominantly associated with programs and grants to address special issues or special-needs populations. The vast majority of education spending, however, is at the state and local level. While non-federal education funding is primarily used for traditional school operations, any of these funds that could potentially be allocated to non-medical opioid use are not included. Additionally, federal education funding is only included for primary and secondary education, due to a lack of information available about higher education spending on substance use programs.
- **Other employer costs.** We included employer costs of long- and short-term disability and workers' compensation payments associated with non-medical opioid use as contributing to lost productivity costs in the United States. Other employer costs related to non-medical opioid use may include those associated with

difficulty hiring qualified candidates, employee termination due to positive drug screens or unemployment compensation following termination for opioid-related offenses.

- **Other productivity costs.** Although several studies have mentioned costs associated with lost productivity due to presenteeism, reliable data on this topic are lacking and are thus excluded from our analysis. Additionally, we have not included the value of lost household work due to non-medical opioid use, which may impact individuals with OUD as well as their family members. We have also not included the value of lost market productivity for family members of those with OUD. Similar to child and family assistance costs that are borne by individual families (as opposed to the federal government), these impacts do not directly generate measurable economic activity and thus fall outside the scope of this analysis. Other potential costs that are not calculated in this report include reductions in tax revenues, which some have estimated have cost states \$11.8 billion between 2000 and 2016 and lost productivity costs for parents of infants born with NAS and/or NOWS.<sup>127</sup>
- **Responses to the crisis.** Other notable costs that were outside the scope of this analysis involve investments made in response to the opioid crisis. The countless economic responses to the crisis include research regarding non-opioid treatment for pain, education for physicians on prescribing practices, research regarding use disorder recovery and treatment, and providing supplies of naloxone and instructions on how to administer it. Additionally, there are many downstream societal costs of the epidemic, such as resources being diverted to respond to the crisis that could have otherwise been used for other reasons.

#### *Other caveats*

- **Data reliance.** The results in this report reflect cost estimates and projections of non-medical opioid use that rely on a variety of sources and assumptions. This report has focused on cost categories for which reasonable data were available. Costs associated with excess health care needs, premature mortality, criminal justice activities, child and family assistance programs, education programs and lost productivity have been included. Although Milliman has not audited the claims research data sets used in this analysis, we have extensive experience working with them and have found them to be reasonable. To the extent that there are errors or omissions in any of the data sources relied upon for this analysis, these results may be in error.
- **Intended use.** This report is intended to highlight the economic impact of non-medical opioid use in the United States. It may not be appropriate and should not be used for other purposes. This report does not represent conclusive recommendations regarding economic responses to the opioid crisis or legal advice. Milliman does not intend to benefit or create a legal duty to any recipient of this work.

## Acknowledgments

This report was funded by the Society of Actuaries (SOA). Any opinions or views expressed in this report are those of the authors, not of Milliman or the Society of Actuaries.

The authors would like to thank Steve Melek, Melanie Kuester and Anne Jackson for their helpful input and peer review of this material. The authors would also like to acknowledge the support and contributions of the Project Oversight Group.

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## Glossary

This glossary is intended to help the reader understand some of the terms that are frequently used throughout this report, including how they are used within the context of this report.

**Child and family assistance costs.** A portion of federal expenditures on child welfare, food and nutritional assistance, income assistance and housing/homeless assistance that is attributable to non-medical opioid use.

**Criminal justice costs.** A portion of federal, state and local expenditures on police protection, legal and adjudication activities, property lost due to crime and correctional facilities that is attributable to opioid-related crimes.

**Disordered use of prescription opioids.** Use of prescription opioids that is outside of intended clinical indications, including use associated with the symptoms of opioid use disorder, as defined below.

**Education costs.** A portion of federal expenditures on education that is attributable to non-medical opioid use.

**Health care costs.** Additional health care costs incurred by those impacted by opioid use disorder beyond the costs typically incurred by similar individuals not impacted by opioid use disorder.

### Health care payers.

- Commercial insurance includes those covered by employer-sponsored health insurance as well as those covered by health insurance plans purchased directly from private insurance companies.
- Medicare is the federal health insurance program for people who are age 65 or older and for certain younger people with qualifying disabilities or health conditions.
- Medicaid is health insurance jointly funded by states and the federal government and is available to eligible low-income adults, children, pregnant women, elderly adults and people with disabilities.
- Other public insurance includes those covered under the military or Veterans Administration (VA).
- Uninsured refers to those not covered by any of the payers listed above.

**Lost productivity costs.** Reductions in economic productivity for individuals with opioid use disorder due to reduced labor force participation, increased absenteeism or incarceration, as well as increased costs to employers for short-term disability, long-term disability and workers' compensation.

**Mortality costs.** The present value of lost lifetime earnings for those who died prematurely from drug overdoses involving opioids, as well as medical costs associated with the fatality.

**Neonatal abstinence syndrome (NAS).** A group of symptoms caused by sudden discontinuation of fetal exposure to substances that were used or abused by the mother during pregnancy.<sup>128</sup>

**Neonatal opioid withdrawal syndrome (NOWS).** A specific occurrence of NAS caused by maternal opioid use.

**Non-medical opioid use.** Within the context of this report, non-medical opioid use is an umbrella term used to capture opioid use that falls outside of intended clinical indications. This includes disordered use of prescription opioids, use of illicit opioids, drug overdoses involving opioids and criminal activity involving opioids.

**Opioid use disorder (OUD).** According to the Diagnostic and Statistical Manual of Mental Disorders (5th edition), opioid use disorder is defined as a problematic pattern of opioid use that leads to serious impairment or distress.<sup>129</sup> To be diagnosed with opioid use disorder, a person must meet two or more of the following symptoms within a 12-month period:

- Substance taken in larger amounts or for a longer time than intended
- Persistent desire or unsuccessful effort to cut down or control use of a substance
- Great deal of time spent obtaining, using or recovering from substance use
- Craving (a strong desire or urge) to use opioids
- Continued opioid use that causes failures to fulfill major obligations at work, school or home
- Continued opioid use despite causing recurrent social or personal problems
- Important social, occupational or recreational activities reduced because of opioid use
- Recurrent opioid use in dangerous situations
- Continued opioid use despite related physical or psychological problems
- Tolerance (the need to take higher doses of a drug to feel the same effects or a reduced effect from the same amount)
- Withdrawal (the experience of pain or other uncomfortable symptoms in the absence of a drug)

Within the context of this report, opioid use disorder was identified in health care claims data using International Classification of Disease codes, including ICD-9-CM codes beginning with 304.0, 304.7, 305.5, 965.0 and ICD-10-CM codes beginning with F11, T40.0, T40.1, T40.2 and T40.3.

**Opioid-related crimes.** Within the context of this report, opioid-related crimes include seizures of opioids by law enforcement, as well as crimes committed while under the influence of opioids or while attempting to obtain opioids.

**Opioid-related deaths.** Drug overdose deaths that involved an opioid, as reported by the Centers for Disease Control and Prevention (CDC).

**Opioids.** Opioids are a class of drugs that include the illegal drug heroin; synthetic opioids such as fentanyl; and pain relievers available legally by prescription, such as oxycodone, hydrocodone, codeine, morphine and many others.<sup>130</sup>

**Presenteeism.** A reduction in productive output for those working while in poor health.

## Endnotes

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## Appendices

**Figure A1**

### BASELINE CHARACTERISTICS FOR PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS

CHARACTERISTIC	MATCHED PAIRS		AVERAGE PRIOR YEAR RISK SCORE		AVERAGE FOLLOW-UP DURATION (DAYS)
	N	%	OUD PATIENTS	MATCHED CONTROLS	
<b>Total</b>	182,355	100%	3.234	3.232	268
<b>Year of Diagnosis</b>					
2015	83,663	45.9%	2.917	2.914	287
2016	98,692	54.1%	3.503	3.501	252
<b>Payer</b>					
Commercial	125,064	68.6%	3.059	3.057	276
Medicare	28,356	15.5%	3.594	3.591	277
Medicaid	28,935	15.9%	3.638	3.636	228
<b>Sex</b>					
Female	94,290	51.7%	3.564	3.561	269
Male	88,065	48.3%	2.881	2.878	267
<b>Age group</b>					
0–14	1,023	0.6%	2.441	2.443	268
15–19	5,834	3.2%	1.460	1.459	280
20–24	16,943	9.3%	1.310	1.310	286
25–29	13,695	7.5%	1.400	1.398	230
30–34	13,199	7.2%	1.699	1.696	250
35–39	14,620	8.0%	2.101	2.100	258
40–44	14,106	7.7%	2.591	2.588	267
45–49	16,670	9.1%	3.241	3.239	269
50–54	20,462	11.2%	3.830	3.828	272
55–59	22,436	12.3%	4.472	4.469	275
60–64	19,674	10.8%	5.422	5.418	272
65–69	8,475	4.6%	4.750	4.744	261
70–74	5,959	3.3%	4.469	4.470	292
75–79	4,116	2.3%	4.704	4.702	289
80+	5,143	2.8%	4.283	4.279	277
<b>State</b>					
AL	2,646	1.5%	2.222	2.217	308
AK	456	0.3%	3.535	3.537	315
AZ	2,330	1.3%	2.703	2.700	290
AR	954	0.5%	2.202	2.196	280
CA	10,235	5.6%	3.636	3.633	265
CO	1,391	0.8%	2.803	2.800	284
CT	1,334	0.7%	2.464	2.460	288
DE	1,501	0.8%	2.541	2.536	259
DC	23	0.0%	0.842	0.841	222
FL	7,596	4.2%	3.944	3.940	268
GA	5,543	3.0%	3.245	3.242	298
HI	18	0.0%	1.070	1.057	345
ID	1,795	1.0%	3.015	3.018	254
IL	2,656	1.5%	3.037	3.040	273
IN	2,351	1.3%	2.555	2.554	293
IA	2,476	1.4%	3.090	3.087	234

CHARACTERISTIC	MATCHED PAIRS		AVERAGE PRIOR YEAR RISK SCORE		AVERAGE FOLLOW-UP DURATION (DAYS)
	N	%	OUD PATIENTS	MATCHED CONTROLS	
KS	717	0.4%	2.372	2.367	279
KY	3,178	1.7%	2.407	2.404	286
LA	6,040	3.3%	2.644	2.641	269
ME	584	0.3%	2.444	2.444	290
MD	2,010	1.1%	2.316	2.313	291
MA	2,606	1.4%	2.062	2.062	262
MI	7,806	4.3%	4.062	4.060	269
MN	1,181	0.6%	2.580	2.578	261
MS	1,969	1.1%	2.221	2.220	287
MO	3,121	1.7%	3.442	3.438	267
MT	198	0.1%	1.332	1.323	284
NE	973	0.5%	2.883	2.884	285
NV	1,189	0.7%	1.843	1.838	300
NH	495	0.3%	1.894	1.894	296
NJ	2,715	1.5%	2.595	2.594	295
NM	3,455	1.9%	2.843	2.844	252
NY	13,430	7.4%	3.329	3.328	275
NC	3,466	1.9%	2.612	2.611	276
ND	86	0.0%	1.048	1.047	259
OH	11,014	6.0%	3.514	3.507	260
OK	2,365	1.3%	2.395	2.389	278
OR	3,451	1.9%	2.675	2.672	249
PA	16,703	9.2%	4.229	4.227	254
RI	1,340	0.7%	2.805	2.804	196
SC	5,248	2.9%	3.560	3.555	251
SD	426	0.2%	2.704	2.691	233
TN	10,645	5.8%	2.975	2.972	282
TX	10,987	6.0%	3.601	3.601	287
UT	5,038	2.8%	3.479	3.474	237
VT	89	0.0%	0.931	0.931	284
VA	2,594	1.4%	3.037	3.037	287
WA	10,337	5.7%	3.186	3.184	244
WV	1,357	0.7%	2.069	2.068	250
WI	2,169	1.2%	3.045	3.043	240
WY	68	0.0%	1.228	1.226	273

**Figure A2**
**BASELINE CHARACTERISTICS FOR FAMILY MEMBERS OF PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS**

CHARACTERISTIC	MATCHED PAIRS		AVERAGE PRIOR YEAR RISK SCORE		AVERAGE FOLLOW-UP DURATION (DAYS)
	N	%	FAMILY OF OUD PATIENTS	MATCHED CONTROLS	
<b>Total</b>	193,646	100%	0.980	0.980	289
<b>Year of Diagnosis</b>					
2015	90,317	46.6%	0.954	0.954	307
2016	103,329	53.4%	1.003	1.003	273
<b>Payer</b>					
Commercial	193,646	100.0%	0.980	0.980	289
Medicare	N/A	N/A	N/A	N/A	N/A
Medicaid	N/A	N/A	N/A	N/A	N/A
<b>Sex</b>					
Female	96,992	50.1%	1.062	1.061	288
Male	96,654	49.9%	0.899	0.899	290
<b>Age group</b>					
0–14	38,416	19.8%	0.331	0.331	286
15–19	25,744	13.3%	0.481	0.481	293
20–24	26,339	13.6%	0.564	0.564	290
25–29	8,814	4.6%	0.671	0.671	217
30–34	4,812	2.5%	0.974	0.974	280
35–39	7,754	4.0%	0.947	0.947	285
40–44	11,601	6.0%	1.042	1.042	292
45–49	16,915	8.7%	1.242	1.243	298
50–54	20,338	10.5%	1.490	1.489	303
55–59	18,228	9.4%	1.800	1.800	302
60–64	11,261	5.8%	2.285	2.285	296
65–69	2,460	1.3%	2.639	2.636	240
70–74	546	0.3%	3.091	3.071	276
75–79	247	0.1%	3.889	3.892	299
80+	171	0.1%	4.751	4.745	317
<b>State</b>					
AL	3,298	1.7%	0.896	0.896	319
AK	597	0.3%	0.954	0.952	309
AZ	3,502	1.8%	0.893	0.893	300
AR	1,055	0.5%	0.806	0.806	284
CA	8,470	4.4%	1.054	1.054	301
CO	2,002	1.0%	0.779	0.779	293
CT	1,855	1.0%	0.899	0.898	307
DE	2,211	1.1%	0.920	0.922	275
DC	17	0.0%	0.215	0.215	212
FL	6,890	3.6%	1.076	1.074	295
GA	6,980	3.6%	1.030	1.029	310
HI	7	0.0%	0.424	0.424	312
ID	2,335	1.2%	0.777	0.777	267
IL	2,935	1.5%	0.855	0.856	301
IN	3,341	1.7%	0.886	0.886	303
IA	3,820	2.0%	0.914	0.915	239

CHARACTERISTIC	MATCHED PAIRS		AVERAGE PRIOR YEAR RISK SCORE		AVERAGE FOLLOW-UP DURATION (DAYS)
	N	%	FAMILY OF OUD PATIENTS	MATCHED CONTROLS	
KS	1,037	0.5%	0.752	0.752	295
KY	4,028	2.1%	0.833	0.832	301
LA	6,682	3.5%	0.913	0.912	282
ME	651	0.3%	0.722	0.720	314
MD	2,401	1.2%	0.928	0.927	305
MA	2,904	1.5%	1.021	1.021	295
MI	6,362	3.3%	1.090	1.089	314
MN	1,773	0.9%	0.758	0.757	268
MS	1,921	1.0%	0.830	0.828	298
MO	3,422	1.8%	1.017	1.017	281
MT	205	0.1%	0.631	0.629	291
NE	1,517	0.8%	0.917	0.916	300
NV	1,498	0.8%	0.761	0.761	302
NH	693	0.4%	0.728	0.728	312
NJ	3,691	1.9%	1.039	1.039	315
NM	651	0.3%	0.752	0.752	236
NY	17,646	9.1%	1.151	1.150	289
NC	3,807	2.0%	0.910	0.910	292
ND	144	0.1%	0.394	0.393	280
OH	7,780	4.0%	0.975	0.975	303
OK	2,495	1.3%	0.953	0.952	282
OR	2,879	1.5%	0.774	0.775	288
PA	17,498	9.0%	1.060	1.060	271
RI	354	0.2%	0.681	0.682	310
SC	5,441	2.8%	0.935	0.934	271
SD	695	0.4%	0.585	0.584	231
TN	11,924	6.2%	1.025	1.024	294
TX	13,119	6.8%	1.029	1.029	299
UT	6,987	3.6%	0.862	0.863	247
VT	78	0.0%	0.547	0.548	275
VA	3,757	1.9%	1.010	1.012	303
WA	6,403	3.3%	1.015	1.014	266
WV	1,499	0.8%	0.961	0.961	271
WI	2,296	1.2%	0.939	0.939	265
WY	93	0.0%	0.478	0.478	291

**Figure A3**

### ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY AGE AND SEX, 2015

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>3.49</b>	<b>608,701</b>	<b>\$20,612</b>	<b>\$12,546.7</b>
Female	3.04	264,578	\$22,073	\$5,839.9
0–14	0.09	1,370	\$48,326	\$66.2
15–19	1.21	7,083	\$28,806	\$204.0
20–24	4.53	28,144	\$28,295	\$796.3
25–29	3.75	23,545	\$18,250	\$429.7
30–34	3.62	22,160	\$16,498	\$365.6
35–39	3.92	23,351	\$17,668	\$412.6
40–44	3.78	22,188	\$20,184	\$447.8
45–49	3.86	24,721	\$21,347	\$527.7
50–54	4.16	28,390	\$21,657	\$614.8
55–59	4.06	27,236	\$21,093	\$574.5
60–64	3.47	19,706	\$22,113	\$435.8
65–69	3.13	12,188	\$24,429	\$297.7
70–74	4.06	9,701	\$25,797	\$250.2
75–79	3.82	6,545	\$31,714	\$207.6
80+	3.99	8,248	\$25,367	\$209.2
Male	3.95	344,123	\$19,490	\$6,706.8
0–14	0.10	1,572	\$46,027	\$72.3
15–19	1.47	8,614	\$24,233	\$208.7
20–24	7.62	47,350	\$26,493	\$1,254.5
25–29	7.67	48,214	\$16,292	\$785.5
30–34	6.58	40,286	\$14,266	\$574.7
35–39	6.28	37,403	\$14,660	\$548.3
40–44	4.69	27,555	\$16,566	\$456.5
45–49	4.02	25,728	\$18,381	\$472.9
50–54	4.10	28,009	\$20,757	\$581.4
55–59	4.19	28,144	\$21,413	\$602.7
60–64	3.82	21,725	\$24,079	\$523.1
65–69	2.95	11,490	\$24,524	\$281.8
70–74	3.18	7,580	\$23,744	\$180.0
75–79	2.84	4,870	\$19,213	\$93.6
80+	2.70	5,583	\$12,688 <sup>a</sup>	\$70.8

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.  
 $p = 0.001$ .



**Figure A4**

# ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY AGE AND SEX, 2016

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>4.20</b>	<b>738,350</b>	<b>\$21,346</b>	<b>\$15,761.1</b>
Female	3.83	336,104	\$22,874	\$7,687.9
0–14	0.11	1,620	\$49,688	\$80.5
15–19	1.25	7,299	\$29,617	\$216.2
20–24	4.24	26,677	\$29,093	\$776.1
25–29	3.88	24,810	\$18,764	\$465.5
30–34	4.09	25,082	\$16,963	\$425.5
35–39	4.67	28,615	\$18,165	\$519.8
40–44	4.63	26,916	\$20,753	\$558.6
45–49	4.89	31,676	\$21,949	\$695.3
50–54	5.25	34,689	\$22,267	\$772.4
55–59	5.27	34,800	\$21,687	\$754.7
60–64	4.91	28,383	\$22,736	\$645.3
65–69	5.18	20,362	\$25,117	\$511.4
70–74	6.35	17,035	\$26,524	\$451.8
75–79	7.08	12,388	\$32,608	\$404.0
80+	7.16	15,751	\$26,082	\$410.8
Male	4.58	402,246	\$20,070	\$8,073.2
0–14	0.12	1,812	\$47,324	\$85.7
15–19	1.46	8,533	\$24,916	\$212.6
20–24	7.16	44,993	\$27,240	\$1,225.6
25–29	7.57	48,462	\$16,751	\$811.8
30–34	6.86	42,069	\$14,668	\$617.1
35–39	7.08	43,355	\$15,073	\$653.5
40–44	5.57	32,364	\$17,033	\$551.2
45–49	4.85	31,432	\$18,899	\$594.0
50–54	5.04	33,325	\$21,342	\$711.2
55–59	5.36	35,363	\$22,017	\$778.6
60–64	5.05	29,193	\$24,757	\$722.7
65–69	4.88	19,177	\$25,215	\$483.5
70–74	4.88	13,090	\$24,413	\$319.6
75–79	4.86	8,509	\$19,754	\$168.1
80+	4.81	10,570	\$13,046	\$137.9

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.001$ .

**Figure A5**

# ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY AGE AND SEX, 2017

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>4.36</b>	<b>770,751</b>	<b>\$21,771</b>	<b>\$16,779.7</b>
Female	3.98	351,882	\$23,388	\$8,229.8
0–14	0.14	2,183	\$50,702	\$110.7
15–19	1.14	6,704	\$30,222	\$202.6
20–24	3.83	23,420	\$29,686	\$695.3
25–29	3.76	24,525	\$19,147	\$469.6
30–34	3.93	24,548	\$17,309	\$424.9
35–39	4.81	30,297	\$18,536	\$561.6
40–44	4.75	27,906	\$21,176	\$590.9
45–49	5.06	32,571	\$22,397	\$729.5
50–54	5.45	35,418	\$22,722	\$804.8
55–59	5.72	37,755	\$22,130	\$835.5
60–64	5.47	32,333	\$23,200	\$750.1
65–69	5.83	22,684	\$25,630	\$581.4
70–74	7.18	19,794	\$27,065	\$535.7
75–79	7.92	13,883	\$33,273	\$461.9
80+	7.98	17,859	\$26,614	\$475.3
Male	4.74	418,869	\$20,412	\$8,549.9
0–14	0.17	2,657	\$48,290	\$128.3
15–19	1.34	7,889	\$25,424	\$200.6
20–24	6.10	37,247	\$27,796	\$1,035.3
25–29	7.15	46,711	\$17,092	\$798.4
30–34	6.65	41,526	\$14,968	\$621.5
35–39	7.31	46,069	\$15,381	\$708.6
40–44	6.08	35,718	\$17,380	\$620.8
45–49	5.20	33,477	\$19,285	\$645.6
50–54	5.33	34,657	\$21,777	\$754.7
55–59	5.51	36,332	\$22,466	\$816.2
60–64	5.58	32,973	\$25,262	\$833.0
65–69	5.61	21,831	\$25,730	\$561.7
70–74	5.90	16,284	\$24,911	\$405.7
75–79	6.68	11,695	\$20,157	\$235.7
80+	6.17	13,803	\$13,312 <sup>a</sup>	\$183.7

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.001$ .

**Figure A6**

### ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY STATE, 2015

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>3.49</b>	<b>608,701</b>	<b>\$20,612</b>	<b>\$12,546.7</b>
AL	5.75	14,349	\$12,273	\$176.1
AK	4.71	1,753	\$29,955	\$52.5
AZ	3.89	13,026	\$26,077	\$339.7
AR	2.55	3,565	\$12,431	\$44.3
CA	2.18	44,593	\$31,190	\$1,390.8
CO	2.93	9,126	\$24,266	\$221.5
CT	4.78	10,097	\$20,601	\$208.0
DE	5.95	3,107	\$14,772	\$45.9
DC	0.86	333	\$25,609 <sup>a</sup>	\$8.5
FL	2.82	27,356	\$27,198	\$744.1
GA	3.20	17,291	\$18,921	\$327.2
HI	1.62	1,317	\$23,030 <sup>a</sup>	\$30.3
ID	3.50	3,227	\$19,393	\$62.6
IL	2.00	14,888	\$22,858	\$340.3
IN	3.84	14,333	\$19,601	\$280.9
IA	1.55	2,899	\$14,663	\$42.5
KS	1.84	3,203	\$20,997	\$67.3
KY	5.15	11,427	\$13,157	\$150.3
LA	5.77	13,416	\$12,404	\$166.4
ME	5.33	3,720	\$21,465	\$79.8
MD	4.12	14,939	\$17,928	\$267.8
MA	4.40	17,562	\$16,736	\$293.9
MI	3.78	20,541	\$15,116	\$310.5
MN	2.40	8,207	\$24,456	\$200.7
MS	5.12	6,926	\$13,879	\$96.1
MO	2.38	8,242	\$17,522	\$144.4
MT	2.57	1,426	\$26,491	\$37.8
NE	1.36	1,603	\$25,362	\$40.7
NV	4.53	6,983	\$23,096	\$161.3
NH	4.80	3,956	\$22,969	\$90.9
NJ	3.67	19,638	\$30,504	\$599.0
NM	4.42	3,714	\$13,690	\$50.8
NY	3.68	38,929	\$21,144	\$823.1
NC	3.32	17,256	\$19,552	\$337.4
ND	2.80	1,334	\$18,067	\$24.1
OH	3.87	24,958	\$19,011	\$474.5
OK	5.07	9,993	\$15,657	\$156.5
OR	3.43	7,209	\$21,420	\$154.4
PA	4.72	34,780	\$15,667	\$544.9
RI	6.25	3,641	\$11,534	\$42.0
SC	2.96	7,280	\$15,640	\$113.9
SD	1.25	604	\$22,694	\$13.7
TN	8.08	27,721	\$13,012	\$360.7
TX	3.18	45,830	\$24,939	\$1,142.9
UT	4.96	9,939	\$17,813	\$177.0
VT	4.28	1,411	\$12,526	\$17.7
VA	2.68	13,132	\$23,320	\$306.2
WA	5.14	20,670	\$21,730	\$449.1
WV	7.09	6,241	\$11,467	\$71.6
WI	2.88	10,097	\$24,653	\$248.9
WY	2.58	913	\$16,457	\$15.0

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.  
 $p < 0.05$ .

**Figure A7****ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY STATE, 2016**

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>4.20</b>	<b>738,350</b>	<b>\$21,346</b>	<b>\$15,761.1</b>
AL	6.97	17,672	\$12,751	\$225.3
AK	7.31	2,692	\$31,122	\$83.8
AZ	4.61	15,571	\$27,092	\$421.8
AR	3.93	5,550	\$12,915	\$71.7
CA	2.51	51,862	\$32,404	\$1,680.5
CO	3.34	10,562	\$25,210	\$266.3
CT	4.78	10,085	\$21,403	\$215.8
DE	7.28	3,909	\$15,347	\$60.0
DC	1.93	730	\$26,606 <sup>a</sup>	\$19.4
FL	2.92	29,016	\$28,257	\$819.9
GA	3.98	21,885	\$19,658	\$430.2
HI	1.86	1,520	\$23,927 <sup>a</sup>	\$36.4
ID	4.65	4,411	\$20,148	\$88.9
IL	2.20	16,415	\$23,748	\$389.8
IN	4.55	17,297	\$20,364	\$352.2
IA	2.38	4,419	\$15,234	\$67.3
KS	2.53	4,413	\$21,815	\$96.3
KY	6.02	13,297	\$13,669	\$181.8
LA	7.48	17,046	\$12,887	\$219.7
ME	5.97	4,264	\$22,301	\$95.1
MD	4.96	18,018	\$18,626	\$335.6
MA	4.64	18,556	\$17,388	\$322.7
MI	4.38	24,074	\$15,704	\$378.1
MN	3.04	10,415	\$25,408	\$264.6
MS	6.84	9,515	\$14,420	\$137.2
MO	4.02	14,120	\$18,204	\$257.0
MT	3.06	1,644	\$27,522	\$45.2
NE	2.30	2,701	\$26,349	\$71.2
NV	5.49	8,681	\$23,995	\$208.3
NH	8.19	6,693	\$23,863	\$159.7
NJ	4.06	21,961	\$31,691	\$696.0
NM	4.53	3,855	\$14,223	\$54.8
NY	4.33	45,812	\$21,967	\$1,006.4
NC	3.96	20,888	\$20,314	\$424.3
ND	3.08	1,462	\$18,771	\$27.4
OH	4.65	29,989	\$19,751	\$592.3
OK	6.84	13,435	\$16,267	\$218.5
OR	4.18	9,131	\$22,254	\$203.2
PA	5.54	39,900	\$16,277	\$649.4
RI	5.87	3,507	\$11,982	\$42.0
SC	4.07	10,197	\$16,249	\$165.7
SD	1.86	953	\$23,578	\$22.5
TN	9.72	33,555	\$13,518	\$453.6
TX	3.83	56,135	\$25,909	\$1,454.4
UT	5.56	11,563	\$18,506	\$214.0
VT	5.89	1,905	\$13,014	\$24.8
VA	3.41	16,858	\$24,228	\$408.4
WA	6.99	28,574	\$22,575	\$645.1
WV	7.68	6,438	\$11,913	\$76.7
WI	4.03	14,077	\$25,613	\$360.6
WY	3.24	1,122	\$17,097	\$19.2

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p < 0.05$ .

**Figure A8**

### ADDITIONAL HEALTH CARE COSTS FOR COMMERCIALLY INSURED PATIENTS WITH OUD BY STATE, 2017

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>4.36</b>	<b>770,751</b>	<b>\$21,771</b>	<b>\$16,779.7</b>
AL	6.85	16,929	\$13,079	\$221.4
AK	5.28	1,813	\$31,924	\$57.9
AZ	5.30	18,391	\$27,790	\$511.1
AR	4.41	6,140	\$13,248	\$81.3
CA	2.65	55,925	\$33,239	\$1,858.9
CO	3.63	11,534	\$25,860	\$298.3
CT	5.13	10,657	\$21,954	\$234.0
DE	9.38	5,091	\$15,742	\$80.1
DC	1.51	589	\$27,291†	\$16.1
FL	3.39	34,343	\$28,985	\$995.4
GA	3.33	18,597	\$20,164	\$375.0
HI	2.24	1,793	\$24,543†	\$44.0
ID	6.48	6,109	\$20,667	\$126.2
IL	2.26	16,752	\$24,360	\$408.1
IN	4.73	17,814	\$20,888	\$372.1
IA	2.83	5,340	\$15,627	\$83.4
KS	3.51	6,093	\$22,377	\$136.3
KY	7.22	15,843	\$14,021	\$222.1
LA	9.30	20,794	\$13,219	\$274.9
ME	5.80	4,196	\$22,875	\$96.0
MD	4.59	16,693	\$19,106	\$318.9
MA	4.67	18,737	\$17,836	\$334.2
MI	4.81	26,531	\$16,109	\$427.4
MN	3.19	11,010	\$26,063	\$287.0
MS	7.40	10,245	\$14,791	\$151.5
MO	3.78	13,107	\$18,673	\$244.8
MT	2.73	1,476	\$28,232	\$41.7
NE	2.61	3,078	\$27,028	\$83.2
NV	5.24	8,433	\$24,613	\$207.6
NH	6.07	4,953	\$24,478	\$121.2
NJ	3.92	21,351	\$32,508	\$694.1
NM	5.06	4,240	\$14,590	\$61.9
NY	4.91	52,412	\$22,533	\$1,181.0
NC	4.32	22,984	\$20,837	\$478.9
ND	2.68	1,304	\$19,254	\$25.1
OH	4.20	27,050	\$20,260	\$548.0
OK	6.96	13,545	\$16,686	\$226.0
OR	5.38	11,844	\$22,827	\$270.4
PA	5.99	43,109	\$16,696	\$719.8
RI	5.89	3,427	\$12,291	\$42.1
SC	7.47	18,700	\$16,668	\$311.7
SD	2.08	1,061	\$24,185	\$25.7
TN	10.09	35,352	\$13,866	\$490.2
TX	3.35	49,540	\$26,577	\$1,316.6
UT	6.94	14,614	\$18,983	\$277.4
VT	5.02	1,542	\$13,349	\$20.6
VA	3.47	17,095	\$24,852	\$424.8
WA	5.28	22,116	\$23,157	\$512.1
WV	7.28	5,976	\$12,220	\$73.0
WI	3.76	13,290	\$26,273	\$349.2
WY	3.61	1,194	\$17,538	\$20.9

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

†  $p < 0.05$ .

**Figure A9**

HEALTH CARE COST AND UTILIZATION DIFFERENCES BETWEEN COMMERCIALLY INSURED PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	UTILIZATION PER 1,000 PATIENTS				TOTAL COST PER PATIENT			ADDITIONAL COSTS FOR PATIENTS WITH OUD PER PATIENT <sup>†</sup>	
	PATIENTS WITH OUD	MATCHED CONTROLS	UNITS	RELATIVE RATE*	PATIENTS WITH OUD	MATCHED CONTROLS	RELATIVE COST*	PERCENT OF TOTAL	
<b>Total</b>					<b>\$29,557</b>	<b>\$8,276</b>	<b>3.6</b>	<b>\$21,281</b>	<b>100.0%</b>
Physical Health					\$20,537	\$5,850	3.5	\$14,687	69.0%
Inpatient Facility	2,033	301	days	6.8	\$8,470	\$1,594	5.3	\$6,875	32.3%
Medical	976	129	days	7.6	\$3,729	\$546	6.8	\$3,183	15.0%
Surgical	509	102	days	5.0	\$4,290	\$922	4.7	\$3,368	15.8%
Maternity	33	21	days	1.6	\$128	\$100	1.3	\$29	0.1%
Skilled Nursing Facility	515	49	days	10.6	\$324	\$27	11.8	\$296	1.4%
Outpatient Facility	4,919	2,220	visits	2.2	\$6,287	\$2,489	2.5	\$3,799	17.9%
Surgery	416	155	visits	2.7	\$2,115	\$772	2.7	\$1,343	6.3%
Pathology/Lab	1,520	516	visits	2.9	\$979	\$165	5.9	\$813	3.8%
Preventive	191	185	visits	1.0	\$58	\$56	1.0	\$2	0.0%
Other Outpatient Facility	2,793	1,364	visits	2.0	\$3,136	\$1,495	2.1	\$1,640	7.7%
Emergency Care					\$1,428	\$266	5.4	\$1,162	5.5%
Ambulance	277	35	cases	7.8	\$316	\$44	7.1	\$272	1.3%
Emergency Room	804	173	visits	4.6	\$1,112	\$222	5.0	\$890	4.2%
Professional					\$4,351	\$1,500	2.9	\$2,851	13.4%
Office/Home Visits—PCP	3,944	1,589	visits	2.5	\$428	\$168	2.6	\$261	1.2%
Office/Home Visits—Specialist	4,604	1,795	visits	2.6	\$521	\$202	2.6	\$319	1.5%
Urgent Care Visits	211	128	visits	1.6	\$28	\$17	1.6	\$11	0.1%
Preventive	1,651	1,486	visits/procedures	1.1	\$119	\$125	0.9	-\$6 <sup>a</sup>	0.0%
Pathology/Lab	25,539	5,490	visits/procedures	4.7	\$1,478	\$140	10.5	\$1,338	6.3%
Other Professional Visits/Services	12,714	5,912	visits/procedures	2.2	\$1,777	\$848	2.1	\$929	4.4%
Behavioral Health					\$4,604	\$173	26.6	\$4,430	20.8%
Mental Health					\$988	\$141	7.0	\$847	4.0%
Inpatient Facility	531	40	days	13.3	\$635	\$45	14.0	\$590	2.8%
Hospital	469	34	days	13.8	\$593	\$42	14.1	\$551	2.6%
Residential	62	6	days	10.3	\$43	\$3	13.4	\$40	0.2%
Outpatient Facility	319	42	visits	7.6	\$159	\$16	9.7	\$142	0.7%
Professional	2,185	907	visits	2.4	\$194	\$79	2.4	\$114	0.5%
Substance Use Disorders					\$3,616	\$32	112.0	\$3,584	16.8%
Inpatient Facility	1,993	20	days	100.0	\$1,746	\$20	87.0	\$1,726	8.1%
Hospital	1,339	13	days	102.8	\$1,160	\$16	74.5	\$1,144	5.4%
Residential	655	7	days	94.6	\$587	\$5	130.2	\$582	2.7%
Outpatient Facility	3,078	25	visits	124.4	\$1,722	\$10	164.3	\$1,712	8.0%
Professional	2,171	60	visits	36.2	\$147	\$2	85.5	\$146	0.7%
Prescription Drugs	34,812	13,898	scripts	2.5	\$4,417	\$2,253	2.0	\$2,163	10.2%
Medication-Assisted Treatment	1,486	18	scripts	81.8	\$339	\$3	103.5	\$335	1.6%
Other Opioids	10,052	1,684	scripts	6.0	\$774	\$82	9.4	\$691	3.2%
Behavioral Health	7,149	2,064	scripts	3.5	\$594	\$201	2.9	\$392	1.8%
Physical Health	16,125	10,131	scripts	1.6	\$2,710	\$1,966	1.4	\$744	3.5%

\* Relative rates and relative costs represent the ratio of the utilization or cost metric between OUD patients and controls.

<sup>†</sup> All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.42$ .

**Figure A10**

HEALTH CARE COST AND UTILIZATION DIFFERENCES BETWEEN FAMILY MEMBERS OF COMMERCIALLY INSURED PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	UTILIZATION PER 1,000 PATIENTS				TOTAL COST PER PATIENT			ADD'L COSTS FOR FAMILY OF OUD PATIENTS	
	FAMILY OF OUD PATIENTS	MATCHED CONTROLS	UNITS	RELATIVE RATE*	FAMILY OF OUD PATIENTS	MATCHED CONTROLS	RELATIVE COST*	PER PATIENT*	PERCENT OF TOTAL
<b>Total</b>					<b>\$5,169</b>	<b>\$4,388</b>	<b>1.2</b>	<b>\$782</b>	<b>100.0%</b>
Physical Health					\$3,853	\$3,204	1.2	\$650	83.1%
Inpatient Facility	171	127	days	1.3	\$1,007	\$783	1.3	\$223	28.6%
Medical	73	55	days	1.3	\$336	\$237	1.4	\$99	12.7%
Surgical	61	44	days	1.4	\$580	\$465	1.2	\$115	14.7%
Maternity	17	16	days	1.1	\$78	\$73	1.1	\$5 <sup>a</sup>	0.6%
Skilled Nursing Facility	19	13	days	1.5	\$12	\$8	1.6	\$4 <sup>b</sup>	0.6%
Outpatient Facility	1,314	1,215	visits	1.1	\$1,526	\$1,291	1.2	\$235	30.1%
Surgery	113	94	visits	1.2	\$588	\$490	1.2	\$98	12.5%
Pathology/Lab	325	306	visits	1.1	\$116	\$92	1.3	\$23	3.0%
Preventive	132	136	visits	1.0	\$42	\$41	1.0	\$0 <sup>c</sup>	0.1%
Other Outpatient Facility	744	679	visits	1.1	\$780	\$667	1.2	\$113	14.5%
Emergency Care					\$273	\$182	1.5	\$91	11.7%
Ambulance	27	19	cases	1.4	\$36	\$25	1.5	\$11	1.4%
Emergency Room	202	133	visits	1.5	\$237	\$157	1.5	\$80	10.2%
Professional					\$1,048	\$948	1.1	\$100	12.8%
Office/Home Visits—PCP	1,521	1,302	visits	1.2	\$157	\$134	1.2	\$23	2.9%
Office/Home Visits—Specialist	1,301	1,174	visits	1.1	\$145	\$132	1.1	\$13	1.7%
Urgent Care Visits	151	126	visits	1.2	\$20	\$17	1.2	\$3	0.4%
Preventive	1,587	1,685	visits/procedures	0.9	\$127	\$135	0.9	-\$7	-0.9%
Pathology/Lab	3,846	3,512	visits/procedures	1.1	\$102	\$86	1.2	\$16	2.0%
Other Professional Visits/Services	4,169	3,787	visits/procedures	1.1	\$496	\$444	1.1	\$52	6.6%
Behavioral Health					\$165	\$123	1.3	\$42	5.4%
Mental Health					\$141	\$112	1.3	\$29 <sup>d</sup>	3.7%
Inpatient Facility	43	25	days	1.7	\$46	\$43	1.1	\$3 <sup>e</sup>	0.4%
Hospital	37	22	days	1.7	\$42	\$41	1.0	\$1 <sup>f</sup>	0.2%
Residential	6	3	days	1.9	\$4	\$2	2.0	\$2 <sup>g</sup>	0.2%
Outpatient Facility	38	25	visits	1.5	\$17	\$8	2.0	\$8	1.1%
Professional	1,202	905	visits	1.3	\$77	\$60	1.3	\$17	2.2%
Substance Use Disorders					\$24	\$11	2.2	\$13	1.7%
Inpatient Facility	12	6	days	1.9	\$12	\$6	2.1	\$6	0.8%
Hospital	7	4	days	1.8	\$8	\$4	2.0	\$4	0.5%
Residential	5	2	days	2.1	\$4	\$2	2.5	\$3	0.3%
Outpatient Facility	26	13	visits	2.0	\$10	\$4	2.3	\$6	0.7%
Professional	22	11	visits	2.1	\$2	\$1	1.9	\$1	0.1%
Prescription Drugs	10,408	8,428	scripts	1.2	\$1,151	\$1,062	1.1	\$90	11.5%
Medication-Assisted Treatment	20	6	scripts	3.3	\$4	\$1	3.8	\$3	0.4%
Other Opioids	1,754	960	scripts	1.8	\$110	\$58	1.9	\$51	6.6%
Behavioral Health	1,534	1,073	scripts	1.4	\$124	\$96	1.3	\$28	3.6%
Physical Health	7,101	6,390	scripts	1.1	\$914	\$906	1.0	\$7 <sup>h</sup>	1.0%

\* Relative rates and relative costs represent the ratio of the utilization or cost metric between family members of OUD patients and controls.

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p=0.1$ , <sup>b</sup>  $p=0.001$ , <sup>c</sup>  $p=0.64$ , <sup>d</sup>  $p=0.02$ , <sup>e</sup>  $p=0.78$ , <sup>f</sup>  $p=0.91$ , <sup>g</sup>  $p=0.06$ , <sup>h</sup>  $p=0.71$

**Figure A11**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY AGE AND SEX, 2015

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>14.64</b>	<b>652,912</b>	<b>\$16,129</b>	<b>\$10,531.1</b>
Female	16.01	356,980	\$15,359	\$5,483.0
0–24	8.51	2,170	\$11,751 <sup>a</sup>	\$25.5
25–44	70.33	46,005	\$9,317	\$428.6
45–64	72.78	168,708	\$12,536	\$2,114.9
65–69	8.35	51,772	\$19,517	\$1,010.4
70–74	7.94	37,112	\$20,472	\$759.7
75–79	6.81	23,836	\$21,546	\$513.6
80+	5.83	27,377	\$23,019	\$630.2
Male	13.27	295,932	\$17,058	\$5,048.1
0–24	4.52	1,152	\$21,791 <sup>b</sup>	\$25.1
25–44	55.71	36,437	\$13,281	\$483.9
45–64	63.15	146,382	\$15,424	\$2,257.7
65–69	7.96	49,393	\$14,542	\$718.3
70–74	6.12	28,588	\$25,318	\$723.8
75–79	4.79	16,782	\$25,148	\$422.0
80+	3.66	17,199	\$24,260	\$417.2

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.02$ , <sup>b</sup>  $p = 0.002$

**Figure A12**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY AGE AND SEX, 2016

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>25.11</b>	<b>1,149,118</b>	<b>\$17,021</b>	<b>\$19,559.7</b>
Female	28.61	654,714	\$16,094	\$10,537.3
0–24	19.08	4,557	\$12,480 <sup>a</sup>	\$56.9
25–44	195.80	120,895	\$9,895	\$1,196.3
45–64	116.27	276,122	\$13,314	\$3,676.2
65–69	14.25	88,884	\$20,728	\$1,842.4
70–74	13.02	66,474	\$21,742	\$1,445.3
75–79	12.71	44,852	\$22,883	\$1,026.3
80+	11.06	52,929	\$24,447	\$1,294.0
Male	21.60	494,404	\$18,249	\$9,022.4
0–24	19.74	4,716	\$23,142 <sup>b</sup>	\$109.1
25–44	134.52	83,056	\$14,105	\$1,171.5
45–64	89.79	213,243	\$16,381	\$3,493.1
65–69	12.71	79,270	\$15,444	\$1,224.3
70–74	9.77	49,856	\$26,889	\$1,340.6
75–79	8.45	29,809	\$26,708	\$796.1
80+	7.20	34,453	\$25,765	\$887.7

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.02$ , <sup>b</sup>  $p = 0.002$



**Figure A13**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY AGE AND SEX, 2017

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>26.08</b>	<b>1,227,442</b>	<b>\$17,351</b>	<b>\$21,297.4</b>
Female	28.89	679,895	\$16,453	\$11,186.3
0–24	15.59	3,588	\$12,463 <sup>a</sup>	\$44.7
25–44	167.03	102,536	\$9,881	\$1,013.2
45–64	113.68	290,685	\$13,295	\$3,864.7
65–69	15.69	98,231	\$20,699	\$2,033.3
70–74	14.05	75,686	\$21,712	\$1,643.3
75–79	13.68	50,011	\$22,851	\$1,142.8
80+	12.25	59,159	\$24,414	\$1,444.3
Male	23.27	547,547	\$18,466	\$10,111.1
0–24	8.00	1,841	\$23,110 <sup>b</sup>	\$42.5
25–44	122.44	75,166	\$14,086	\$1,058.8
45–64	91.97	235,152	\$16,358	\$3,846.6
65–69	15.44	96,675	\$15,423	\$1,491.0
70–74	11.27	60,718	\$26,852	\$1,630.4
75–79	10.18	37,208	\$26,671	\$992.4
80+	8.45	40,787	\$25,729	\$1,049.4

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.02$ , <sup>b</sup>  $p = 0.002$

**Figure A14**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY STATE, 2015

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>14.64</b>	<b>652,912</b>	<b>\$16,129</b>	<b>\$10,531.1</b>
AL	19.23	15,190	\$8,300	\$126.1
AK	21.07	1,296	\$59,888 <sup>a</sup>	\$77.6
AZ	19.42	20,984	\$24,227	\$508.4
AR	10.08	4,803	\$8,343	\$40.1
CA	13.76	63,493	\$23,077	\$1,465.2
CO	16.27	10,845	\$18,306	\$198.5
CT	16.63	8,254	\$23,410	\$193.2
DE	19.92	3,142	\$5,975 <sup>b</sup>	\$18.8
DC	31.18	1,970	\$14,317 <sup>c</sup>	\$28.2
FL	11.98	43,384	\$19,686	\$854.0
GA	15.15	18,484	\$13,483	\$249.2
HI	9.79	1,881	\$304 <sup>d</sup>	\$0.6
ID	11.42	2,680	\$16,057	\$43.0
IL	9.22	15,249	\$15,508	\$236.5
IN	11.98	11,469	\$17,474	\$200.4
IA	5.54	2,497	\$13,102	\$32.7
KS	8.19	3,209	\$17,259	\$55.4
KY	22.80	16,247	\$11,794	\$191.6
LA	25.04	15,543	\$9,633	\$149.7
ME	15.63	3,779	\$19,423	\$73.4
MD	25.52	18,333	\$15,129	\$277.4
MA	21.59	20,070	\$23,858	\$478.8
MI	16.01	25,041	\$14,311	\$358.4
MN	16.94	12,614	\$18,054	\$227.7
MS	28.75	12,226	\$10,347	\$126.5
MO	7.33	6,877	\$13,392	\$92.1
MT	18.39	3,245	\$22,559	\$73.2
NE	3.90	988	\$17,884	\$17.7
NV	25.97	10,256	\$20,385	\$209.1
NH	25.79	5,426	\$10,378	\$56.3
NJ	15.79	18,843	-\$5,352 <sup>e</sup>	-\$100.8
NM	17.07	5,306	\$17,402	\$92.3
NY	9.29	25,100	\$18,623	\$467.5
NC	13.50	20,040	\$14,193	\$284.4
ND	13.99	1,358	\$19,189	\$26.1
OH	11.41	20,027	\$14,201	\$284.4
OK	30.01	17,015	\$13,545	\$230.5
OR	19.11	12,063	\$20,997	\$253.3
PA	10.47	21,156	\$13,740	\$290.7
RI	12.83	2,052	\$20,582 <sup>f</sup>	\$42.2
SC	4.92	3,905	\$11,491	\$44.9
SD	6.91	859	\$46,584 <sup>g</sup>	\$40.0
TN	33.76	34,245	\$12,505	\$428.2
TX	14.46	41,885	\$14,955	\$626.4
UT	14.90	4,297	\$13,764	\$59.1
VT	25.09	2,440	\$13,104 <sup>h</sup>	\$32.0
VA	10.54	11,781	\$16,671	\$196.4
WA	15.62	15,539	\$17,935	\$278.7
WV	10.76	3,771	\$10,974	\$41.4
WI	11.05	9,492	\$14,990	\$142.3
WY	29.22	2,258	\$49,242 <sup>i</sup>	\$111.2

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.003$ , <sup>b</sup>  $p = 0.05$ , <sup>c</sup>  $p = 0.008$ , <sup>d</sup>  $p = 0.74$ , <sup>e</sup>  $p = 0.99$ , <sup>f</sup>  $p = 0.002$ , <sup>g</sup>  $p = 0.003$ , <sup>h</sup>  $p = 0.005$ , <sup>i</sup>  $p = 0.0002$

**Figure A15**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY STATE, 2016

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>25.11</b>	<b>1,149,113</b>	<b>\$17,021</b>	<b>\$19,559.6</b>
AL	28.94	22,624	\$8,624	\$195.1
AK	43.87	2,792	\$62,219 <sup>a</sup>	\$173.7
AZ	27.76	30,765	\$25,170	\$774.3
AR	25.34	12,183	\$8,668	\$105.6
CA	28.44	133,483	\$23,975	\$3,200.3
CO	32.03	22,563	\$19,019	\$429.1
CT	29.28	14,239	\$24,321	\$346.3
DE	30.64	4,642	\$6,207 <sup>b</sup>	\$28.8
DC	42.42	2,538	\$14,874 <sup>c</sup>	\$37.8
FL	19.20	71,189	\$20,452	\$1,456.0
GA	23.97	30,331	\$14,008	\$424.9
HI	14.80	3,052	\$316 <sup>d</sup>	\$1.0
ID	23.29	5,821	\$16,683	\$97.1
IL	16.71	28,264	\$16,111	\$455.4
IN	25.75	25,343	\$18,154	\$460.1
IA	17.54	8,121	\$13,612	\$110.6
KS	15.28	6,488	\$17,931	\$116.3
KY	38.24	27,212	\$12,253	\$333.4
LA	41.94	27,113	\$10,008	\$271.4
ME	49.35	12,153	\$20,179	\$245.2
MD	44.72	33,959	\$15,718	\$533.8
MA	46.95	42,512	\$24,786	\$1,053.7
MI	24.42	38,063	\$14,869	\$565.9
MN	29.80	23,155	\$18,756	\$434.3
MS	45.67	20,268	\$10,750	\$217.9
MO	16.83	16,402	\$13,914	\$228.2
MT	27.55	4,850	\$23,437	\$113.7
NE	13.48	3,395	\$18,580	\$63.1
NV	36.66	14,644	\$21,178	\$310.1
NH	35.26	7,553	\$10,782	\$81.4
NJ	22.64	27,937	-\$5,560 <sup>e</sup>	-\$155.3
NM	32.15	10,448	\$18,079	\$188.9
NY	14.90	40,699	\$19,348	\$787.5
NC	26.52	40,510	\$14,746	\$597.4
ND	21.29	2,115	\$19,936	\$42.2
OH	13.58	25,050	\$14,754	\$369.6
OK	45.25	26,419	\$14,073	\$371.8
OR	25.39	16,952	\$21,814	\$369.8
PA	14.16	29,947	\$14,275	\$427.5
RI	28.97	4,863	\$21,383 <sup>f</sup>	\$104.0
SC	8.46	7,111	\$11,939	\$84.9
SD	16.01	1,984	\$48,397 <sup>g</sup>	\$96.0
TN	54.00	55,222	\$12,992	\$717.5
TX	23.98	72,192	\$15,538	\$1,121.7
UT	19.34	5,616	\$14,299	\$80.3
VT	30.64	3,090	\$13,614 <sup>h</sup>	\$42.1
VA	17.82	20,871	\$17,320	\$361.5
WA	34.95	35,899	\$18,633	\$668.9
WV	23.78	8,552	\$11,401	\$97.5
WI	19.49	16,724	\$15,574	\$260.5
WY	14.55	1,196	\$51,159 <sup>i</sup>	\$61.2

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.003$ , <sup>b</sup>  $p = 0.05$ , <sup>c</sup>  $p = 0.008$ , <sup>d</sup>  $p = 0.74$ , <sup>e</sup>  $p = 0.99$ , <sup>f</sup>  $p = 0.002$ , <sup>g</sup>  $p = 0.003$ , <sup>h</sup>  $p = 0.005$ , <sup>i</sup>  $p = 0.0002$

**Figure A16**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICARE PATIENTS WITH OUD BY STATE, 2017

STATE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>26.08</b>	<b>1,227,450</b>	<b>\$17,351</b>	<b>\$21,297.5</b>
AL	29.31	24,084	\$8,846	\$213.0
AK	30.83	2,322	\$63,823 <sup>a</sup>	\$148.2
AZ	30.10	34,522	\$25,818	\$891.3
AR	26.32	13,169	\$8,891	\$117.1
CA	28.55	138,259	\$24,593	\$3,400.2
CO	30.84	21,652	\$19,509	\$422.4
CT	28.04	14,591	\$24,948	\$364.0
DE	39.86	6,576	\$6,367 <sup>b</sup>	\$41.9
DC	40.68	2,528	\$15,258 <sup>c</sup>	\$38.6
FL	23.11	88,787	\$20,979	\$1,862.7
GA	20.58	26,917	\$14,369	\$386.8
HI	20.29	4,325	\$324 <sup>d</sup>	\$1.4
ID	23.96	6,028	\$17,112	\$103.2
IL	17.17	30,435	\$16,527	\$503.0
IN	26.85	26,467	\$18,622	\$492.9
IA	16.62	7,809	\$13,963	\$109.0
KS	18.31	7,749	\$18,393	\$142.5
KY	40.98	29,994	\$12,569	\$377.0
LA	37.90	24,671	\$10,266	\$253.3
ME	41.47	10,963	\$20,700	\$226.9
MD	40.88	32,801	\$16,123	\$528.9
MA	44.86	41,153	\$25,425	\$1,046.3
MI	30.03	49,322	\$15,252	\$752.2
MN	37.98	31,353	\$19,240	\$603.2
MS	41.15	18,777	\$11,027	\$207.0
MO	15.04	15,195	\$14,272	\$216.9
MT	29.79	5,333	\$24,041	\$128.2
NE	14.47	3,807	\$19,059	\$72.6
NV	35.60	15,559	\$21,724	\$338.0
NH	40.68	9,187	\$11,060	\$101.6
NJ	28.00	35,712	-\$5,704 <sup>e</sup>	-\$203.7
NM	35.11	11,538	\$18,545	\$214.0
NY	16.13	45,479	\$19,847	\$902.6
NC	25.42	39,783	\$15,126	\$601.8
ND	18.94	1,882	\$20,450	\$38.5
OH	20.76	38,643	\$15,134	\$584.8
OK	41.19	24,156	\$14,435	\$348.7
OR	26.28	17,603	\$22,376	\$393.9
PA	20.13	42,764	\$14,643	\$626.2
RI	23.39	3,724	\$21,935 <sup>f</sup>	\$81.7
SC	11.34	9,775	\$12,246	\$119.7
SD	16.78	2,179	\$49,645 <sup>g</sup>	\$108.2
TN	42.05	43,681	\$13,327	\$582.1
TX	21.92	67,477	\$15,938	\$1,075.4
UT	22.49	6,825	\$14,668	\$100.1
VT	34.67	3,569	\$13,965 <sup>h</sup>	\$49.8
VA	22.12	25,783	\$17,766	\$458.1
WA	30.77	32,529	\$19,113	\$621.7
WV	25.12	8,987	\$11,695	\$105.1
WI	21.89	19,310	\$15,975	\$308.5
WY	19.94	1,714	\$52,477 <sup>i</sup>	\$90.0

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.003$ , <sup>b</sup>  $p = 0.05$ , <sup>c</sup>  $p = 0.008$ , <sup>d</sup>  $p = 0.74$ , <sup>e</sup>  $p = 0.99$ , <sup>f</sup>  $p = 0.002$ , <sup>g</sup>  $p = 0.003$ , <sup>h</sup>  $p = 0.005$ , <sup>i</sup>  $p = 0.0002$

**Figure A17**

HEALTH CARE COST AND UTILIZATION DIFFERENCES BETWEEN MEDICARE PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	UTILIZATION PER 1,000 PATIENTS				TOTAL COST PER PATIENT			ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PATIENTS WITH OUD	MATCHED CONTROLS	UNITS	RELATIVE RATE*	PATIENTS WITH OUD	MATCHED CONTROLS	RELATIVE COST*	PER PATIENT†	PERCENT OF TOTAL
<b>Total</b>					<b>\$29,930</b>	<b>\$13,080</b>	<b>2.3</b>	<b>\$16,850</b>	<b>100.0%</b>
Physical Health					\$22,996	\$8,833	2.6	\$14,163	84.1%
Inpatient Facility	8,430	1,960	days	4.3	\$13,143	\$3,243	4.1	\$9,900	58.8%
Medical	2,997	699	days	4.3	\$6,362	\$1,462	4.4	\$4,900	29.1%
Surgical	1,264	313	days	4.0	\$4,710	\$1,307	3.6	\$3,403	20.2%
Skilled Nursing Facility	4,169	948	days	4.4	\$2,071	\$474	4.4	\$1,597	9.5%
Outpatient Facility	9,683	6,489	visits	1.5	\$3,992	\$2,687	1.5	\$1,306	7.7%
Surgery	646	329	visits	2.0	\$1,423	\$783	1.8	\$640	3.8%
Pathology/Lab	2,065	1,529	visits	1.4	\$189	\$436	0.4	-\$247 <sup>a</sup>	-1.5%
Preventive	408	402	visits	1.0	\$50	\$47	1.1	\$3 <sup>b</sup>	0.0%
Other Outpatient Facility	6,564	4,229	visits	1.6	\$2,330	\$1,421	1.6	\$909	5.4%
Emergency Care					\$1,157	\$356	3.3	\$801	4.8%
Ambulance	941	255	cases	3.7	\$444	\$114	3.9	\$330	2.0%
Emergency Room	977	361	visits	2.7	\$713	\$242	2.9	\$471	2.8%
Professional					\$4,704	\$2,547	1.8	\$2,157	12.8%
Office/Home Visits—PCP	5,376	3,012	visits	1.8	\$477	\$265	1.8	\$212	1.3%
Office/Home Visits—Specialist	6,383	3,521	visits	1.8	\$595	\$327	1.8	\$268	1.6%
Urgent Care Visits	117	80	visits	1.5	\$12	\$8	1.5	\$4	0.0%
Preventive	2,578	2,312	visits/procedures	1.1	\$106	\$104	1.0	\$2 <sup>c</sup>	0.0%
Pathology/Lab	18,156	8,760	visits/procedures	2.1	\$514	\$161	3.2	\$353	2.1%
Other Professional Visits/Services	30,101	15,651	visits/procedures	1.9	\$3,000	\$1,681	1.8	\$1,319	7.8%
Behavioral Health					\$809	\$161	5.0	\$648	3.8%
Mental Health					\$583	\$153	3.8	\$429	2.5%
Inpatient Facility	464	88	days	5.2	\$478	\$93	5.2	\$386	2.3%
Outpatient Facility	137	98	visits	1.4	\$26	\$17	1.5	\$9 <sup>d</sup>	0.1%
Professional	906	569	visits	1.6	\$78	\$43	1.8	\$35	0.2%
Substance Use Disorders					\$226	\$7	30.4	\$219	1.3%
Inpatient Facility	186	5	days	35.8	\$209	\$6	33.1	\$203	1.2%
Outpatient Facility	86	5	visits	16.5	\$11	\$1	14.1	\$10	0.1%
Professional	113	4	visits	27.7	\$6	\$0	16.7	\$5	0.0%
Prescription Drugs	62,382	37,287	scripts	1.7	\$6,125	\$4,087	1.5	\$2,038	12.1%
Medication-Assisted Treatment	749	43	scripts	17.6	\$91	\$4	23.9	\$87	0.5%
Other Opioids	14,512	4,089	scripts	3.5	\$973	\$154	6.3	\$820	4.9%
Behavioral Health	10,658	5,556	scripts	1.9	\$762	\$464	1.6	\$298	1.8%
Physical Health	36,463	27,598	scripts	1.3	\$4,298	\$3,465	1.2	\$833	4.9%

\* Relative rates and relative costs represent the ratio of the utilization or cost metric between OUD patients and controls.

† All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.35$ , <sup>b</sup>  $p = 0.06$ , <sup>c</sup>  $p = 0.16$ , <sup>d</sup>  $p = 0.003$

**Figure A18****ADDITIONAL HEALTH CARE COSTS FOR MEDICAID PATIENTS WITH OUD BY AGE AND SEX, 2015**

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>12.24</b>	<b>732,082</b>	<b>\$8,062</b>	<b>\$5,902.2</b>
Female	10.23	305,901	\$7,805	\$2,387.4
0–14	0.17	2,188	\$13,395	\$29.3
15–19	1.54	5,321	\$7,889	\$42.0
20–24	10.74	23,225	\$6,378	\$148.1
25–29	23.06	43,750	\$6,243	\$273.1
30–34	29.20	49,158	\$6,589	\$323.9
35–39	26.65	42,345	\$5,724	\$242.4
40–44	23.88	32,124	\$7,482	\$240.4
45–49	23.65	29,558	\$8,894	\$262.9
50–54	25.91	31,400	\$9,589	\$301.1
55–59	21.68	27,587	\$11,005	\$303.6
60–64	16.16	18,940	\$11,506	\$217.9
65+	6.49	305	\$8,913	\$2.7
Male	14.25	426,181	\$8,247	\$3,514.8
0–14	0.24	3,089	\$9,914	\$30.6
15–19	1.66	5,756	\$8,369	\$48.2
20–24	14.78	31,969	\$5,331	\$170.4
25–29	35.13	66,643	\$5,921	\$394.6
30–34	42.16	70,973	\$4,667	\$331.2
35–39	38.03	60,425	\$8,100	\$489.4
40–44	33.56	45,138	\$8,619	\$389.0
45–49	31.89	39,863	\$8,242	\$328.6
50–54	31.13	37,723	\$11,237	\$423.9
55–59	28.74	36,567	\$13,495	\$493.5
60–64	23.47	27,514	\$15,008	\$412.9
65+	11.10	521	\$4,503	\$2.3

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

**Figure A19**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICAID PATIENTS WITH OUD BY AGE AND SEX, 2016

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>14.11</b>	<b>865,771</b>	<b>\$8,549</b>	<b>\$7,401.5</b>
Female	12.19	374,196	\$8,240	\$3,083.5
0–14	0.20	2,663	\$13,917	\$37.1
15–19	1.88	6,682	\$8,196	\$54.8
20–24	11.26	24,980	\$6,626	\$165.5
25–29	25.47	49,570	\$6,486	\$321.5
30–34	33.08	57,135	\$6,845	\$391.1
35–39	32.01	52,180	\$5,947	\$310.3
40–44	27.53	37,982	\$7,774	\$295.3
45–49	29.29	37,560	\$9,240	\$347.0
50–54	31.78	39,510	\$9,963	\$393.6
55–59	28.96	37,792	\$11,434	\$432.1
60–64	23.01	27,671	\$11,954	\$330.8
65+	9.83	474	\$9,278	\$4.4
Male	16.02	491,574	\$8,784	\$4,318.0
0–14	0.24	3,116	\$10,300	\$32.1
15–19	2.06	7,325	\$8,695	\$63.7
20–24	14.94	33,157	\$5,539	\$183.7
25–29	35.63	69,336	\$6,152	\$426.5
30–34	45.41	78,418	\$4,849	\$380.2
35–39	43.76	71,327	\$8,415	\$600.2
40–44	37.23	51,373	\$8,955	\$460.0
45–49	37.41	47,979	\$8,563	\$410.9
50–54	35.90	44,629	\$11,674	\$521.0
55–59	36.31	47,389	\$14,020	\$664.4
60–64	30.43	36,591	\$15,592	\$570.5
65+	19.41	935	\$5,083	\$4.8

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

**Figure A20**

### ADDITIONAL HEALTH CARE COSTS FOR MEDICAID PATIENTS WITH OUD BY AGE AND SEX, 2017

SEX AND AGE	PREVALENCE OF OUD		ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PER 1,000	TOTAL	PER PATIENT*	TOTAL (MILLIONS)
<b>Total</b>	<b>14.66</b>	<b>892,445</b>	<b>\$8,847</b>	<b>\$7,895.6</b>
Female	12.62	384,211	\$8,536	\$3,279.4
0–14	0.20	2,592	\$14,275	\$37.0
15–19	1.32	4,661	\$8,407	\$39.2
20–24	10.47	23,062	\$6,797	\$156.8
25–29	24.28	46,865	\$6,653	\$311.8
30–34	34.25	58,680	\$7,022	\$412.0
35–39	33.69	54,486	\$6,101	\$332.4
40–44	29.92	40,960	\$7,974	\$326.6
45–49	29.92	38,066	\$9,478	\$360.8
50–54	31.99	39,456	\$10,219	\$403.2
55–59	32.72	42,371	\$11,728	\$496.9
60–64	27.04	32,262	\$12,262	\$395.6
65+	15.68	750	\$9,467	\$7.1
Male	16.69	508,234	\$9,083	\$4,616.2
0–14	0.25	3,295	\$10,566	\$34.8
15–19	1.57	5,533	\$8,919	\$49.3
20–24	14.25	31,379	\$5,682	\$178.3
25–29	36.34	70,149	\$6,310	\$442.7
30–34	47.79	81,886	\$4,974	\$407.3
35–39	46.67	75,474	\$8,632	\$651.5
40–44	39.76	54,435	\$9,185	\$500.0
45–49	38.03	48,379	\$8,784	\$425.0
50–54	37.15	45,817	\$11,975	\$548.7
55–59	38.60	49,979	\$14,382	\$718.8
60–64	34.22	40,834	\$15,994	\$653.1
65+	22.46	1,074	\$6,334	\$6.8

\* All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.



**Figure A21**

HEALTH CARE COST AND UTILIZATION DIFFERENCES BETWEEN MEDICAID PATIENTS DIAGNOSED WITH OUD AND MATCHED CONTROLS, BY SERVICE CATEGORY (AVERAGE ACROSS PATIENTS DIAGNOSED IN 2015 OR 2016)

SERVICE CATEGORY	UTILIZATION PER 1,000 PATIENTS				TOTAL COST PER PATIENT			ADDITIONAL COSTS FOR PATIENTS WITH OUD	
	PATIENTS WITH OUD	MATCHED CONTROLS	UNITS	RELATIVE RATE*	PATIENTS WITH OUD	MATCHED CONTROLS	RELATIVE COST*	PER PATIENT†	PERCENT OF TOTAL
<b>Total</b>					<b>\$14,049</b>	<b>\$5,633</b>	<b>2.5</b>	<b>\$8,416</b>	<b>100.0%</b>
Physical Health					\$10,451	\$3,723	2.8	\$6,728	79.9%
Inpatient Facility	3,347	1,023	days	3.3	\$5,633	\$1,291	4.4	\$4,342	51.6%
Medical	1,588	267	days	6.0	\$3,240	\$552	5.9	\$2,687	31.9%
Surgical	616	139	days	4.4	\$1,938	\$510	3.8	\$1,429	17.0%
Maternity	117	51	days	2.3	\$203	\$105	1.9	\$98	1.2%
Skilled Nursing Facility	1,026	566	days	1.8	\$253	\$124	2.0	\$128	1.5%
Outpatient Facility	5,029	3,816	visits	1.3	\$1,694	\$967	1.8	\$727	8.6%
Surgery	232	145	visits	1.6	\$404	\$246	1.6	\$158	1.9%
Pathology/Lab	1,031	704	visits	1.5	\$184	\$73	2.5	\$110	1.3%
Preventive	251	232	visits	1.1	\$28	\$25	1.1	\$3 <sup>a</sup>	0.0%
Other Outpatient Facility	3,515	2,734	visits	1.3	\$1,078	\$622	1.7	\$456	5.4%
Emergency Care					\$845	\$238	3.6	\$607	7.2%
Ambulance	917	208	cases	4.4	\$168	\$34	4.9	\$134	1.6%
Emergency Room	2,162	711	visits	3.0	\$676	\$204	3.3	\$472	5.6%
Professional					\$2,279	\$1,227	1.9	\$1,053	12.5%
Office/Home Visits—PCP	3,915	2,072	visits	1.9	\$249	\$127	2.0	\$122	1.5%
Office/Home Visits—Specialist	2,920	1,598	visits	1.8	\$183	\$95	1.9	\$88	1.0%
Urgent Care Visits	307	172	visits	1.8	\$22	\$13	1.8	\$10	0.1%
Preventive	1,780	1,310	visits/procedures	1.4	\$65	\$59	1.1	\$6 <sup>b</sup>	0.1%
Pathology/Lab	27,745	5,146	visits/procedures	5.4	\$457	\$76	6.0	\$381	4.5%
Other Professional Visits/Services	17,780	9,608	visits/procedures	1.9	\$1,303	\$857	1.5	\$446	5.3%
Behavioral Health					\$982	\$148	6.6	\$834	9.9%
Mental Health					\$500	\$129	3.9	\$370	4.4%
Inpatient Facility	467	74	days	6.3	\$352	\$54	6.5	\$298	3.5%
Hospital	361	56	days	6.4	\$319	\$48	6.7	\$271	3.2%
Residential	106	18	days	5.9	\$33	\$6	5.3	\$27	0.3%
Outpatient Facility	237	104	visits	2.3	\$41	\$16	2.7	\$26	0.3%
Professional	2,966	1,804	visits	1.6	\$106	\$60	1.8	\$47	0.6%
Substance Use Disorders					\$482	\$18	26.1	\$464	5.5%
Inpatient Facility	421	13	days	33.5	\$266	\$11	25.2	\$256	3.0%
Hospital	275	11	days	25.4	\$228	\$10	22.3	\$218	2.6%
Residential	146	2	days	84.6	\$38	\$0	114.6	\$38	0.4%
Outpatient Facility	658	30	visits	21.7	\$73	\$4	20.3	\$69	0.8%
Professional	5,595	126	visits	44.5	\$143	\$4	33.0	\$139	1.7%
Prescription Drugs	41,053	25,225	scripts	1.6	\$2,616	\$1,762	1.5	\$853	10.1%
Medication-Assisted Treatment	1,704	38	scripts	44.6	\$252	\$3	84.2	\$249	3.0%
Other Opioids	8,141	2,942	scripts	2.8	\$231	\$65	3.6	\$166	2.0%
Behavioral Health	7,298	3,888	scripts	1.9	\$419	\$270	1.6	\$149	1.8%
Physical Health	23,910	18,357	scripts	1.3	\$1,714	\$1,424	1.2	\$290	3.4%

\* Relative rates and relative costs represent the ratio of the utilization or cost metric between OUD patients and controls.

† All cost differences are statistically significant with  $p < 0.0001$  unless otherwise indicated.

<sup>a</sup>  $p = 0.008$ , <sup>b</sup>  $p = 0.006$

**Figure A22****LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2015**

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	15,967	\$7,032	\$112	17%	\$19
20–24	107,165	\$26,233	\$2,811	17%	\$478
25–29	184,707	\$51,065	\$9,432	17%	\$1,603
30–34	182,247	\$63,723	\$11,613	17%	\$1,974
35–39	154,281	\$70,599	\$10,892	17%	\$1,852
40–44	117,921	\$72,383	\$8,535	17%	\$1,451
45–49	103,264	\$72,470	\$7,484	17%	\$1,272
50–54	100,590	\$71,256	\$7,168	17%	\$1,218
55–59	94,863	\$58,447	\$5,544	17%	\$943
60–64	69,179	\$44,214	\$3,059	17%	\$520
65–69	63,974	\$17,795	\$1,138	17%	\$194
70–74	37,051	\$10,997	\$407	17%	\$69
75–79	22,065	\$6,175	\$136	17%	\$23
80+	23,187	\$4,343	\$101	17%	\$17
Female					
15–19	13,773	\$5,640	\$78	18%	\$14
20–24	71,002	\$18,858	\$1,339	18%	\$241
25–29	112,819	\$31,741	\$3,581	18%	\$645
30–34	120,391	\$33,415	\$4,023	18%	\$724
35–39	105,144	\$37,755	\$3,970	18%	\$715
40–44	86,460	\$40,469	\$3,499	18%	\$630
45–49	82,291	\$41,697	\$3,431	18%	\$618
50–54	88,835	\$41,540	\$3,690	18%	\$664
55–59	77,646	\$34,369	\$2,669	18%	\$480
60–64	52,442	\$24,029	\$1,260	18%	\$227
65–69	65,829	\$7,365	\$485	18%	\$87
70–74	47,591	\$3,293	\$157	18%	\$28
75–79	30,879	\$1,434	\$44	18%	\$8
80+	36,129	\$729	\$26	18%	\$5
<b>Total</b>	<b>2,267,693</b>				<b>\$16,719</b>

**Figure A23**

## LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2016

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	17,644	\$7,138	\$126	17%	\$21
20–24	100,998	\$26,626	\$2,689	17%	\$457
25–29	181,107	\$51,830	\$9,387	17%	\$1,596
30–34	193,181	\$64,677	\$12,494	17%	\$2,124
35–39	173,636	\$71,657	\$12,442	17%	\$2,115
40–44	129,304	\$73,467	\$9,500	17%	\$1,615
45–49	121,077	\$73,556	\$8,906	17%	\$1,514
50–54	114,469	\$72,323	\$8,279	17%	\$1,407
55–59	117,410	\$59,323	\$6,965	17%	\$1,184
60–64	90,156	\$44,876	\$4,046	17%	\$688
65–69	103,872	\$18,062	\$1,876	17%	\$319
70–74	64,559	\$11,161	\$721	17%	\$122
75–79	39,229	\$6,267	\$246	17%	\$42
80+	45,876	\$4,408	\$202	17%	\$34
Female					
15–19	15,736	\$5,724	\$90	18%	\$16
20–24	68,371	\$19,141	\$1,309	18%	\$236
25–29	119,363	\$32,217	\$3,845	18%	\$692
30–34	134,884	\$33,916	\$4,575	18%	\$823
35–39	123,785	\$38,320	\$4,743	18%	\$854
40–44	98,527	\$41,075	\$4,047	18%	\$728
45–49	101,811	\$42,321	\$4,309	18%	\$776
50–54	106,431	\$42,162	\$4,487	18%	\$808
55–59	100,305	\$34,884	\$3,499	18%	\$630
60–64	74,570	\$24,389	\$1,819	18%	\$327
65–69	112,390	\$7,475	\$840	18%	\$151
70–74	84,888	\$3,343	\$284	18%	\$51
75–79	58,316	\$1,455	\$85	18%	\$15
80+	69,785	\$740	\$52	18%	\$9
<b>Total</b>	<b>2,761,680</b>				<b>\$19,356</b>

**Figure A24****LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2017**

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	14,857	\$7,286	\$108	17%	\$18
20–24	92,637	\$27,180	\$2,518	17%	\$428
25–29	183,849	\$52,908	\$9,727	17%	\$1,654
30–34	199,685	\$66,022	\$13,184	17%	\$2,241
35–39	188,151	\$73,146	\$13,763	17%	\$2,340
40–44	139,451	\$74,994	\$10,458	17%	\$1,778
45–49	122,018	\$75,084	\$9,162	17%	\$1,557
50–54	119,249	\$73,827	\$8,804	17%	\$1,497
55–59	122,301	\$60,556	\$7,406	17%	\$1,259
60–64	102,072	\$45,809	\$4,676	17%	\$795
65–69	124,148	\$18,437	\$2,289	17%	\$389
70–74	80,076	\$11,393	\$912	17%	\$155
75–79	50,057	\$6,397	\$320	17%	\$54
80+	55,783	\$4,499	\$251	17%	\$43
Female					
15–19	12,592	\$5,843	\$74	18%	\$13
20–24	63,621	\$19,538	\$1,243	18%	\$224
25–29	115,903	\$32,886	\$3,812	18%	\$686
30–34	137,579	\$34,621	\$4,763	18%	\$857
35–39	132,814	\$39,117	\$5,195	18%	\$935
40–44	105,958	\$41,929	\$4,443	18%	\$800
45–49	102,170	\$43,201	\$4,414	18%	\$794
50–54	108,361	\$43,038	\$4,664	18%	\$839
55–59	110,825	\$35,609	\$3,946	18%	\$710
60–64	87,000	\$24,896	\$2,166	18%	\$390
65–69	124,786	\$7,631	\$952	18%	\$171
70–74	97,933	\$3,412	\$334	18%	\$60
75–79	65,366	\$1,486	\$97	18%	\$17
80+	78,647	\$755	\$59	18%	\$11
<b>Total</b>	<b>2,937,889</b>				<b>\$20,717</b>

**Figure A25**
**LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2018**

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON-MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	15,441	\$7,393	\$114	17%	\$19
20–24	96,287	\$27,580	\$2,656	17%	\$451
25–29	190,936	\$53,686	\$10,251	17%	\$1,743
30–34	207,294	\$66,994	\$13,887	17%	\$2,361
35–39	195,358	\$74,223	\$14,500	17%	\$2,465
40–44	144,814	\$76,098	\$11,020	17%	\$1,873
45–49	126,708	\$76,190	\$9,654	17%	\$1,641
50–54	123,854	\$74,913	\$9,278	17%	\$1,577
55–59	126,990	\$61,447	\$7,803	17%	\$1,327
60–64	106,000	\$46,483	\$4,927	17%	\$838
65–69	131,849	\$18,709	\$2,467	17%	\$419
70–74	85,009	\$11,561	\$983	17%	\$167
75–79	53,127	\$6,492	\$345	17%	\$59
80+	59,189	\$4,565	\$270	17%	\$46
Female					
15–19	13,087	\$5,929	\$78	18%	\$14
20–24	66,106	\$19,826	\$1,311	18%	\$236
25–29	120,329	\$33,370	\$4,015	18%	\$723
30–34	142,787	\$35,131	\$5,016	18%	\$903
35–39	137,882	\$39,692	\$5,473	18%	\$985
40–44	110,039	\$42,546	\$4,682	18%	\$843
45–49	106,137	\$43,837	\$4,653	18%	\$837
50–54	112,580	\$43,672	\$4,917	18%	\$885
55–59	115,121	\$36,133	\$4,160	18%	\$749
60–64	90,389	\$25,262	\$2,283	18%	\$411
65–69	132,559	\$7,743	\$1,026	18%	\$185
70–74	104,003	\$3,462	\$360	18%	\$65
75–79	69,407	\$1,508	\$105	18%	\$19
80+	83,487	\$766	\$64	18%	\$12
<b>Total</b>	<b>3,066,771</b>				<b>\$21,852</b>

**Figure A26**

## PROJECTED LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2019 MID ESTIMATE

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON- MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	16,047	\$7,519	\$121	17%	\$21
20–24	100,055	\$28,051	\$2,807	17%	\$477
25–29	198,215	\$54,603	\$10,823	17%	\$1,840
30–34	215,100	\$68,137	\$14,656	17%	\$2,492
35–39	202,759	\$75,490	\$15,306	17%	\$2,602
40–44	150,323	\$77,398	\$11,635	17%	\$1,978
45–49	131,529	\$77,490	\$10,192	17%	\$1,733
50–54	128,590	\$76,192	\$9,798	17%	\$1,666
55–59	131,817	\$62,496	\$8,238	17%	\$1,400
60–64	110,048	\$47,277	\$5,203	17%	\$884
65–69	140,034	\$19,028	\$2,665	17%	\$453
70–74	90,251	\$11,759	\$1,061	17%	\$180
75–79	56,389	\$6,603	\$372	17%	\$63
80+	62,808	\$4,643	\$292	17%	\$50
Female					
15–19	13,602	\$6,031	\$82	18%	\$15
20–24	68,669	\$20,165	\$1,385	18%	\$249
25–29	124,870	\$33,940	\$4,238	18%	\$763
30–34	148,124	\$35,730	\$5,293	18%	\$953
35–39	143,085	\$40,370	\$5,776	18%	\$1,040
40–44	114,233	\$43,273	\$4,943	18%	\$890
45–49	110,220	\$44,585	\$4,914	18%	\$885
50–54	116,925	\$44,418	\$5,194	18%	\$935
55–59	119,547	\$36,750	\$4,393	18%	\$791
60–64	93,885	\$25,693	\$2,412	18%	\$434
65–69	140,824	\$7,875	\$1,109	18%	\$200
70–74	110,458	\$3,521	\$389	18%	\$70
75–79	73,704	\$1,533	\$113	18%	\$20
80+	88,633	\$779	\$69	18%	\$12
<b>Total</b>	<b>3,200,744</b>				<b>\$23,094</b>

**Figure A27**

## PROJECTED LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2019 LOW ESTIMATE

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON- MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	14,889	\$7,519	\$112	17%	\$19
20–24	92,809	\$28,051	\$2,603	17%	\$443
25–29	183,793	\$54,603	\$10,036	17%	\$1,706
30–34	199,425	\$68,137	\$13,588	17%	\$2,310
35–39	188,001	\$75,490	\$14,192	17%	\$2,413
40–44	139,387	\$77,398	\$10,788	17%	\$1,834
45–49	121,966	\$77,490	\$9,451	17%	\$1,607
50–54	119,245	\$76,192	\$9,086	17%	\$1,545
55–59	122,236	\$62,496	\$7,639	17%	\$1,299
60–64	102,053	\$47,277	\$4,825	17%	\$820
65–69	129,805	\$19,028	\$2,470	17%	\$420
70–74	83,661	\$11,759	\$984	17%	\$167
75–79	52,275	\$6,603	\$345	17%	\$59
80+	58,227	\$4,643	\$270	17%	\$46
Female					
15–19	12,620	\$6,031	\$76	18%	\$14
20–24	63,691	\$20,165	\$1,284	18%	\$231
25–29	115,773	\$33,940	\$3,929	18%	\$707
30–34	137,320	\$35,730	\$4,907	18%	\$883
35–39	132,666	\$40,370	\$5,356	18%	\$964
40–44	105,926	\$43,273	\$4,584	18%	\$825
45–49	102,219	\$44,585	\$4,557	18%	\$820
50–54	108,439	\$44,418	\$4,817	18%	\$867
55–59	110,872	\$36,750	\$4,075	18%	\$733
60–64	87,076	\$25,693	\$2,237	18%	\$403
65–69	130,540	\$7,875	\$1,028	18%	\$185
70–74	102,394	\$3,521	\$361	18%	\$65
75–79	68,326	\$1,533	\$105	18%	\$19
80+	82,168	\$779	\$64	18%	\$12
<b>Total</b>	<b>2,967,799</b>				<b>\$21,414</b>

**Figure A28**

## PROJECTED LOST PRODUCTIVITY DUE TO NON-MEDICAL OPIOID USE BY AGE AND SEX, 2019 HIGH ESTIMATE

	PREVALENCE OF OUD	PER PERSON ANNUAL PRODUCTION VALUE	ANNUAL PRODUCTIVITY (MILLIONS)	PROPORTION OF PRODUCTIVITY LOST TO DRUG USE	PRODUCTIVITY LOST TO NON- MEDICAL OPIOID USE (MILLIONS)
Male					
15–19	18,257	\$7,519	\$137	17%	\$23
20–24	112,953	\$28,051	\$3,168	17%	\$539
25–29	222,048	\$54,603	\$12,125	17%	\$2,061
30–34	240,405	\$68,137	\$16,381	17%	\$2,785
35–39	227,054	\$75,490	\$17,140	17%	\$2,914
40–44	168,416	\$77,398	\$13,035	17%	\$2,216
45–49	147,507	\$77,490	\$11,430	17%	\$1,943
50–54	144,328	\$76,192	\$10,997	17%	\$1,869
55–59	148,051	\$62,496	\$9,253	17%	\$1,573
60–64	123,807	\$47,277	\$5,853	17%	\$995
65–69	170,711	\$19,028	\$3,248	17%	\$552
70–74	109,963	\$11,759	\$1,293	17%	\$220
75–79	68,698	\$6,603	\$454	17%	\$77
80+	76,471	\$4,643	\$355	17%	\$60
Female					
15–19	15,471	\$6,031	\$93	18%	\$17
20–24	77,380	\$20,165	\$1,560	18%	\$281
25–29	139,564	\$33,940	\$4,737	18%	\$853
30–34	165,282	\$35,730	\$5,906	18%	\$1,063
35–39	160,075	\$40,370	\$6,462	18%	\$1,163
40–44	128,016	\$43,273	\$5,540	18%	\$997
45–49	123,874	\$44,585	\$5,523	18%	\$994
50–54	131,459	\$44,418	\$5,839	18%	\$1,051
55–59	134,546	\$36,750	\$4,945	18%	\$890
60–64	105,864	\$25,693	\$2,720	18%	\$490
65–69	171,850	\$7,875	\$1,353	18%	\$244
70–74	134,752	\$3,521	\$475	18%	\$85
75–79	89,880	\$1,533	\$138	18%	\$25
80+	108,016	\$779	\$84	18%	\$15
<b>Total</b>	<b>3,664,700</b>				<b>\$25,995</b>



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